A STUDY ON THE DYNAMICS OF PARENT SATISFACTION AND STUDENT ACADEMIC ACHIEVEMENT AT SCHOOLS USING SYSTEM DYNAMICS MODELING

BY

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CLAIM FOR ORIGINALITY

This thesis is comprised of four original features. The first one, a wide range of literature review was made over the effects of student, teacher, parent and school dimensions on student academic achievement. The second one is the causal loop model drawn for each sector. Those causal loop diagrams are completely original, not mentioned in the literature. The third one is the stock flow diagrams drawn using only two dimensions; parent and teacher ones. The stock flow diagrams are completely original, not mentioned in the literature. The fourth one is the simulation and multivariate sensitivity tests for those stock flow diagrams. These four features have been elaborated below:

1. **Literature Review:** The literature review indicated to an absence of a system dynamics view in the field of education. There were a few researches about implementation of system dynamics modeling on developing curriculum. They focused on learning environment in class and they have micro views. From a wide perspective, how system dynamics modeling describes student academic achievement using different dimensions couldn't be found in the literature.

2. **The Causal Loop Models:** Prior to this study there were no previous examples of causal loop diagrams regarding student academic achievement. In order to be able to develop a methodology proposal, literature data was required. In the literature, only classical correlations between parameters are taken. Complex relationships between variables were decided by the researcher using system dynamics modeling and group model building sessions among teachers.

3. **The Stock-flow Models:** During the study, thesis progress community members have decided to focus on only two dimensions such as teacher and parent. Based on the key findings during all stages of the research, four stock flow diagrams were created using those two dimensions parameters with a total originality.

4. **The Simulation and Multivariate Sensitivity Test:** Based on originally drawn stock-flow diagrams, simulation and multivariate sensitivity test are implemented using Vensim PLE 6.3 software.

DECEMBER, 2015 **MURAT DİNÇER**

ABSTRACT

Education is dynamic and complex system. Many parameters are interrelated independently. Student Academic Achievement is an important outcome. But, to evaluate causes behind achievement and school satisfaction have always been conflicting process for educationalists and school administration.

System dynamics is suitable for this research because it emphasizes multi-loop character of education system. It is powerful tool that can make future predictions for complex systems. Group model building was implemented among twenty managers to use the most important parameters in the model.

The aim of this study is to develop a system dynamics simulation tool that could be used by school administrators to increase effectiveness of school. This study covers effects of student, parent, teacher and school sectors on student academic achievement.

A wide literature review was made over effects of parent, teacher, student and school sectors on student academic achievement. Causal loops for each sector were drawn. Only teacher and parent sectors were considered for drawing stock-flow diagrams. Four stocks were formed. To test the model, direct structure and structure-oriented behavior tests have been implemented.

After simulation and multivariate sensitivity analysis, parameter effects are same as they are in real life. Parent and Teacher parameters have strong effect on student academic achievement as found in literature and observed in real life. Parent Involvement is key stock to increase student academic achievement.

In the future, researchers may focus on how to create effective school organization and satisfy its clients from system perspective. Educational researchers may focus on curriculum development using system dynamics modeling.

ÖZET

Eğitim dinamik ve karmaşık bir sistemdir. Bir çok değişkenler birbirleriyle bağımsız olarak ilişkilidir. Eğitim sisteminde öğrencinin akademik başarısı önemli bir üründür. Fakat eğitimciler ve okul yöneticileri için bu başarının ve okul tatmininin arkasındaki sebepleri bulmak çok çelişkili bir süreç olmuştur.

Sistem dinamik çok döngülü ilişkileri vurguladığı için bu araştırma için çok uygun bir yöntemdir. Sistem dinamik modelleme bize karmaşık sistemler hakkında gelecek varsayımları yapabilen güçlü bir araçtır. Bununa birlikte grup model kurma seansları da 20 kadar farklı eğitim yöneticisi arasında yapılarak modeldeki en önemli değişkenlerin kullanılması sağlandı.

Bu çalışmanın amacı, okul idarecileri tarafından okul sisteminin etkinliğini artırabilmek amacıyla kullanılabilecek bir sistem dinamik simülasyon aracı geliştirmektir. Bu çalışma öğrenci, öğretmen, ebeveyn ve okul boyutlarının öğrenci başarısı üzerindeki etkilerini içerir.

Ebeveyn, öğrenci, öğretmen ve okul boyutlarının öğrencinin akademik başarısı üzerindeki etkileri üzerine geniş bir literatür çalışması yapıldı. Her bir boyut için nedensel döngü diyagramları çizildi. Stok-akış diyagramları çizilirken sadece öğretmen ve ebeveyn boyutları dikkate alındı. Dört tane stok-akış diyagramı çizildi. Modeli test etmek için direk yapı ve yapı odaklı davranış testleri gerçekleştirildi.

Her bir stok-akış diyagramı için simülasyon ve hassaslık testlerinden model bütün parametrelerin etkilerini gerçek hayattaki gibi gösteriyor. Literatürde ve gerçek hayattaki gözlemlerde görüldüğü gibi öğretmen ve ebeveyn boyutları öğrencinin akademik başarısı üzerinde güçlü bir etkiye sahipler. Ebeveyn katılımı, öğrenci akademik başarısını artırmada anahtar bir stoktur.

Gelecekte araştırmacılar sistem yaklaşımı açısından nasıl bir etkin okul örgütü oluşturulacağı ve okul müşterilerini tatmin edeceği üzerine odaklanabilirler. Eğitim araştırmacıları ayrıca sistem dinamik modelleme kullanılarak müfredat gelişimine odaklanabilirler.

DEDICATION

This dissertation is dedicated to my wife Şenay and daughter Damla whose unyielding love, support, and encouragement have enriched my soul and inspired me to pursue and complete this research.

ACKNOWLEDGEMENTS

This thesis is dedicated to my family Şenay Dinçer and Damla Dinçer. I would not have been able to make it through these five years without their love, encouragement, consideration and confidence in me.

I would like to thank my thesis advisor Associate Professor M. Atilla Öner for his relentlessly support on my thesis. He presented me with many opportunities to learn new skills throughout this thesis. I found a chance to integrate my previous educational background with management skills and system dynamics modelling by the help of his contribution. I sincerely appreciate all of his feedback regarding my thesis.

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Finally I would like to thank members of yahoo thesis group who have made my thesis preparation years supportive and interesting experience. I have benefited from their valuable ideas during presentations.

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Symbols	Units	Parameters	Definitions
acoac	dimensionless	acceptability of achievement by teacher	Level of acceptability of teachers about their student's current academic achievement
adjsaa	month	adjustment time for student academic achievement	Time duration of adaptation to the current academic achievement situation
ag	grade	academic gap	Difference between desired student academic achievement (dsaa) and Student Academic Achievement (SAA)
crm	1/hour	changing ratio multiplier	Multiplier for the conversion of parent involvement (PI) into a scale between 0 and 1
crpe	dimensionless	changing ratio in parent expectation	Conversion of Parent Expectation (PE) between 0 and 1
crpi	dimensionless	changing ratio in parent involvement	Conversion of Parent Involvement (PI) between 0 and 1
crtpc	dimensionless	changing ratio in teacher-parent contact	Conversion of Teacher-Parent Contact (TPC) between 0 and 1
DPE	grade/month	decrease in parent expectation	Rate at which family expectation decreases
DPP	hour/month	decrease in parent educational practice rate	Rate at which parent educational practices decrease. Parent educational practices are the practice time dedicated for the education of his child both at home and at school
DSAA	grade/month	decrease in student academic achievement	Rate at which student academic achievement decreases
dsaa	grade	desired student academic achievement	Parent's expected grade from his child or parent expectation (PE)
DTPC	hour/month	decrease in teacher-parent contact	Rate at which teacher-parent contact time decreases
eftpc	dimensionless	effectiveness of teacher-parent contact on achievement	Level of how teacher-parent contact affect student academic achievement between o and 1
fs	dimensionless	family size	Number of members in family
IPE	grade/month	Increase in parent expectation	Rate at which family expectation increases
IPP	hour/month	increase in parent educational practices rate	Rate at which parent educational practices increase. Parent educational practices are the practice time dedicated for the education of his child both at home and at school
ISAA	grade/month	increase in student academic achievement	Rate at which student academic achievement increases
ITPC	hour/month	increase in teacher-parent contact	Rate at which teacher-parent contact time increases

Symbols	Units	Parameters	Definitions
lifsa	month	lifetime for satisfaction	Time that shows how much a parent can continue with the same level of satisfaction depending on student academic achievement
lpe	month	level of parent engagement	Categorization of parent's desire to engage in school and educational activities
maxpe	grade	maximum parent expectation	Maximum grade that a student can take it from written exams
maxpi	hour	maximum parent involvement	Maximum time that a parent will be able to dedicate it for educational practices in a month
maxsaa	grade	maximum student academic achievement	Highest available grade that a student will be able to gain from a written exam
maxtpc	hour	maximum teacher-parent contact	Maximum plausible time in a month that a teacher can communicate with a parent
ms	dimensionless	marital status	A parent's state of being single, married, separated, divorced, or widowed
PE	grade	parent expectation	Expected grade of parents about his child's academic performance measured by written assessments
pel	dimensionless	parent education level	Highest level of schooling that a parent has reached
pepi	dimensionless	effect of PE on PI	Effectiveness of Parent Expectation on Parent Involvement
PI	hour	parent involvement	Participation of parents in school activities or helping students at home. It is the commitment of time, energy, and good will to promote success for students
pip	dimensionless	parent involvement pressure	Conversion of Parent Involvement (PI) between 0 and 1
pipg	hour/grade	needed parent involvement per grade	Hours needed for parents to spend for educational practices in order to increase their student's academic achievement by 1 grade
pw	dimensionless	fraction of parent workload time to total time	Percentage of parent's non educational activities (hours of employment, sleeping time and the time for daily activities) to total time
SAA	grade	student academic achievement	Outcome of education as grade
sasaa	dimensionless	satisfaction with student academic achivement	Level of parent satisfaction depending on the difference between the parent expectation (PE) and student academic achievement (SAA)
sca	dimensionless	school community awareness constant	Level of school community awareness about the importance of getting contact with parents in order to increase student academic achievement
sel	dimensionless	student energy level	Level of energy to make student focused on studying
sem	1/grade	self-efficacy multiplier	Conversion of student academic achievement to the range of 0 and 1 for self-efficacy scale

Symbols	Units	Parameters	Definitions
ser	dimensionless	student effort rate	Serious attempts of students towards learning
spis	dimensionless	school parent involvement support effectiveness	Level of support that a school makes to encourage parent involvement
sse	dimensionless	student self-efficacy	Student’s beliefs about their capabilities to produce a certain level of performance
tc	dimensionless	teacher caring constant	Level of how teachers support students in order to make them succeed more
tce	dimensionless	teacher classroom effectiveness	Level of how teacher cultivates thinking skills, stimulates interest in the subject and motivates students to learn
tcq	dimensionless	teacher communication quality	Level of teacher effectiveness during parent meeting
ter	dimensionless	teacher expectation rate	Level of teacher academic expectation from students
totpi	hour	total needed parent involvement	Total number of hours needed for parents to make educational practices with their children in order to decrease the academic gap
tp	dimensionless	teacher pedagogical knowledge	Level of teacher knowledge about his job
TPC	hour	teacher-parent contact	Total meeting time of teacher and parents
tq	dimensionless	teacher quality	Level of quality that shows how a teacher makes his job well in the learning environment
tsk	dimensionless	teacher subject knowledge	Level of content and curricular knowledge for a specific field that a teacher has experience on it
tv	dimensionless	teacher verbal ability	Level of how teachers use effective language during parent and student meetings
uoam	dimensionless	usage of various activities and methods	Level of usage that shows how often a teacher uses different activities and methods to attract student’s attention and to make them better learned
upi	hour	unit parent involvement	Smallest piece of parent involvement which is one hour
utpe	month	unit time for parent expectation	Taken as one month since the time step is in months
utpi	month	unit time for parent involvement	Taken as one month since the time step is in months
uttpc	month	unit time for teacher-parent contact	Taken as one month since the time step is in months

PART I - INTRODUCTION

1.1. General Background

Education has always been a major issue in the society. Education program is designed according to the needs of societies. To understand the education system of a country means at the same time to understand the political and economical structures of the same country. When a society has made a transition from a single-culture to multi-culture structure, high technology knowledge economy has gained so much importance. There is no doubt that educational reforms are essentially important to grow up a generation adapting to external environment and to establish competitive advantage in the global economy.

However, education level of a country fundamentally also implicates the social and the personal development. All the researches done worldwide have also focused on the educational welfare of the countries in addition to their economic growth statistics. It is easy to say that the educational situation of the country determines its position in macro economy as well. Therefore, educational policymakers and reformists frequently focus on the reasons behind the student academic achievement and better educational programs fitting with the external environment demands.

Educational reformists always need a wealth of information to make decisions in the educational arena. Making general academic exams, evaluation of student's cognitive skills, analyzing their critical thinking level, collecting an array of data about their physical environment both at home and at the school by completing questionnaires are recognized as the main tools to understand the main trends in student academic achievement and contexts for teaching and learning. Program for International Student Assessment (PISA) and International Association for the Evaluation of Educational Achievement (IEA) studies can be given as such universal exams to measure performance of each country's entire education system. Standardized test scores are not only determinant factors about a certain education system outcomes. Teacher, school, principal, parents and students are taken as integral parts of an educational system.

Economists and policy researchers are demonstrating that all the educational role players 'matter' within the entire educational system. Therefore, legislators, governors and other policymakers try to make difficult choices among attractive educational programs.

1.2. Problem Statement

The main focus of the research is to analyze the variables and their relations that affect a student academic achievement and parent satisfaction. Education in high schools as an entire system mainly consists of student, parent, teacher and school sectors. The variables in the school environment are connected interchangeably and they contribute to the student academic achievement and parent satisfaction at the end of schooling year.

In the literature, the researches mostly concentrate on each sector differently and try to make a correlation between two only variables. For example, the effect of student's intelligence, student characteristics, personality, motivation; the effect of parent involvement, parent education, parent participation; the effect of teacher experience, teacher knowledge, teacher performance, teacher attitudes; the effect of school physical structure, class size, teacher-child ratio, principal, organizational structure, heating systems on student academic achievement are studied differently to make a linear relationship. Linear relationships between each variable and student academic achievement are made interdependently.

On the other hand, the relationships of these variables are more complex. Student, teacher, parent and school characteristics affect student Academic Achievement at different ratios. Hence, to understand the reasons behind the student academic achievement and parent satisfaction, the network system should be analyzed from a holistic view.

However, the school, class and family environments cannot be separated from each other to understand the educational process. There are multi-related relationships between them. Both the amount and the quality of contacts between school, teacher, parent and student parameters characterize these relationships between them. All these dimensions impact student academic achievement individually, as well as through their interactions with one another.

At the center of such a complex system, parents are in dilemma about deciding which school would be more suitable to enhance the potential growth of the child, increase his academic achievement and increase parent satisfaction. How can different educational variables affect the educational outcomes? At this point, System Dynamics can be helpful to show and put different variables into a more holistic approach. This research will attempt to come up with causal relationship between the sectors mentioned above. This research aims to provide a model for Effective School System for students, parents, teachers and school administrators based on System Dynamics Modeling.

1.3. Purpose of the Study

The purpose of this study is to develop a system dynamics simulation tool that could be used by school administrators to increase the effectiveness of school system by understanding the relations between student academic achievement, parent satisfaction, teacher characteristics and school environment, and to propose and discuss solutions for Effective School Administration and System in Turkey as in another countries.

In a competitive and highly dynamic environment, it is essential that school administrators must create a school environment where parents realize it valuable for their children's education. Parents also value the social and environmental factors of schools in addition to their academic quality. These characters of a school together contribute to the education of students. The dynamic models of parent school satisfaction regarding with academic achievement are critical to create an effective school system.

1.4. Management Questions

Based on the articles in the literature and the discussion with the 15 school managers, the following management questions are formulated:

1. How can the school top management create a formal and informal school structure to maximize the student academic achievement and parent satisfaction?
2. How can the schools organize the educational facilities that enhance parent involvement and parent satisfaction?
3. How can the school administration motivate the teachers in order to create effective classroom environment for both student academic achievement and parent and student satisfaction?
4. How can the school top management design a strategy that enhances organizational capabilities and creates competitive advantage in order to affect parents' school choice decisions?

Some of these management questions are overlapping and are related to each other.

1.5. Research Questions

The purpose of this research is to formulate and answer the following research questions, starting from the management questions in section 1.4:

1. What are the factors affecting the student academic achievement?
2. What are the major factors for students and parents to be satisfied with their schools?
3. What are the critical factors for an organization to create an effective school environment?
4. What are the main reasons behind the parent's school choice decisions?

1.6. Scope of the Study

Scope of this study is to investigate the effective school system that achieves both academic achievement and parent satisfaction by developing a model using System Dynamics Modeling. This study will also cover the effects of other factors like student, parent, teacher and school characteristics on academic achievement and parent satisfaction.

These dimensions are considered at the same time as sectors in system dynamics approach. Parent sector combines all the parameters regarding with parents. Parent education level, marital status, SES of families, parent involvement, and family size are the parameters from parent sector.

The study will not focus on Ministry of Education, Government policies, word of mouth, state economic stability, ranking of the school among other schools, and GDP. These variables are considered as exogenous.

1.7. Significance of the Study

This study is important for:

- **School Administrator:** Top management generally pay attention to the school characteristics, such as class size, student-faculty ratio, quality of teacher, and school environment to maximize the student academic achievement and hence parent satisfaction. Education is actually a marketplace for especially private schools. To supply both parent and student satisfaction will enable the school administrators to enhance their capabilities.

- **Teachers:** Teachers play a crucial role in creating an effective learning environment and setting the academic expectations for student progress. Teacher is a key factor to boost the student motivation in a learning environment and hence the quality of the relationships between teachers and students are critical for educational attaintment and academic success. Teachers are extremely important determinants of student academic achievement.
- **Parents:** Family characteristics and behavior like home environment, and family–child interaction are important contributors to maximize the academic achievement. However, this model would show the dynamics of interactions between parent preferences, needs and expectations.
- **Students:** In order to reach satisfaction and achievement, students should be aware of the environmental conditions in the school context. The model would emphasize the ways of how to supply academic achievement in addition to both student and parent satisfaction.
- **Educational Policy makers:** Educational policymakers give equal importance to the affective characteristics of student, teacher, parent and school parameters to improve school achievement.

1.8. Limitations of the Study

The study is conducted within limitations. The effect of external environment on parent satisfaction and student academic achievement is neglected. The government policies, economic stability of the country and cultural changes are not taken into consideration. The generalization of the results was limited, as the data was collected from only secondary schools. The sample was limited to formal education systems without specific focus on the other non-formal educational institutions.

1.9. Organization of the Dissertation

Chapter 1 - Covers the general background, problem statement, main purpose, management and research questions, scope, significant contributions and research limitations.

Chapter 2 - Performs a Literature Review on School Choice Process as educational expectations and school choice decisions.

Chapter 3 - Performs a Literature Review on Educational Process as student, teacher, parent and school sectors.

Chapter 4 - Performs a Literature Review on Educational Outcomes as parent satisfaction and student academic achievement.

Chapter 5 - Presents the Methodology, which includes systems dynamics modeling, applicability of SD to the problem, problem definition, scope, time horizon, purpose and formulation of dynamic hypotheses.

Chapter 6 - Covers the Conceptual Model and Causal Loop Diagrams, which include tentative causal loop diagrams for student, teacher, parent and school sectors, and research data.

Chapter 7 - Presents the Simulation Model and Stock-Flow Diagrams, which include four stock-flow diagrams and simulation model.

Chapter 8 - Presents Tests, Simulation Results and Sensitivity Analysis, which include simulation results and sensitivity analysis.

Chapter 9 - Presents the Conclusion, which summarizes the results, managerial implications and implications for further research.

PART-II LITERATURE REVIEW

Educational System is a dynamic and complex system. Since it is dynamic, many variables are interrelated and correlated independently with the educational outcomes. From the systems theory approach, educational system can be thought as depicted in the Figure1. As an educational input, parent decisions and expectations play a crucial role. Every parent depending family structure and characteristics have different types of expectations from the schools, teachers and also their kids. Parents select the schools depending on these expectations from the schools.

When a student enters a school, he or she will be in a complex educational system. Parents, teachers, schools and student must be studied together to understand the educational outcomes at the end of the school years such as academic achievement, educational satisfaction, social and cultural gains etc. So, educational process within these variables is rather complex and there are many interrelations. Within each part and between the parts, the relations cannot be easily determined to understand educational outcomes.

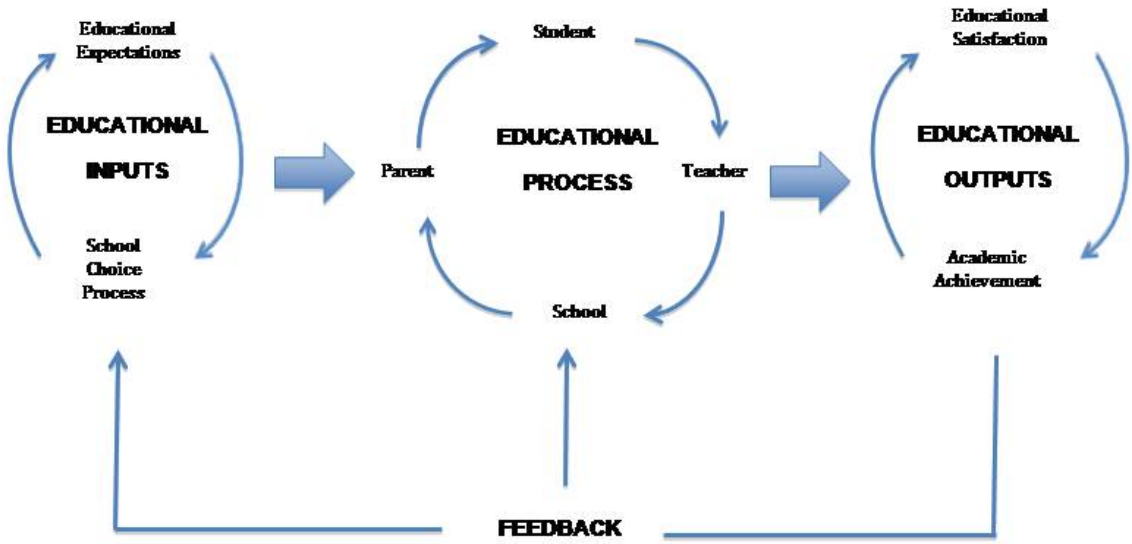


Figure 1 - Educational System elements and their complex relations

In the literature, the effects of all variables on student academic achievement and educational satisfaction are studied separately and many correlations are established such as the effect of parent’s SES on student academic achievement, the effect of parent involvement on parent satisfaction etc. But none of these studies discussed the educational system from the systems perspective. Since the educational system is dynamic, its behavioral character is mainly determined by the characteristics of the whole, not by the characteristics of its individual parts.

Generally, people tend to think in simple causal chains like parent involvement and achievement rather than networks of related variables. It is rare for people to see more than one cause of a problem. People concentrate on parts rather than wholes. They seem to disregard interconnections between different elements in a system. In that sense, we concentrate on the study of each dimension separately and then thinking them as whole by the help of system dynamics approach. The system dynamics can be helpful to create a more adequate problem description by eliciting the hidden causal assumptions that all of us automatically hold and by integrating these into a more complete problem representation.

In the following body of the literature review, we will focus on educational inputs, educational process, educational outputs and their sub-variables separately. All the constructs related with the research are shown in the italic once at the beginning of the literature review.

The research has mainly three implications for policy makers. Firstly, educationalist can monitor the importance of each parameter and their level of contributions to student academic achievement. Second implication is for managers. School administration may strategically think the school system as an organization in order to increase the profit and its effectiveness among other competitive schools. To do that, fist way is to catch up parent and student satisfaction since they are considered as clients. The last implication is for system dynamicists. They monitor the usage of this enormous feedback system in a different sectors compared to financial sectors.

2. LITERATURE REVIEW ON SCHOOL CHOICE PROCESS

Parents do not generally choose a school for one particular reason. Rather, parents have a number of issues that they consider simultaneously when exercising school choices. More parents choose their specific school for *academic reasons*, such as *special programs* and *smaller class sizes*, and value reasons, such as "the *teaching style* of the school and the *satisfaction* with that school" (Hausman and Goldring, 2000).

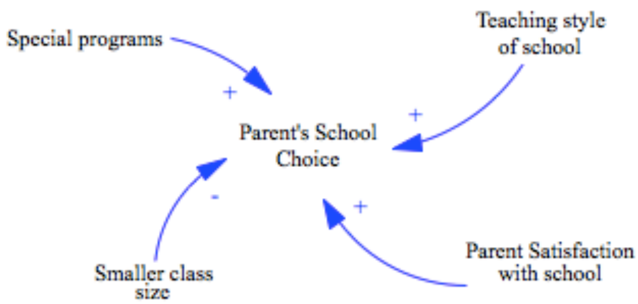


Figure 2 - The effect of academic and value reasons on parent's school choice decisions (drawn from Hausman and Goldring, 2000).

The quality of education plays a crucial role about school choice process of parents. Actually, "delivering *quality education* means identifying and conforming to the expectations of parents on a consistent basis. If parents are satisfied with their children's school, they are more likely to keep their children at that school and send their other children to the same school" (Taylor and Baker, 1994). Therefore parent satisfaction affects strongly parent's decision making about school choice

Apart from quality of instruction, the highest other levels of *parental satisfaction* are associated with *educational assessment*, *the teacher* and *the fairness of treatment*, *child's school success*. However, "the *academically educated parents* showed more satisfaction with their child's school success" (Raty and Kasanen, 2007).

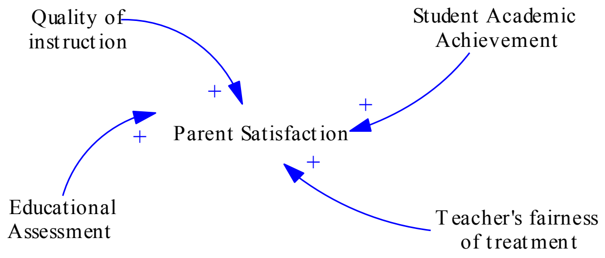


Figure 3 - The effect of quality of instruction, educational assessment, teacher's fairness of treatment and student academic achievement on parent's school choice decisions (drawn from Raty and Kasanen, 2007).

"Parents are also likely to tell other parents of their positive experience which further impacts school choice positively" (Friedman, Bobrowski and Geraci, 2005). The observation and experience of a parent influence other parent's decision-making process. "*Parent school referrals* and *word of mouth* played key roles in parents' discovery of the school" (Friedman, Bobrowski and Geraci, 2005).

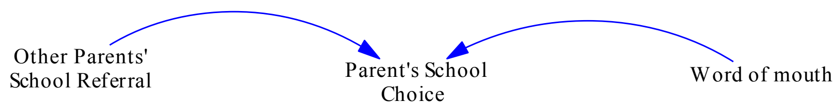


Figure 4 - The effect of parents' school referrals and word of mouth on parents' school choice decisions (drawn from Friedman, Bobrowski and Geraci, 2005).

Parent satisfaction is very important factor that influences the parent's school choice decisions. One important predictor of parent satisfaction is *parent involvement* in educational process and vice versa. "Studies have documented the increasing parent involvement and participation in the schools and educational activities of their children. Global educational views of parents are likely to be reflected in their expectations regarding school goals" (Tatar and Horenczyk, 2000). There is a strong relation between the rise in the parent involvement and the rise in the parent expectations from their kids.

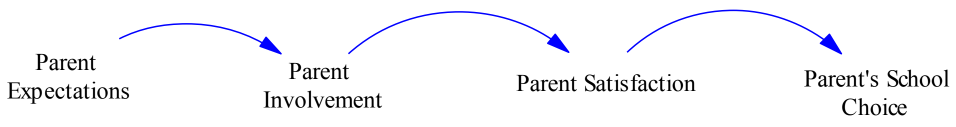


Figure 5 - The effect of parent involvement on parent’s school decision (drawn from Tatar and Horenczyk, 2000).

When the parents feel that they did not participate in the educational processess, they will probably re-think of school choice decisions. According to the some researchers, one of the ideas behind why parents choose private schools is the the *school organizational structure* that encourages parent participation. “Parents who communicate very frequently with their children about school and are more involved in school are more likely to consider private schools; and parents who felt that the level of collaboration between teachers and parents was not adequate, were also more likely to consider private schools” (Bast and Walberg, 2004).

However, “the extent to which parents are empowered and informed, is dependent largely on *school structural characteristics* and *school climate*. Parental involvement, in turn, has been associated with higher levels of parental satisfaction and better student *academic achievement* through involvement’s presumed effects on student academic behavior and on the classroom itself” (Griffith, 1997).

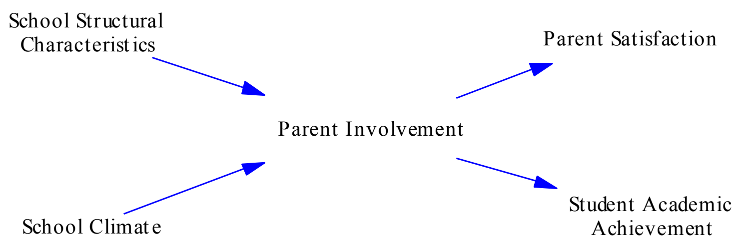


Figure 6 - The factors that affect parent involvement and its main effects on educational outcomes (drawn from Griffith, 1997).

Actually, “education will resemble more of a marketplace. ‘Satisfaction’ or ‘dissatisfaction’ alone may not drive the market-based decisions parents make about their children’s education. Offering a ‘good’ school that parents are satisfied with may not be good enough to keep their patronage. The market mechanisms may not operate as a function of supply and demand. Rather, a variety of social dimensions must be considered as they influence parents' reasons for exercising school choice" (Goldring and Phillips, 2008).

In addition to *parental characteristics* and *parental behaviour*, in order to understand the student academic achievement, we need to analyse *student, teacher, parent and school characteristics* at the same time. Those characteristics are the integral parts of student academic achievement. Many relations among them are non-linear. The combination of these non-linear relationships gives rise to a wide variety of behavioral characteristics of the system.

System Dynamics approach is the most preferable one to analyze such a complex education system. Every element can contribute to the student academic achievement differently and each of them affects each other. If we have a chance to look at the parent satisfaction and student academic achievement using system dynamics modeling, this view will be helpfull for not only teachers but also academicians and policy-makers.

2.1. EDUCATIONAL EXPECTATIONS

All parents highly value *academic quality*. However, "preferences for academic quality increase with *family income* and *student academic ability*" (Jacob and Lefgren, 2007). "*Socioeconomic status (SES)*, *race*, and background characteristics of parents and children influence the degree to which parents set high goals for themselves and their children. High parent expectations lead children to set high standards for their education and to make greater demands on themselves from an early age that result in high academic achievement" (Gill and Reynolds, 1999).

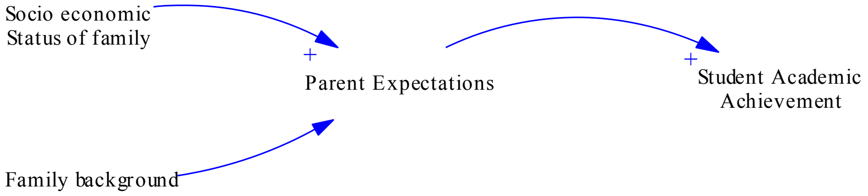


Figure 7 - The effect of parent expectations on student academic achievement (drawn from Gill and Reynolds, 1999).

“Parent expectations have been defined along many dimensions such as short-term expectations for specific grades at the end of a marking period versus long-term expectation for completing high school or a definite number of years of schooling; specific success versus general success such as minimum standards for a child’s intellectual performance; and future educational expectations versus occupational expectations” (Gill and Reynolds, 1999).

Parental educational expectations are mainly conceptualized in three dimensions (Tatar and Horenczyk, 2000);

1) “realistic expectation - parental predictions of the level of academic performance of their children”;
2) “idealistic expectations - including the wishes and hopeful anticipations held by the parents related to their children in academic realms”; and
3) “standards of academic achievement, the implicit measures by which the parents evaluate their children's academic attainments”.

Parent expectations later will affect not only educational process but also educational outputs. However, parent expectations would be the main component of parent involvement. These parent expectations can be categorized into two perceptions. The first one “relates to the learning environment at home like family expectations and behaviours etc. whereas the second one focuses on the same parameters but as perceived by the children themselves” (Tatar and Horenczyk, 2000).

However, “parents and students can also have some expectations of teachers. These expectations can be grouped into three categories; *teaching competence*, *help and assistance* and *fairness*” (Tatar and Horenczyk, 1996). Teaching competence means the behaviour of the teachers in the learning environment. It also shows his level of quality in terms of setting up discipline, being organized and using many teaching tactics. Teacher image also means how he helps and supports students make them improve. Helpful teachers also set a level of trust among students. Fairness is related with how teachers work fairly in school. It means appropriate functioning of teachers.

Parents have many expectations from schools. These expectations mainly affect the decision making process for *school choice*. According to these expectations, parents decide which school would be more suitable to these preferences. But once a decision is made, parent’s expectations and preferences can also be changeable according to the environmental situations. These expectations can be shaped in both class and school contexts. For class activities, “parent preferences were not associated with any additional observable teacher characteristics such as *experience* or *educational background*” (Jacob and Lefgren, 2007).

Parents cannot evaluate teacher characteristics. They do not have necessary background information to assess their skills and competence. However parents can observe the teachers in learning environment and during meeting times. They can have a level of information about their competencies to some extent. Rather than parents, principals are the key persons to assess teacher characteristics such as experience, quality, usage of various teaching tactics and methodologies.

For school context, parent expectations are related with the school environment. “When academic inputs are relatively scarce in higher-poverty schools—for example, more disruptive peers, lower academic expectations, fewer financial resources, or less competent teachers—parents in these schools may seek teachers skilled at improving academic achievement even if this comes at the cost of student satisfaction” (Jacob and Lefgren, 2007).

Finally we can conclude that parent expectations changes depending on the other variables such as student, teacher and school. However, parents evaluate the educational system based on how their kids have gained the educational attainments and how they are satisfied by making ther expectations real at the end of a certain educational process. Therefore, “expectation is an important input to evaluate the educational system” (Jacob and Lefgren, 2007). Within the text, the reasons that affect parent’s expectations will be discussed.

2.2. SCHOOL CHOICE DECISIONS

Parental choice of school is an important step for academic life. Under a complex decision process, researchers wanted to understand school choice reasons of families for assessing the schools and making some suggestions to both the teachers and school staff. It is essential to know how parents evaluate schools to increase student academic achievement and how schools attract the parents from the marketing perspective. “All schools try to raise their standard and become more responsive to parent’s demands in today’s competitive environment” (Jarvis and Alvanides, 2008).

The factors that affect the school choice decisions of parents according to the literature can be summarized as follows;

1. *Discipline* (Kraushaar, 1972),
2. *Convenience* (Maddaus, 1990),
3. *Safety* (Schneider, 1998),
4. *Academic Achievement* (Hausman and Goldring, 2000),
5. *School structure encouraging parent participation, communication and involvement* (Bast and Walberg, 2004),
6. *School quality as school consisting of high-ability pupils* (O’Shaughnessy, 2007),
7. *Income of household* (O’Shaughnessy, 2007),
8. *Travel cost* (O’Shaughnessy, 2007),
9. *Racial composition of the school* (Jacob and Lefgren, 2007),
10. *Socioeconomic composition of the school* (Jacob and Lefgren, 2007),
11. *Family income* (Tamm, 2008),
12. *Parents’ education* (Goldring and Phillips, 2008),
13. *Parent satisfaction* (Goldring and Phillips, 2008),
14. *School size* (Goldring and Phillips, 2008),
15. *School neighbourhood* (Goldring and Phillips, 2008),
16. *The diversity of the school* (Goldring and Phillips, 2008),
17. *The level of satisfaction from the previous school* (Goldring and Phillips, 2008).
18. *Teacher quality* (Lai, Sadoulet and Janvry, 2009),
19. *School reputation* (Lai, Sadoulet and Janvry, 2009),
20. *School performance* (Lai, Sadoulet and Janvry, 2009),

We will discuss these reasons in more detail in the following sub-sections.

2.2.1. Dimensions for school choice

“It is often suggested that parents choose schools for academic reasons” (Goldring and Hausman, 2000). It is a general tendency that more parents choose their specific school for academic reasons, such as special programs, smaller class sizes, teaching style of the school

In addition to academic side of the schools, other school characteristics can also change the school choice decisions of the parents. “Parents care about the quality of their children’s educational experience that, in turn, depends on the interaction between the quality of the school and the quality (ability plus motivation) of the child. Parents choose schools according to the quality of school, the quality of the child in household and the income of household” (O’Shaughnessy, 2007).

“Parents clearly give overwhelming importance to teacher quality and to school reputation and performance” (Lai, Sadoulet and Janvry, 2009). However, “other school characteristics aside from academic factors like school size, school neighbourhood and the diversity of the school are important to some choosers” (Goldring and Phillips, 2008).

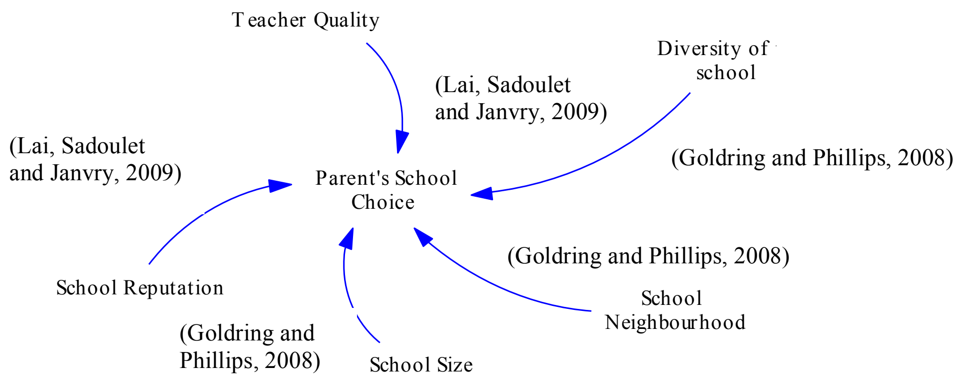


Figure 8 - The effect of some school characteristics on parent’s school choice decisions (drawn from Lai, Sadoulet and Janvry, 2009; Goldring and Phillips, 2008).

School convenience and easy transportation to the school is another important factor for the families as well as the school quality (Maddaus, 1990). According to the study on the Minnesota choice plan report, 40% of participating parents did so for reasons of convenience, while only 20% cited academic reasons (Hausman and Goldring, 2000).

Again according to O'Shaughnessy (2007), distance from home to school due to the cost is important factor to make school choice decisions.

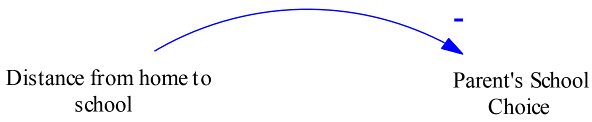


Figure 9 - The effect of school convenience on parent's school choice decisions (drawn from O'Shaughnessy, 2007).

In accordance with the school achievement, parent involvement in school activities can be regarded as important contributor to student academic achievement. Since the private schools establish good communication channels with parents, they may mostly prefer private schools than public schools. "Parents who choose private schools are more involved than public school parents in general. Parents may be more comfortable with and supportive of a school they have chosen" (Hausman and Goldring, 2000).

However, "parents who considered private schools were more likely to give assistance to their children at home; they were more likely to participate in their children's schools; they were more likely to communicate with their children about school; and they were more likely to feel that their participation in their children's education was meaningful and helpful to their children's academic success" (Goldring and Phillips, 2008). According to another research made by O'Shaughnessy (2007), "there is an important relationship between parents who report high levels of parent involvement and the likelihood of considering a private school".

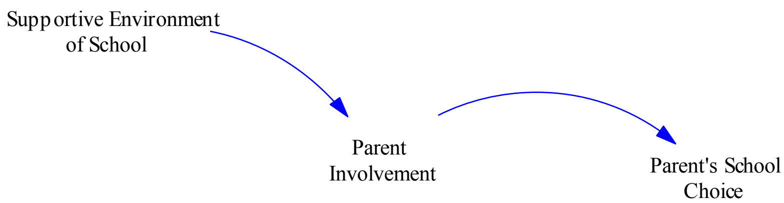


Figure 10 - The effect of parent involvement in schools on parent's school choice decisions (drawn from Goldring and Phillips, 2008).

In private schools, parents can easily communicate their expectations with teachers and school staff. “Parents who communicate very frequently with their children about school and are more involved in school are more likely to consider private school” (Bast and Walberg, 2004). The schools that allow parent involvement easily can be most preferable among the parents. That is why, according to Bast and Walberg (2004), “parent involvement seemed to be an important predictor of parents’ choice processes. Parents may perceive that parent involvement and parent communication are more easily facilitated and valued in private schools. Perhaps since many private schools are smaller and have fewer formal rules and regulations, parents believe they will have more opportunities for involvement and communication” (Bast and Walberg, 2004).

In addition to parent involvement, easy communication channels with the parents affect especially the parents’ private school decisions positively. “The more a parent engages in communication about school with their child, the higher the probability that they will consider a private school for their child. Parents who consider sending their children to private schools are somewhat dissatisfied with the communication between home and school that they perceive to exist in the public school system” (Goldring and Phillips, 2008).

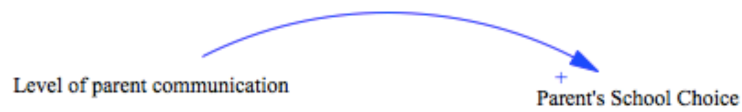


Figure 11 - The effect of parent communication with school on parent’s school choice decisions (drawn from Goldring and Phillips, 2008).

Some family characteristics are actually the starting point of school choice decision processes. The fundamental framework is constructed according to family characteristics. There is no doubt that, family income is a very basic demographic variable that is positively related to choosing schools, especially for the private school.

“Family income is often thought of as an indicator of resources, a higher family income increases one’s chances of affording a private education” (Goldring and Phillips, 2008). School choice is highly correlated with household income. “This might be due either to a causal effect of income on school choice or to differences in child or household characteristics which both are associated with differences in income and school choice" (Tamm, 2008).

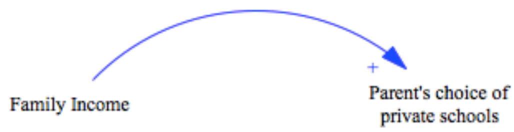


Figure 12 - The effect of family income on parent's school choice decisions (drawn from O'Shaughnessy, 2007; Goldring and Phillips, 2008; Tamm, 2008).

"Parents with higher educational attainment tend to place emphasis on the importance of education, and they are more likely to seek out information on the varieties of educational choices. There is a positive relationship between parents' education and the likelihood that they would send their children to a private school" (Goldring and Phillips, 2008).

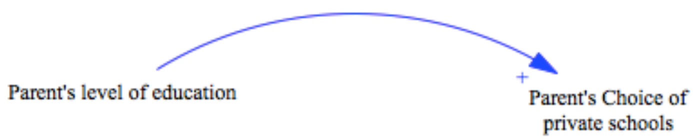


Figure 13 – The effect of parent's educational attaintment on their school choice decisions about their children (drawn from Goldring and Phillips, 2008).

On the other hand, according to Jacob and Lefgren (2007), "parents can also consider the location and racial or socioeconomic composition of a school more important than its academic quality".

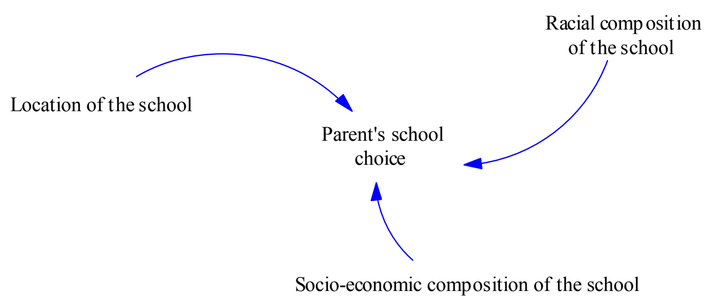


Figure 14 - The effect of school characteristics on parent's school choice decisions about their children (drawn from Jacob and Lefgren, 2007).

If the parents are satisfied with their previous schools, probably they will choose the same school for the next years. Satisfaction is broad concept that includes all the variables mentioned above like achievement, convenience, school characteristics, school quality, composition of the school etc.

When parents are satisfied with the current school. They probably continue to send their children to the school. If they are dissatisfied, they will look for the new one. “The school choice research consistently demonstrates that parents tend to be more satisfied with the school their child attends if they are able to choose the school when compared to parents who are assigned to a school” (Goldring and Phillips, 2008).

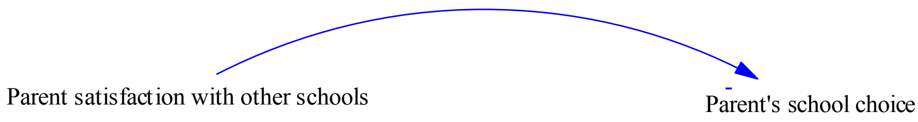


Figure 15 - The effect of parent dissatisfaction with other students on parent’s school choice decisions about their children (Goldring and Phillips, 2008).

2.2.2. Parent mistakes about school choice

Parents have such a point of view that they evaluate the schools correctly. “Most parents choose schools on the basis of their perceived academic quality (showing they are choosing in the child’s best long-term interests); and data showing student academic achievement gains are higher in schools of choice than in traditional public schools” (Cullen, Jacob and Levitt, 2005).

Parents sometimes give more importance to the location of the school and social life in the school rather than its academic focus. However, according to Coulson (1993), “National Household Survey conducted by the US Department of Education found “better academic environment” was the most common reason parents gave for choosing an independent school”.

Figure 16 - The effect of better academic environment on parent's school choice decisions (drawn from Coulson, 1993).

Bast and Walberg (2004) have mentioned about the consequences of a research. "The Study of Arizona charter schools found that the three most common reasons given by parents for choosing a charter school were 'better teachers at this school' (44.8%), 'unhappy with curriculum or teaching at prior school' (40.0%), and 'people told me this is a better school' (34.6%). All three answers indicate a concern for academic achievement. Parents choose schools for their children based on costs and benefits (incentives), the availability of information, and the presence of opportunities (choices)" (Bast and Walberg, 2004).

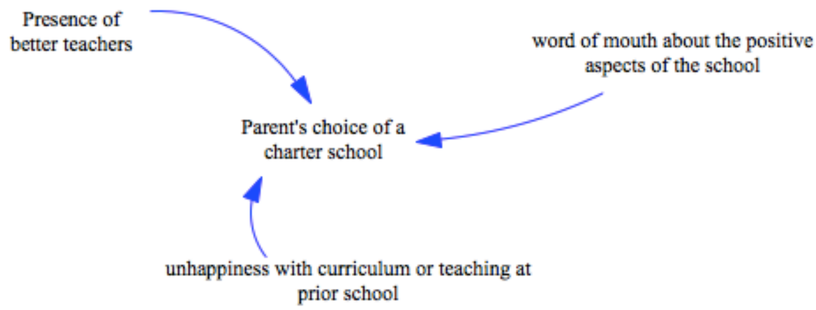


Figure 17 - The effect of importance of academic achievement on parent's school choice decisions about their children (drawn from Bast and Walberg, 2004).

"The parents' school choice errors are very costly in terms of the future academic success of their children. Parents with a higher level of education or parents whose children had higher primary school performance were less likely to report a top-tier school as their second or later choices" (Lai, Sadoulet and Janvry, 2009).

"Parents also demonstrated limited knowledge and preparation for playing the school choice game, with only 28% claiming that they had listened to teachers and other parents' opinions about schools, and only 30% stating that they had some sense about the admission quota and their chance of entry for their second-choice school. Parents clearly gave overwhelming importance to teacher quality (73% named this among their first three factors in selecting schools) and to school reputation and performance. However, corresponding knowledge was also lacking: only 25% of the parents said they knew the reputation and previous performance of their second choice school" (Lai, Sadoulet and Janvry, 2009).

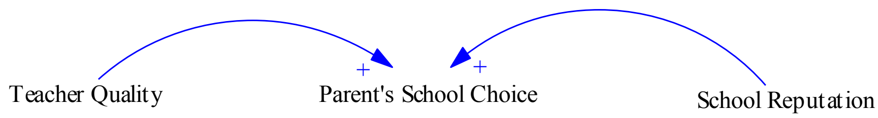


Figure 18 - The effect of teacher quality and school reputation on parent's school choice decisions (drawn from Lai, Sadoulet and Janvry, 2009).

"Parents with lower education levels or parents with children who had low performance in primary school were more likely to make this error in school choice. The children of parents who made judgment errors in school selection were admitted to lower quality schools and achieved lower test scores on the High School Entrance Examination. Parents who had less education, whose children performed at lower levels in primary school, and who were less attentive to teachers' opinions about schools were more prone to make these errors" (Lai, Sadoulet and Janvry, 2009).

3. LITERATURE REVIEW ON EDUCATIONAL PROCESS

From a system perspective, the field of education is a complex structure. There is no direct correlation between the variables. The relation between the school inputs and outputs have always became a serious topic among educationalists. For school output as student academic achievement, personal growth and educational attaintment, parent, teacher, student and school inputs altogether contribute to these outputs. They are important determinant factors over the school outputs.

The great part of the research in the literature mainly focuses on just the correlation between a single input and a single output. There are interchangeble relationships between the variables we need to understand how to analyze this complex network. The goal of this study is to understand the behaviour of the education system mostly determined by the characteristics of not only the whole but also its individual dimensions. As system dynamicists do, the research will tend to take an endogenous rather than an exogenous view and focus on the internal structure rather than external factors. To do that, first of all we need to see the dimensions in more detail.

In this study, all the input factors are categorized into four dimensions. In order to understand the components of such a complex system, we need to analyze the sub-dimensions using the previous research and then we can approach such a complex system from a perspective of system dynamic concept. Here are these dimensions;

1. Student
2. Teacher
3. Family and Parent
4. School

dimensions separately and then establish the huge network channels among them. Parent, teacher, student and school are the integral parts of educational process and thus success.

Salfi and Saeed (2007) state that "it is imperative that these factors should properly function for the quality of education. There are many factors that affect the students' learning in schools. These include: teachers' qualifications and experiences, teachers' guidance to students, availability of teaching learning resources, physical facilities, students' own cognitive and other abilities, and their socio-economic backgrounds".

We will discuss these dimensions such as student, teacher, parent and school in detail.

3.1. STUDENT DIMENSION

Student is at the heart of the education system. All other dimensions and environmental factors only help them to achieve their goals. Student characteristics that enhance student academic achievement are given below;

1. *Student attitudes to school* (Silins and Harvey, 2000),
2. *Student emotions* (Meyer and Turner, 2002),
3. *Engagement* (Silins et al., 2002),
4. *Student self-efficacy* (Bruinsma, 2004),
5. *Student self-competence* (Bruinsma, 2004),
6. *Motivation* (Spinath et al., 2006),
7. *Student mastery goal structure* (Urdan and Schoenfelder, 2006),
8. *Intelligence* (Laidra, Pullmann and Allik, 2007),
9. *Personality* (Laidra, Pullmann and Allik, 2007),
10. *Student perceptions of treatment by teachers* (Demir, 2009),
11. *Student perceptions of number of friends at school* (Demir, 2009),
12. *Gender* (Demir, 2009),
13. *Total hours spent on studies per week* (Demir, 2009),
14. *Getting help with studies outside school* (Demir, 2009),
15. *Total number of days absent from school* (Demir, 2009),
16. *Social Capital of a student* (Huang, 2009),
17. *Child–parent interaction* (Huang, 2009),

We will discuss these variables in detail as in the following section.

3.1.1. Student characteristics

“The linear combination of family and student characteristics is significantly related to school achievement. Student perceptions of treatment by teachers, student perceptions of number of friends at school, gender, total hours spent on studies per week, getting help with studies outside school and total number of days absent from school independently had significant effects on academic achievement” (Demir, 2009). However, “student perceptions of treatment by teachers, and student perceptions of having many friends are closely related to school climate variables in that they represent additions to school quality from a student perspective” (Demir, 2009).

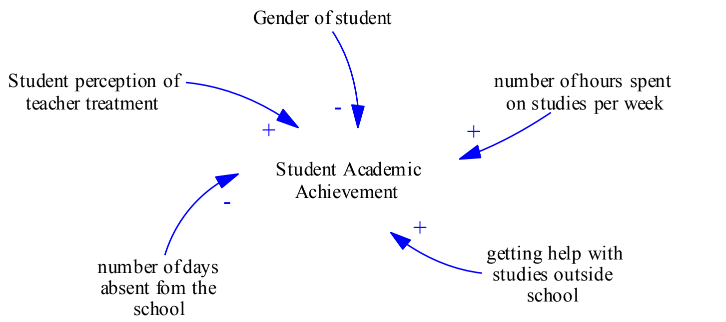


Figure 19 - The effect of some student characteristics on their student academic achievement (drawn from Demir, 2009).

Student characteristics directly affect the school outputs. However it is a reciprocal process that school environment also has an influence on student attitude. Attitude to school is the important student factor that increase school performance. “Students’ attitude to school mainly is composed of the student’s perceptions of the opportunity for success in life that schools provide, general satisfaction with school, the extent of their social integration and perceived achievement” (Silins and Harvey, 2000).

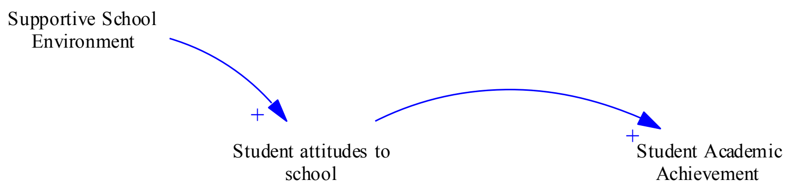


Figure 20 - The effect of student attitudes to the school on his or her academic achievement (drawn from Silins and Harvey, 2000).

3.1.2 Social capital

“Most of the variation in follow-up achievement stems from individual-level characteristics that are unobserved” (Bacolod and Tobias, 2006). Human capital is measured by fathers’ and mothers’ educational attainment. This educational attaintment has an impact on student academic achievement.

“Home human capital is strongly positively associated with ‘good peer teacher interactions’ and student academic achievement. However, ‘good child–parent interaction’ is a strongly positive asset for school academic achievement. Factors at home play an important role in building student social capital, a result that positively influences achievement at school" (Huang, 2009). Path diagram for "linking students' home, community and school backgrounds with social capital and student academic achievement" (Huang, 2009) is shown in the Figure 21.

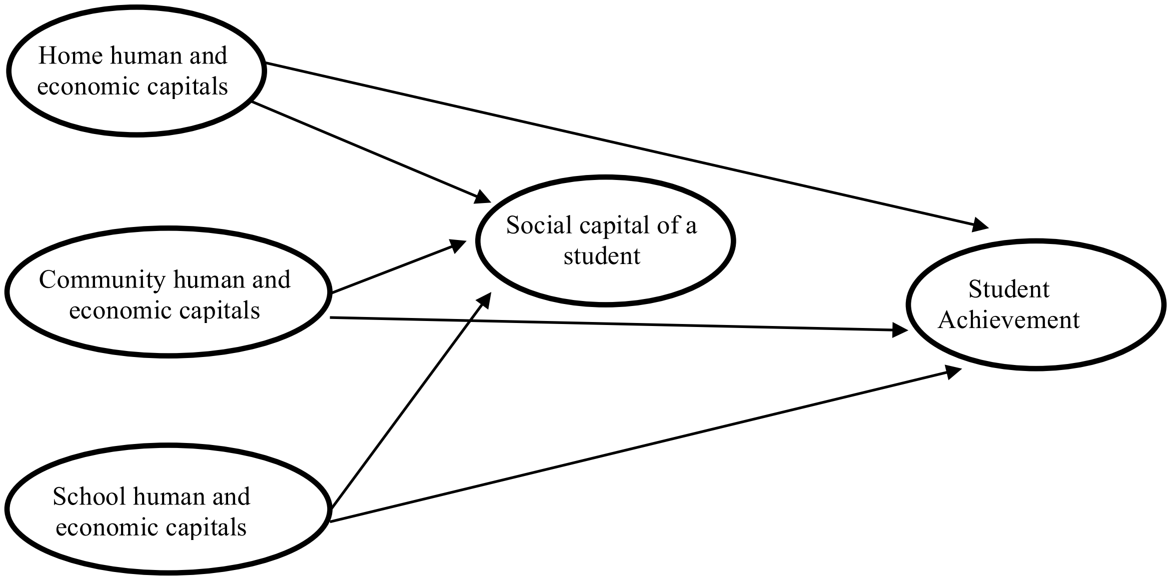


Figure 21 - Path diagram for "linking students' home, community and school backgrounds with social capital and student academic achievement" (Huang, 2009).

3.1.3 Motivation

"Motivation is a complex part of human psychology and behavior that influences how individuals choose to invest their time, how much energy they exert in any given task, how they think and feel about the task, and how long they persist at the task" (Urdan and Schoenfelder, 2006).

Some learning theories such as achievement goal theory give more importance to giving challenging work in order to boost student motivation and enhance student academic achievement. "When the work is too difficult, motivation is diminished because students lack confidence, feel coerced into completing work that is too difficult, and become overly concerned with failing" (Urdan and Schoenfelder, 2006).

In addition to achievement goal theory, social cognitive and self-determination theories also indicate the importance of challenging work for the success. "Similarly, all three theoretical perspectives note the importance of providing a *sense of ownership over the learning process* to students. Achievement goal theory suggests autonomy and choice as key ingredients for creating mastery goal structures in schools and classrooms" (Urdan and Schoenfelder, 2006).

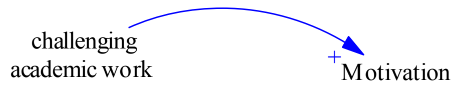


Figure 22 - The effect of challenging academic work expected from students on their motivation (drawn from Urdan and Schoenfelder, 2006).

"Self-determination theory places a premium on autonomy supportive teaching practices, including providing students with choices" (Deci and Ryan, 1985). "Social-cognitive theorists place *self-efficacy* that includes having students take ownership of their learning. In all of these theories, teachers are encouraged to shift their roles away from the lecturing, controlling expert to a supportive facilitator to learn for themselves at their own pace" (Urdan and Schoenfelder, 2006).

"Motivation research and theory has emphasized a social-cognitive perspective" (Bandura, 1986). According to this view, "the cognitions of individuals regarding academic work (e.g., beliefs about their academic ability, expectations about the outcomes of engaging in the task, goals for the task) are influenced by social-contextual factors, such as messages from the teacher about the difficulty of the task, the perceived abilities of classmates, information about the importance of learning the material, and so on" (Urdan and Schoenfelder, 2006).

From this perspective, "motivation does not reside entirely within the individual or entirely within the context. Rather, motivation emerges from the interaction between individuals within the social context of the classroom and school. Thus, the study of motivation offers valuable clues for the understanding and improvement of school achievement" (Spinath et al., 2006).

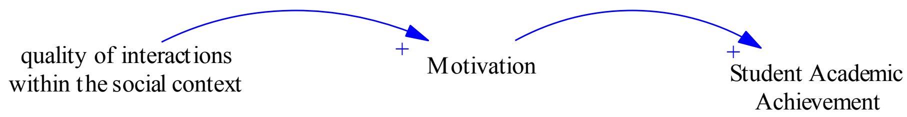


Figure 23 - The effect of interactions within the social context on student academic achievement (drawn from Spinath et al., 2006).

Expectancy-value approach named by Eccless can be elaborated and tested to school contexts (Ecless et al., 1996). According to this model, expectations contribute to future student academic achievement. In terms of values, “the Eccles-model focuses on intrinsic task values as the major reason for task engagement in elementary school children. Intrinsic values refer to the extent to which a person likes to engage in a certain task for reasons intrinsic to the task and not for anticipated consequences” (Spinath et al., 2006).

Motivation, in addition to cognitive factors have also considerable effects on educational outputs. According to Bruinsma (2004), “Motivation consists of three components, namely”;

a) “an expectancy component which concerns the student’s belief about his or her ability to perform the task or, in other words, it concerns the question; can I do the task?”;
b) “a value-component which refers to the student’s goals and beliefs about the importance and interest of the task or, in other words; why am I doing this task?”; and finally
c) “an affective component, which refers to the student’s emotional responses to the task, in other words; how do I feel performing this task?”.

“The students who believe that they are capable of performing a task tend to use more, and more appropriate, cognitive and meta-cognitive strategies. Furthermore, these students are more likely to persist in performing the task, resulting in higher levels of achievement” (Bruinsma, 2004).

“Various studies on the values, goals and beliefs about the importance and interest of a task have shown that goals influence school achievement through the quality, timing and appropriateness of various cognitive strategies” (Covington, 2000). “Studies on the affective-component have shown that various emotions influence both the quality of thinking and cognitive information processing” (Meyer & Turner, 2002).

“Positive emotions, such as curiosity, generally enhance motivation and facilitate learning and performance. Researchers have started to investigate other emotions that are, in addition to test anxiety, important predictors of learning outcomes. For example, positive emotions such as enjoyment, hope and pride predicted high achievement, and negative emotions, such as hopelessness and boredom, predicted low achievement and that these emotions affected the decision to withdraw from university courses” (Bruinsma, 2004).

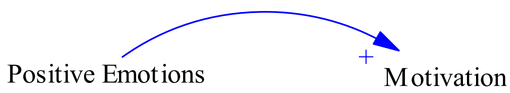


Figure 24 - The effect of positive emotions on student motivation (drawn from Bruinsma, 2004).

“Both the expectancy and the values are significantly related to the deep information processing approach. Students with a high self-competence and interest in the study showed a deep information processing approach. Students indicating that they experienced fear of failure, or incompetence fear, reported that they used deep information processing strategies less often. Students with higher self-competence read more critically, structured the information and broadened their context” (Bruinsma, 2004).

3.1.4. Engagement

Engagement like motivation also plays a crucial role on educational outputs. They are powerful predictors for student academic achievement. Engagement shows a level of dedication towards learning and it is integral part of how student learns.

“Engagement, sometimes called motivation or effort, has commonly been linked to school performance. A substantial body of research has been devoted to the identification of specific aspects of and factors contributing to engagement under the assumption that the link between engagement and school performance is independent of academic ability or intelligence. Interaction effects of engagement and intelligence have also been investigated, but no consistent findings have been obtained” (Johnson et al, 2007).

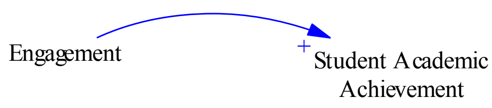


Figure 25 - The effect of student engagement on student academic achievement (drawn fromSilins et al., 2002).

3.1.5. Personality and intelligence

"Four personality factors contributed independently to Grade Point Average (GPA) in both samples, three of which were the same at different educational levels (*Conscientiousness*, *Openness*, and *Extraversion*)" (Laidra, Pullmann and Allik, 2007). Intelligence and personality have an enormous effect on student success.

"Conscientiousness was found to correlate significantly to GPA in all grade levels. The prominent role of intelligence and Conscientiousness in predicting academic achievement agrees with the common sense notion that any kind of success is a result of ability and effort" (Huang, 2010).

"Another personality factor consistently predicting academic achievement through all grades was Openness, which is related to the ability to grasp new ideas and to the tendency to seek novel educational experiences" (Laidra, Pullmann and Allik, 2007).

"*Neuroticism* and Extraversion were expected to have positive relationships with academic success in childhood. Although some traits have more effect in elementary school (e.g., Agreeableness) and others become relatively more relevant later (e.g., Conscientiousness), student academic achievement relies most strongly on their cognitive abilities through all grade levels" (Laidra, Pullmann and Allik, 2007).

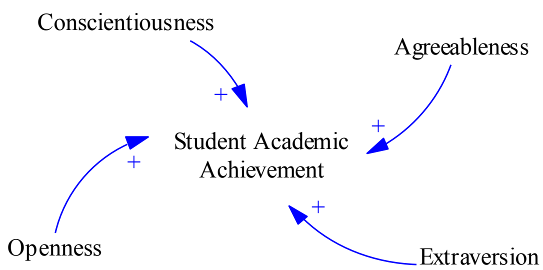


Figure 26 - The effect of personality factors on student academic achievement (drawn fromLaidra, Pullmann and Allik, 2007).

Finally among personality traits, “Openness, Agreeableness, and Conscientiousness correlated positively and Neuroticism correlated negatively with GPA. When all measured variables were entered together into a regression model, IQ was still the strongest predictor of GPA” (Laidra, Pullmann and Allik, 2007). “IQ had the largest association with academic achievement” (Huang, 2010).

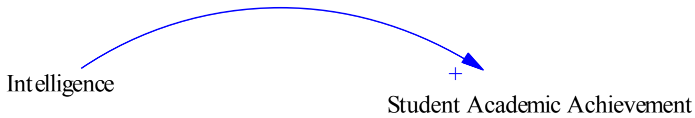


Figure 27 - The effect of IQ on student academic achievement (drawn fromLaidra, Pullmann and Allik, 2007; Huang, 2010).

3.2. TEACHER DIMENSION

The effect of teacher on academic achievement is a complex phenomenon. “Teachers are extremely important determinants of student academic achievement, but identifying specific teacher attributes that improve student performance is a difficult task” (Jepsen, 2005).

“Definitions range from the kinds of knowledge, training, and certification teachers possess, what should be taught to students and how knowledge should be imparted, to teacher cognitive processes, classroom effectiveness, and social relationships between students and teachers” (Heck, 2009; Seidel and Shavelson, 2007).

“As teachers play a special role in setting the standards and creating the conditions for children's school attainments, it is critical to understand the key mechanisms through which teachers contribute to their students' academic success” (Caprara et al., 2006). Followings are the important elements showing the effects of teacher dimension on student academic achievement;

1) *Subject Knowledge* (Warwick and Riemers, 1992; Acevedo, 2009; Aslam and Kingdon, 2011),
2) *Content Area Preparation* (Monk, 1994),
3) *Classroom Teaching Effectiveness* (Sanders and Rivers, 1996; Heck and Mahoe, 2010),

4) *Teacher Methods and Tactics* (Turner et al., 1999),
5) *In-service Workshops* (Swinton et al., 2000),
6) *Teacher's Involvement* (Silins and Mulford, 2002),
7) *Teacher's Motivation* (Bruinsma, 2004),
8) *Teachers' Mastery Goal Settings* (Gutman, 2006),
9) *Teachers' Self Efficacy* (Caprara et al., 2006),
10) *Teacher Pay* (Kingdon and Teal, 2007),
11) *Teacher Attitudes* (Ryabov and Hook, 2007),
12) *Teacher Expectations from students* (Ryabov and Hook, 2007),
13) *Verbal Skills* (Smith, 2008),
14) *Teacher Education* (Smith, 2008),
15) *Math SAT Scores* (Boyd et al., 2008),
16) *Certification Status* (Boyd et al., 2008),
17) *Test Scores* (Boyd et al., 2008),
18) *Teacher Experience* (Acevedo, 2009),
19) *Pedagogical Content Knowledge* (Marshall, 2009),
20) *Licensure Test Scores* (Buddin and Zamarro, 2009),
21) *Teachers' Skill* (Acevedo, 2009),
22) *Pedagogical Skills* (Acevedo, 2009),
23) *Teacher-child Relationships* (O'Connor, 2010),
24) *General Intellectual Skills* (Heck and Mahoe, 2010),
25) *Professional Qualifications* (Heck and Mahoe, 2010),
26) *General Intellectual Skills* (Heck and Mahoe, 2010).

We will discuss these variables in detail as in the following section.

3.2.1. Teacher characteristics and quality

"A consistent finding in the research literature is that teachers are important for student learning and that great variation exists in the effectiveness of teachers" (Boyd et al, 2008).

Teacher characteristics and quality are important determinants of student academic achievement. Therefore, many survey researches have been made among teachers by educational policymakers. Teacher experience, content area preparation, subject knowledge, content knowledge, skills, professional qualifications, teaching effectiveness, pedagogical and classroom management skills can be given some examples to explain the affective characteristics of teacher. These teacher charateristics are the important indicators of teacher quality.

In the literature these characteristics are generally considered as teacher qualities. In a classroom environment, teachers can have these characteristics at the desired level, but the important thing is how a teacher uses them effectively. “More experienced or better-educated or more skilled teachers may inherently be better able to teach, but they may not persistently practice those abilities in the classroom” (Behrman et al., 1997). Therefore, only looking at the teacher qualifications from physical perspective will not mean nothing for educational policy makers.

Even though it is not clear what qualities make a good teacher, “teacher characteristics are generally significant predictors of student academic achievement. Teachers are extremely important determinants of student academic achievement, but identifying specific teacher attributes that improve student performance is a difficult task” (Jepsen, 2005).

High verbal skills and strong subject knowledge may be among them. Finally, the important teacher attributes are mostly related with the usage of them effectively in the class environment. “Effective teachers appear to be effective with students for academic achievement. If the teacher is ineffective, students under that teacher's tutelage will achieve inadequate progress academically, regardless of how similar or different they are regarding their academic achievement” (Wright, Horn and Sanders, 1997).

In the literature, “research has suggested teacher quality is related to student academic achievement” (Heck and Mahoe, 2010).

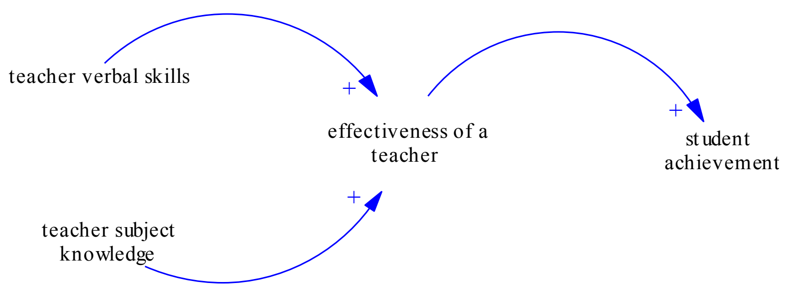


Figure 28 - The Relation between the teacher quality, teacher effectivenes and student academic achievement (drawn from Wright, Horn and Sanders, 1997).

“Studies generally report that teacher experience has a positive effect on student test scores” (Acevedo, 2009) and on classroom effectiveness. However, teachers’ content area preparation affects student learning. Monk (1994) emphasizes “the relationship between teacher content preparation and student academic achievement”.

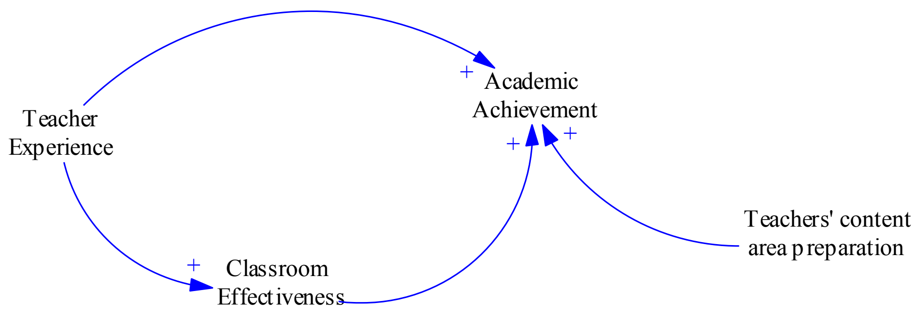


Figure 29 - The effect of teacher experience and content area preparation on student academic achievement (drawn fromAcevedo, 2009).

“In addition to experience and content area preparation, teachers’ skill and knowledge are another characteristics that directly affects classroom learning environment and hence student academic achievement. Teachers’ skill and knowledge are important factors to consider when measuring the impact of teacher inputs on student academic achievement” (Acevedo, 2009).

In the literature, the general tendency about deciding teacher quality is seen as teacher education. “Warwick and Riemers (1992) in their study at Harvard found that teachers’ qualifications and subject knowledge had a strong correlation with student academic achievement” (Smith, 2008). But for certificate, there is a conflicting opinion about teaching certificate as an indicator of teacher quality.

According to Boyd et al. (2008), “recruiting teachers with stronger observed qualifications—for example, math SAT scores or certification status—could substantially improve student academic achievement”. Moreover, “the recent research results examining teacher effectiveness emphasized that some teachers’ attributes, such as higher test scores and greater teaching experience, will produce students with higher achievement. Education experts are suggesting to rethink the knowledge requirements for new teachers and develop tests that more accurately predict classroom performance” (Buddin and Zamarro, 2009).

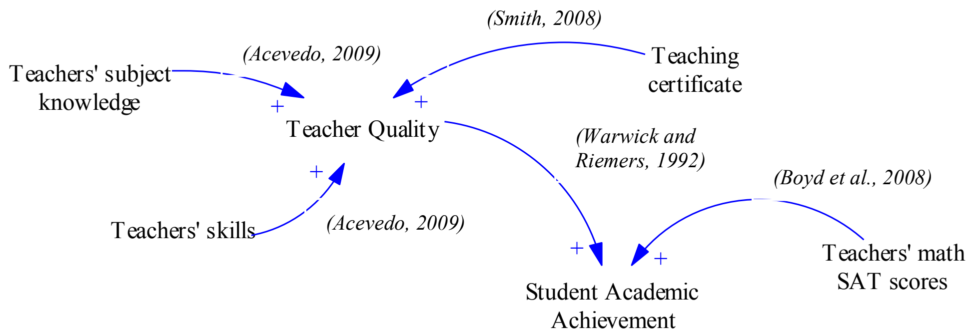


Figure 30 - The effect of Teacher's subject knowledge and skills on student academic achievement (drawn from Acevedo, 2009; Warwick and Riemers, 1992; Smith, 2008; Boyd et al., 2008).

"Pedagogical and classroom management skills that are integral to teaching success, while supporters of alternative programs assert that content knowledge is the most important attribute of a quality teacher. Both content and pedagogical knowledge are important to effective teaching" (Acevedo, 2009). However, in accordance with those teacher training process, Swinton et al. (2000) have emphasized the importance of teacher workshops on teachers' effectiveness and therefore student academic achievement.

"Teachers' beliefs and expectations have also been linked with children's performance in school and teacher expectations influence student academic achievement" (Ryabov and Hook, 2007). Student grade is also influenced by teachers' expectations and attitudes.

"Teachers behave differentially with students for whom they hold high versus low expectations and these behaviors in turn are linked with student outcomes" (Gill and Reynolds, 1999). Teacher and parent expectations made an educationally meaningful contribution for academic achievement. Such as, "prior academic achievement was influenced by socio-demographic variables and, in turn, influenced parent and teacher expectations" (Gill and Reynolds, 1999). And then, parent and teacher expectations influence the later achievement level.

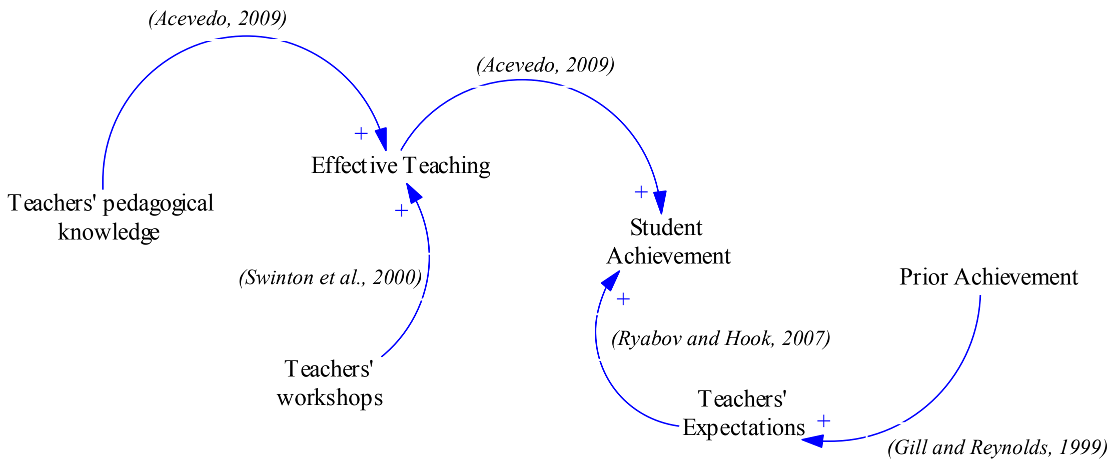


Figure 31 - The effect of teachers’ pedagogical knowledge and teachers’ expectations on student academic achievement (drawn fromAcevedo, 2009; Swinton, et al., 2000; Ryabov and Hook, 2000; Gill and Reynolds, 1999).

There are wide variations about the effectiveness of teachers. “The immediate and clear implication of this fact is that seemingly more can be done to improve education by improving the effectiveness of teachers than by any other single factor” (Wright et al., 1997).

It should not be neglected that “a large portion of the variation in teacher effectiveness in improving student academic achievement is not only related to measurable teacher characteristics such as test scores or certification. As a result, policies that enable school leaders to better understand the strengths and weaknesses of teacher so that they can target professional development and effectively utilize the due-process system to continually improve the teacher workforce are likely to be important” (Boyd et al., 2008).

“Teacher effectiveness demonstrates a positive relationship with student academic achievement” (Heck, 2009). On the other hand, “teachers’ classroom practices and the teaching ‘process’ may matter more to student learning than teachers’ observed résumé characteristics (such as certification and experience). The teaching ‘process’ variables matter significantly to student academic achievement rather than the standard characteristics of teachers” (Aslam and Kingdon, 2011).

Curing the teaching process, “the teachers’ involvement and engagement with school is critical for the school to function as a learning organisation and the level of system or organisational learning in the school impacts on students’ participation in and engagement with school, and their learning” (Silins and Mulford, 2002).

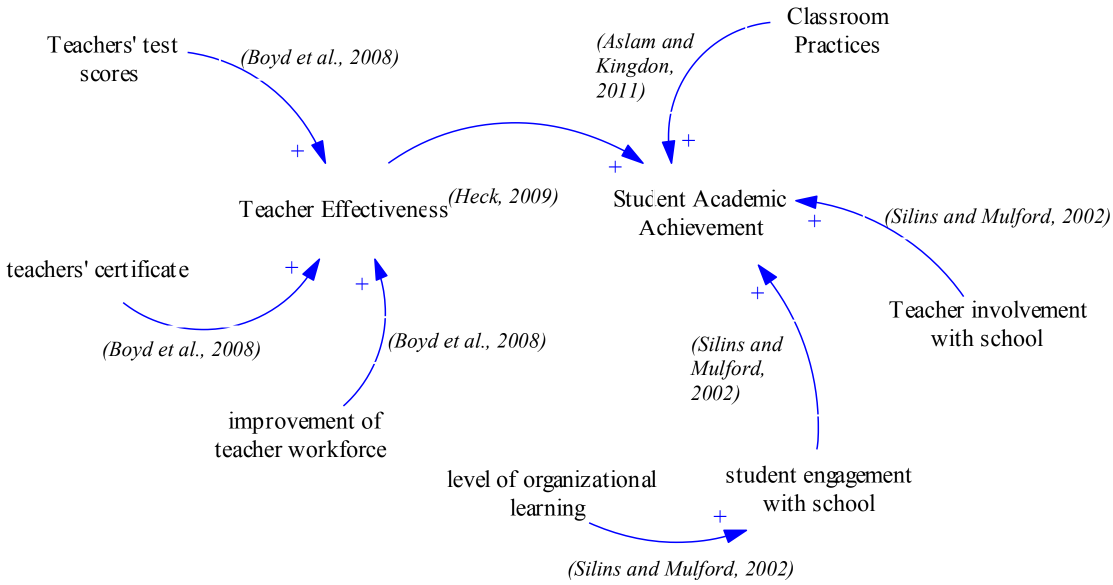


Figure 32 - The effect of teacher effectiveness and other non-measurable factors in the school context on student academic achievement (drawn from Wright et al., 1997; Boyd et al., 2008; Heck, 2009; Aslam and Kingdon, 2011; Silins and Mulford, 2002).

Finally, we can say that the improvements in teacher quality enhance student academic achievement. Teachers who show high level of engagement in education process can boost student motivation and contribute to their success..

3.2.2. Teachers self-efficacy

In the literature, there is a relationship between teachers' efficacy beliefs and their job satisfaction. This is commonly discussed perspective. “Teachers' self-efficacy beliefs contribute on their job satisfaction and provide new elements that attest to the influence that their perceived self-efficacy in the ability to effectively handle various tasks, obligations, and challenges related to their professional role exert on student academic achievement at the school level” (Caprara et al., 2006).

According to Bandura (1986), “self-efficacy judgments are influenced by three environmental factors”:

1) “past success and failure with similar tasks”,
2) “available social comparison information”, and
3) “verbal persuasion”.

"For example, teachers can tell students that they have the skills to succeed and will do well on a task if they are willing to try (verbal persuasion). One effective method of verbal persuasion is to help students understand how new tasks are related to previous tasks on which the students were successful. Another method of promoting self-efficacy beliefs is through modeling. For example, teachers can model the appropriate use of a learning strategy so that students will have an example of a successful strategy that they can readily imitate" (Urdan and Schoenfelder, 2006).

Teacher's self-efficacy beliefs have different types of effects on student success. "Teachers with high self-efficacy beliefs are more likely than teachers with a low sense of self-efficacy to implement didactic innovations in the classroom and to use classroom management approaches and adequate teaching methods that encourage students' autonomy and reduce custodial control, to take responsibility for students with special learning needs to manage classroom problems and to keep students on task" (Caprara et al., 2006).

Furthermore, teacher's perceived self-efficacy beliefs have a correlation with those parameters mentioned below;

1) enhanced student's motivation (Caprara et al., 2006),
2) increased self-esteem (Borton, 1991),
3) strong self-direction (Rose and Medway, 1981),
4) ease in managing school transitions (Midgley, Feldlaufer and Eccles, 1989), and
5) more positive attitudes toward school (Miskel, McDonald and Bloom, 1983).

"Teacher's self-efficacy may also contribute to promote student's sense of efficacy, fostering their involvement in class activities and their efforts in facing difficulties" (Caprara et al., 2006).

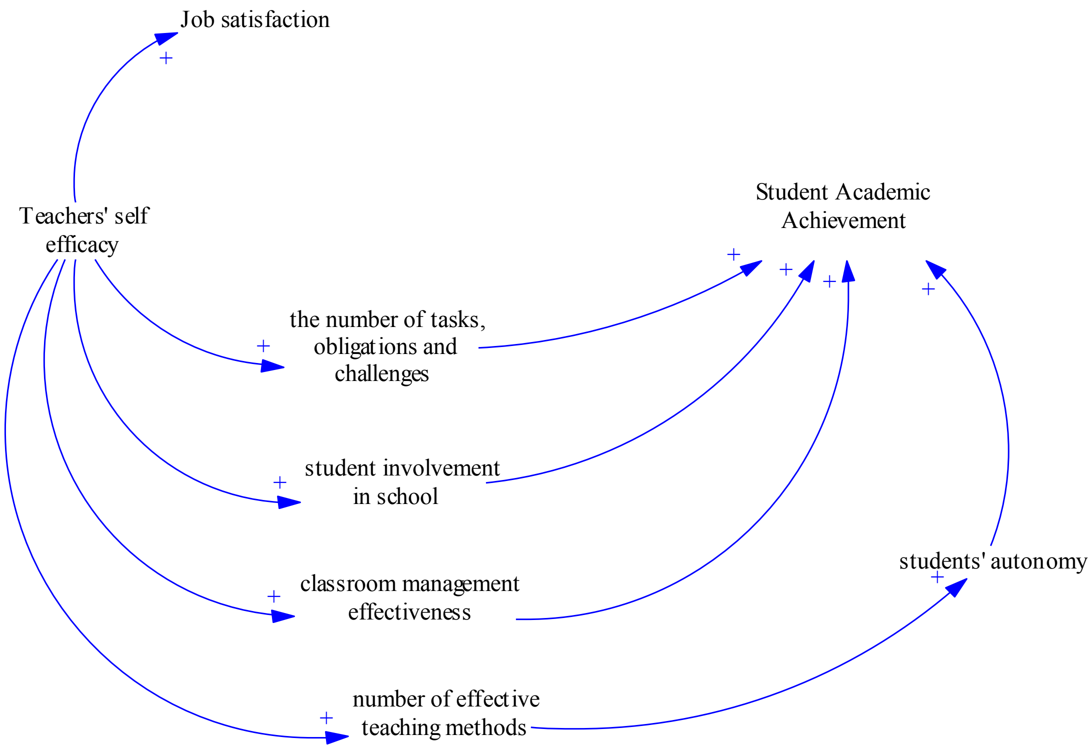


Figure 33 - The effect of teachers' self-efficacy on student academic achievement (drawn from Caprara et al., 2006).

3.2.3. Teacher expectations

Teacher expectations are correlated with student academic achievement. Teacher and parent expectations made an educationally meaningful contribution for achievement. For example, "prior achievement was influenced by socio-demographic variables and, in turn, influenced parent and teacher expectations. And then, parent and teacher expectations influence the later achievement level" (Gill and Reynolds, 1999).

In addition, Wright et al. (1997) observed "wide variation in effectiveness among teachers. Effective teachers appear to be effective with students of all achievement levels, regardless of the level of heterogeneity in their classrooms". However, "if teacher is ineffective, students will achieve inadequate progress academically, regardless of how similar or different they are regarding their academic achievement. This finding is corroborated by researches on the cumulative effects of teachers on the academic progress of students" (Sanders & Rivers, 1996).

According to studies made in 1990's, "teacher effects on student learning as inferred from standardized test scores are additive and cumulative over grade levels with little evidence of compensatory effects. Thus students in classrooms of very effective teachers, following relatively ineffective teachers, make excellent academic gains but not enough to offset previous evidence of less than expected gains" (Wright et al., 1997).

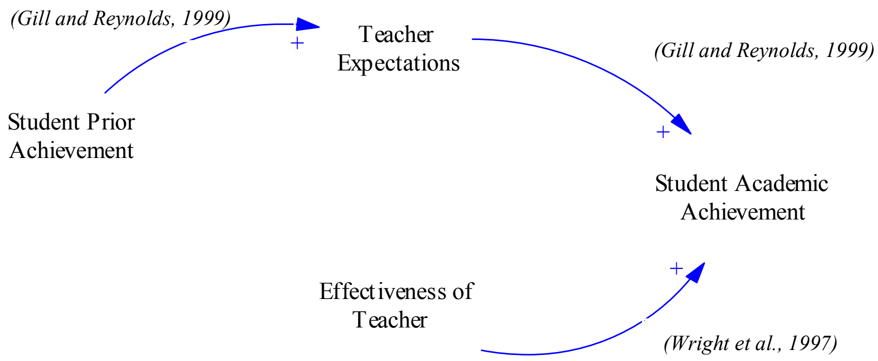


Figure 34 - The effect of teacher expectations and effective teacher on student academic achievement (drawn from Gill and Reynolds, 1999; Wright et al., 1997).

3.2.4. Teacher attitudes in the class social environment

The social environment in school contributes to the growth of students emotionally and also their academic success. It is an important determinant for the personal development of students. In such an important environment, teachers have the key roles to do that. Teachers set up the learning environment where students will communicate and find a way to learn better. This environment have also an impact on the perception of students towards all the components of the educational system.

Wentzel (1994) found that "students' perceptions of positive relationships with their teachers were correlated with their pursuit of pro-social classroom goals such as getting along with others and being socially responsible, and were more strongly linked to student interest in school than perceived support from parents and peers. Teacher 'caring' has a direct effect on student attitudes towards academic and social goal pursuits".

"Research on the effects of teacher caring are consistent with research described earlier regarding the creation of mastery goal structures and autonomy supportive instructional practices. Students care about their relationships with their teachers and respond with greater engagement and effort when they believe that their teachers care about them and are supportive" (Urdan and Schoenfelder, 2006).

As a result of teacher caring, students can show positive attitudes towards academic and social goals and establish their own mastery goals for their school life. "Mastery goal orientation may be an important factor in preventing the decline in performance and motivation. Mastery goals are defined as cognitive representations of children's purposes in achievement situations. Presumably, they guide students' academic and social behavior towards desired outcomes" (Bruyn et al., 2003).

Mastery goals are influential on student motivation and achievement since they create a sense of direction. According to Wentzel (1996), "the pursuit of social goals predicted levels of academic effort for the students. Teachers may encourage student mastery goals by stressing the importance of learning the subjects and their relevance to future goals; for example, by inviting adult role models into the classroom to discuss the use of subject courses in their daily work lives". Additionally, to indicate the importance of mastery goals in classrooms, "teachers may provide more meaningful, challenging problems that encourage understanding rather than drill and memorization" (Gutman, 2006).

Teacher attitudes are more meaningful for students to have self-efficacy. "The students who believe that they are capable of performing a task tend to use more appropriate meta-cognitive strategies and create mastery goals. These students are more likely to persist in performing the task, and then resulting in higher levels of achievement" (Bruinsma, 2004).

The important effective attitude of teachers must also be to motivate and encourage the students to have their own goals about their school life. In the literature, some researchers have concluded that orientation of students to have their own mastery goals about their education life influence school achievement.

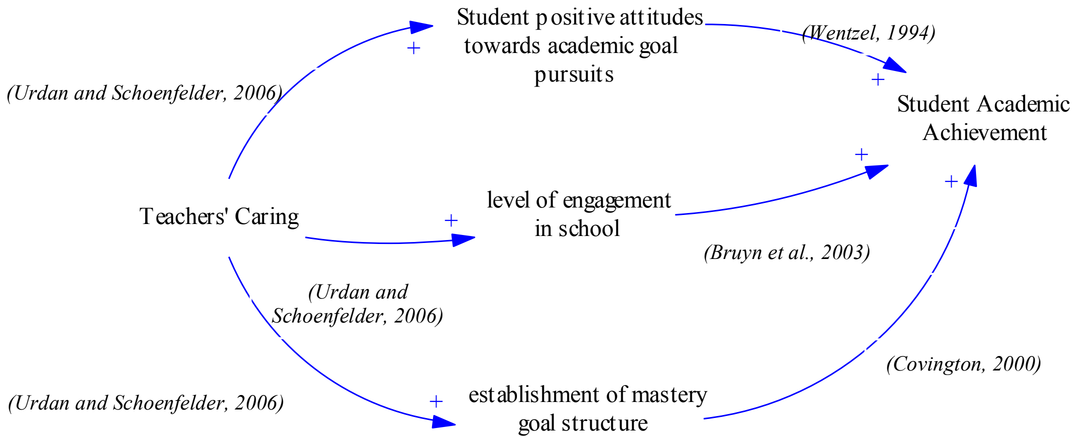


Figure 35 - The Effect of Teacher Caring on student academic achievement (drawn from Urdan and Schoenfelder, 2006; Wentzel, 1994; Bruyn et al., 2003; Gutman, 2006; Covington, 2000).

Furthermore, "studies on the affective-component have shown that various emotions influence both the quality of thinking and cognitive information processing" (Meyer and Turner, 2002). "Positive emotions, such as curiosity, generally enhance motivation and facilitate learning and performance. Researchers have investigated other emotions that are, in addition to test anxiety, important predictors of learning outcomes. For example, positive emotions such as enjoyment, hope and pride predicted high achievement, and negative emotions, such as hopelessness and boredom, predicted low achievement" (Bruinsma, 2004).

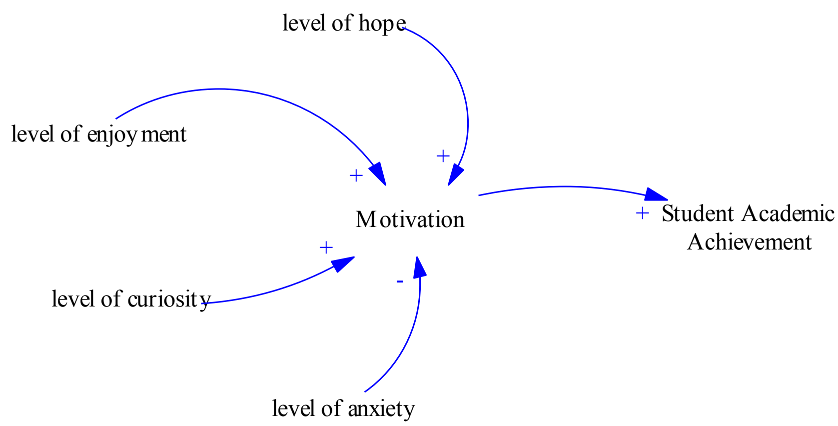


Figure 36 - The effect of affective dimension of students on their academic achievement (drawn from Bruinsma, 2004).

However, teachers' methodology also affects the student outcomes. The teaching methods and tactics in class keep the students' needs for learning alive and enhance students' motivation towards learning. Using constructive approaches, "being flexible about accepting mistakes, encouraging risk-taking and challenges, creating a sense of safety situation in the class, allowing students to take their academic risks, making the topics personally meaningful to students by tailoring them to appropriate attention levels and stressing the practical applications of subjects, giving the students responsibility for their learning to promote self-regulation, providing intrinsic support for learning by giving it value and fostering confidence are the important teacher practices and teaching methodologies within the classroom to increase student's motivation and academic achievement" (Turner et al.,1999).

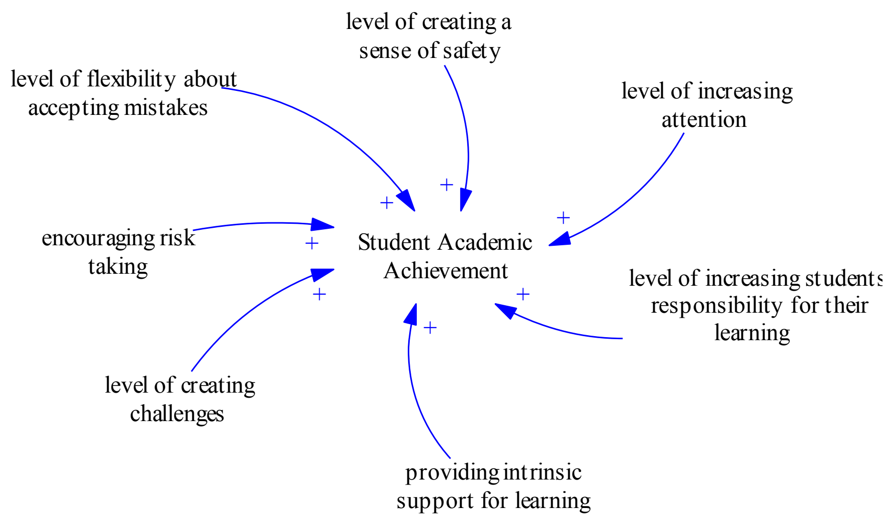


Figure 37 - The effect of teachers' methodologies and tactics on student academic achievement (drawn from Turner et al., 1999).

3.2.5. Teacher-child relationship

"The classroom system includes aspects of the environment that involve interactions between individuals in the classroom, such as the instructional support that teachers provide students, as well as structural characteristics, including child–teacher ratios, which are independent of interactions between individuals" (Helmke & Schrader, 1988). There is no doubt that the individual characteristics of teachers and students also shape their behaviours. The quality of teacher-student relationship depends on teacher experience, verbal ability of teachers, classroom management skills of teachers, dedication of teachers, student motivation, the level of parent involvement, child-teacher ratio and so on.

Some family, school and individual characteristics can influence also this quality. “Children from less advantaged backgrounds tend to develop lower quality relationships with teachers. In particular, children from lower income families and whose parents have fewer years of education tend to have less close and more conflicting relationships with their teachers than their more advantaged peers” (O'Connor, 2010).

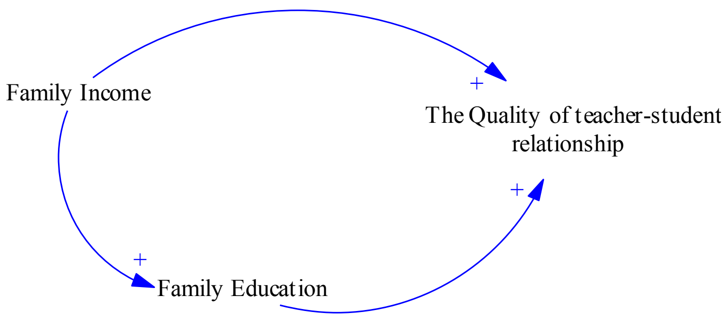


Figure 38 - The effect of family income on the quality of teacher-stundet relationship (drawn from O'Connor, 2010).

Literature demonstrates that “high quality teacher–child relationships contribute to children's social and cognitive skill development in elementary school” (O'Connor, 2010). “Teacher and student relationships are critical to promoting student engagement with school and learning” (Silins, and Mulford, 2002). Salfi and Saeed (2007) found that “parental qualifications, family size, school liking and teachers’ guidance have impact on student academic achievement”.

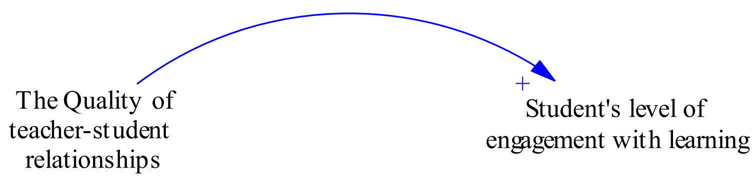


Figure 39 - The effect of the quality of teacher-student relationships on the level of engagement (drawn from Silins, and Mulford, 2002).

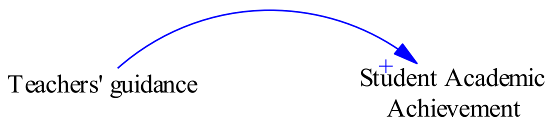


Figure 40 - The effect of teacher guidance on stundet academic achievement (drawn fromSalfi and Saeed, 2007).

At the classroom level, “characteristics of the classroom are associated with relationship quality as well. Higher quality teacher–child relationships are observed in classes with lower child–teacher ratios, where teachers interact with students more positively, observe their development more diligently and interact with them in a more individualized fashion” (O'Connor, 2010).

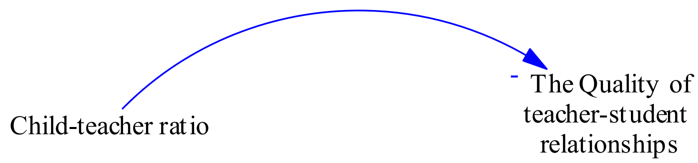


Figure 41 - The effect of child-teacher ration on the quality of teacher-student relationships (drawn from O'Connor, 2010).

Children in positive and well-managed learning environment will try to establish qualified relationships with teachers. “Teachers in classrooms with more positive emotional climates tend to demonstrate a greater appreciation of children's individual needs and to have more interactions with children that are high in reciprocity, which are associated with high quality teacher–child relationships” (La Paro et al., 2004).

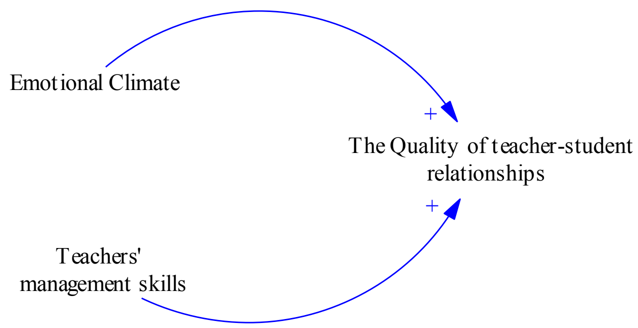


Figure 42 - The effect of classroom positive emotional climate and well-managed classroom on the quality of teacher-student relationships (drawn from La Paro et al., 2004).

"A well-managed classroom may promote goodness-of-fit between teachers and students resulting in higher quality relationships. In a well-managed classroom children are encouraged to engage in behaviors that the teacher values and are provided with clearness of behavioral expectations and clearness of academic expectations" (Emmer & Stough, 2001).

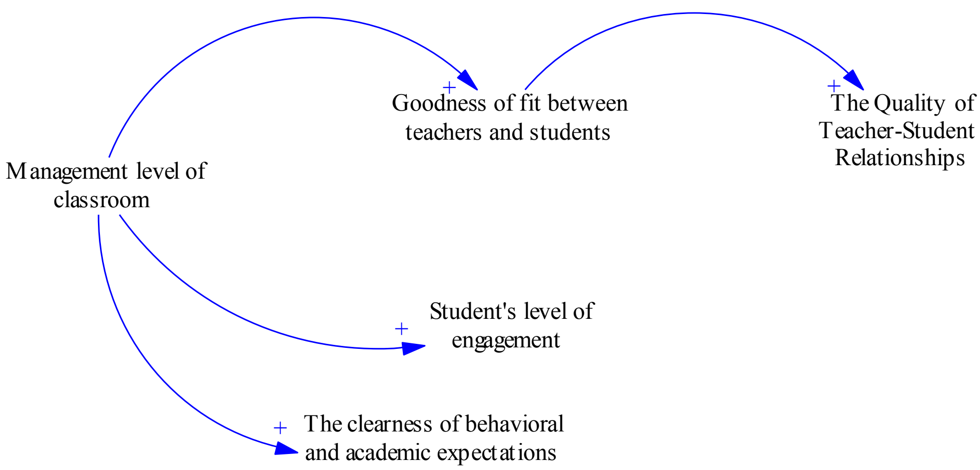


Figure 43 - The effect of good managed classrooms' atmosphere on the quality of teacher-student relationships (drawn from Emmer & Stough, 2001).

Teacher characteristics are also valuable to create the learning class atmosphere and therefore enhance the teacher-student relationships. "Teacher characteristics, including education and experience, also correlate with relationship quality. Teachers with more years of education tend to develop higher quality relationships with students. In addition to that, researchers have identified various child characteristics, including gender, behavior problems and language ability, associated with the quality of the teacher–child relationship" (O'Connor, 2010). As a teacher characteristic, teacher experience is also related with the quality of the relationship with students.

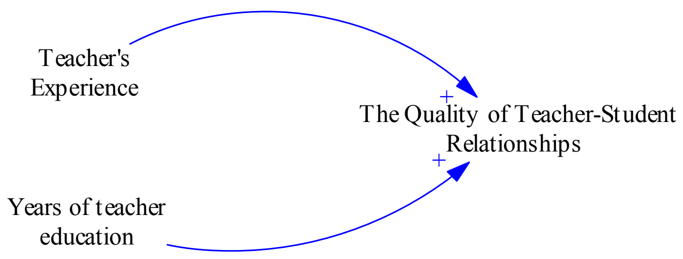


Figure 44 - The effect of teachers' education and experience on the quality of teacher-student relationships (drawn from O'Connor, 2010).

Moreover, teacher experience corresponds with an increase in classroom effectiveness. In regards to teacher characteristics, "teacher self-efficacy was positively associated with a less rapid decline in relationship quality. Associations between relationship quality and teacher self-efficacy are likely a reflection of variation in the manner in which teachers interact with students" (Jepsen, 2005). "Teachers who report greater feelings of self-efficacy may be better able to foster students' independence and pro-social behaviors, which foster more positive relationships" (O'Connor, 2010).

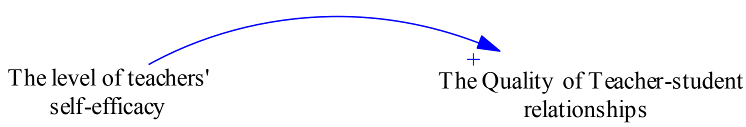


Figure 45 - The effect of teachers' self-efficacy on the quality of teacher-student relationships (drawn fromO'Connor, 2010).

At the school level, school principles and the organization climate also play a crucial role for deciding the quality of teacher-student relationships. "Teachers report higher quality interactions and relationships with students in schools in which there are supportive and involved principals" (Pianta, 1999).

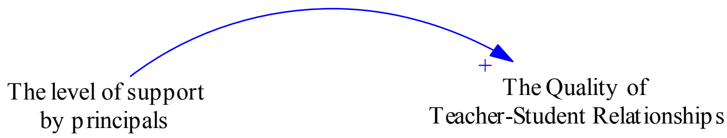


Figure 46 - The effect of school principal's attitude on the quality of teacher-students relationships (drawn from Pianta, 1999).

At the family level, "the family–school relationship was associated with teacher–child relationship quality in elementary school. Children whose parents had greater contact with the school evidenced less rapid rates of decline in relationship quality. Children whose parents had higher quality interactions with the school tend to establish more relationships with their teachers. Contact between parents and the school likely supports children's development of high quality relationships with teachers, as it helps teachers learn about children and their families and encourages teachers' understandings of child and family values" (Smolkin, 1999).

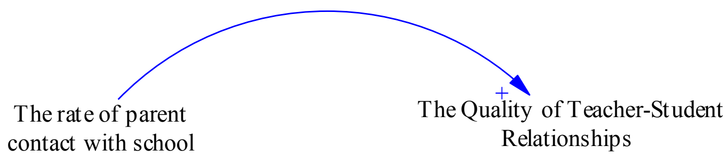


Figure 47 - The effect of rate of parent's school contact on the quality of teacher-student relationships (drawn from Smolkin, 1999).

3.2.6. Teachers' salary and merit pay system

Teachers are at the heart of a learning activity. They are strong role models in a learning environment. Teachers's dedication becomes so much important to create an qualified learning environment.

Teachers who are skillfull and experienced are critical factors for the student academic achievement and the quality of teacher-parent relationships. But, these teacher characteristics may not be persistently practiced in the classroom. At that point, to raise the skillful teachers' motivation is another important issue for the school managers who want to create effective learning environment in order to enhance student academic achievement.

Teacher motivation impacts student test scores. However, "teachers' attitudes and effectiveness can vary depending on the pay system and incentives they face. Pay structure is potentially an important incentive-tool in the hands of theeducation policy maker and proposals which link pay to teacher's performance and then student academic achievement have been discussed by education managers" (Acevedo, 2009).

Especially "private schools relate pay to teacher's performance as measured by student achievement and that achievement is improved by increasing teacher's pay. We considered two interpretations for this result. The first was that higher wages proxy for highly qualified teachers, the second was that higher wages motivate higher teacher effort" (Kingdon and Teal, 2007).

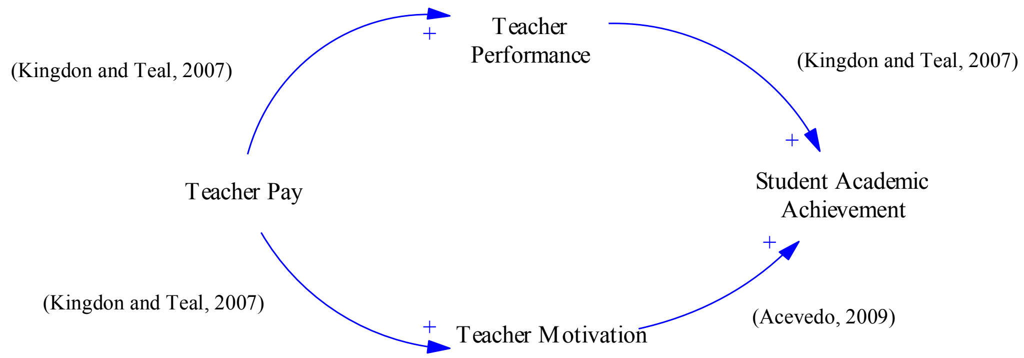


Figure 48 - The effect of teacher pay on the student academic achievement (drawn from Kingdon and Teal, 2007; Acevedo, 2009).

As an organizational strategy, teachers' salary affects the teachers' attitudes toward teaching in the classroom. "Teacher salary influenced both change in relationship quality and relationship quality. Children whose teachers reported higher salaries evidenced a less rapid rate of decline in relationship quality and higher quality relationships" (O'Connor, 2010).

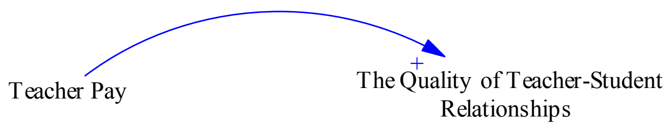


Figure 49 - The effect of teacher pay on the quality of teacher-student relationships (drawn from O'Connor, 2010).

In school systems, Teacher pay system is decided by putting their characteristics such as education, number of experienced years and so on rather than their performance in the class. By doing that, this will not encourage teachers to show their maximum performance as the pay system enables little incentives to do that. “Merit pay is ‘‘results oriented” in the sense that compensation focuses on the production of specific student outcomes. Ideally, merit pay would improve the teacher workforce in two ways. First, teachers would have incentives to increase effort to produce specific student outcomes. Second, linking pay directly with classroom outcomes would encourage high-quality teachers to remain in the teaching” (Buddin and Zamarro, 2009).

“Teacher pay is not significantly related to student cognitive achievement. But, there may be substantial efficiency gains from changing the mix of schooling inputs, perhaps through better incentives” (Behrman et al., 1997).

3.3. PARENT DIMENSION

“Parents contribute significantly to school effectiveness and to students’ success” (Rosenblatt and Peled, 2002). “Family, home structure and residential stability can influence parental expectations, parent–child discussion of school activities, type of school attended, school changing, parental involvement in school activities and parent–school academic contact. These factors, in turn, are strongly associated with student school achievement” (Güzel & Berberoglu, 2005; Huang, 2009).

“Most of the variation in academic achievement stems from individual-level characteristics that are unobserved. This suggests that policies implemented in developing countries to stimulate improvements in human capital should not only be targeted at schools but also at households” (Bacolod et al., 2006). Family is an important element in the educational process. Salfi and Saeed (2007) quote that “family environment and parents’ involvement in educational activities of their children had a positive impact on their academic achievement”.

Following variables are positively related with the student academic achievement;

1) *Race/ethnicity of family* (Natriello, McDill, & Pallas, 1990),
2) *Parental involvement* (Goldring & Shapira, 1993; Cheung, 2009; Marlow, 2000),
3) *Socioeconomic status of the family* (Griffith, 1997, Gill and Reynolds, 1999; Uline and Moran, 2008; Buddin and Zamarro, 2009; Huang, 2010;),
4) *Parents' education* (Griffith, 1997; Marlow, 2000; McEwan, 2003; Nguyen, 2006; Salfi and Saeed, 2007; Demir, 2009;),
5) *The number of books in the home* (Griffith, 1997),
6) *Parental empowerment* (Griffith, 1997),
7) *Parent Expectations (Gill and Reynolds, 1999),*
8) *Marital Status (*Gill and Reynolds, 1999),
9) *Education of family* (Gill and Reynolds, 1999),
10) *Family structure* (Gill and Reynolds, 1999),
11) *Parents' trust in school* (Rosenblatt et al., 2002),
12) *Mean classroom income* (McEwan, 2003),
13) *Family background (*Hakkinen, Kirjavainen and Usitalo, 2003),
14) *Parenting* (Bruyn, Dekovic and Meijnen, 2003),
15) *Parents' educational expectations* (Ryabov and Hook, 2007; Barnard, 2004),
16) *Father involvement* (McBride, Sullian, and Ho-Ho, 2005),
17) *Parental beliefs about their children's learning* (Fantuzzo, Perry and Childs, 2006),
18) *Socially,educationally and economically advantaged parents* (Ryabov and Hook, 2007),
19) *Parents' involvement in educational activities* (Salfi and Saeed, 2007),
20) *Home ownership* (Demir, 2009),
21) *Mother's occupation* (Nguyen, 2006; Huang, 2010),
22) *The quality of the interactions between parents and the school* (O'Connor, 2010),
23) *Parental support for children's cognitive and academic development* (O'Connor, 2010).

We will discuss these variables in detail as in the following section.

3.3.1. Family characteristics and demographic variables

In the literature, the effect of family on the student academic achievement takes a wide discussion. Parent demographic variables, parent's education, race, ethnicity, style of leadership at home, parent's expectations, family background, SES, family structure are the important inputs that affect the parents' behavior towards their kids and the level of engagement in the education process.

However, these variables affect the parent expectations from the students and parents' beliefs about the kids' academic and social capacities. "High parent expectations lead children to set high standards that result in high achievement" (Gill and Reynolds, 1999). High standard expectations will affect the parents' attitudes, students' self-efficacy and the level of involvement in education process.

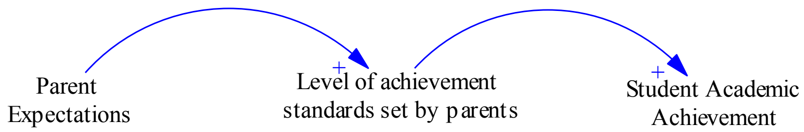


Figure 50- The effect of parent expectations on the expected academic standards for the students and their academic achievement (drawn from Gill and Reynolds, 1999).

"A number of sociocultural risk factors such as race/ethnicity, SES, education of family, and family structure have been correlated with academic achievement" (Natriello, McDill, and Pallas, 1990). "Poverty, poorly educated mothers, and single-parent family structure that have been correlated with lower academic achievement and related school problems" (Gill and Reynolds, 1999). "Students' family background and earlier academic achievement have a large effect on the student exam results" (Hakkinen, Kirjavainen and Usitalo, 2003).

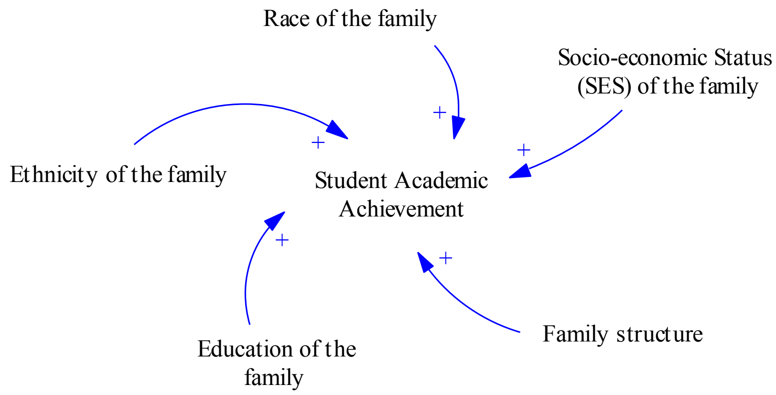


Figure 51 - The effect of sociocultural risk factors on student academic achievement (drawn from Natriello, McDill, and Pallas, 1990).

Some studies about the effect of families on student academic achievement focus on students' previous achievement. "Prior achievement significantly predicted the academic achievement above and beyond the family socio-demographic variables" (Gill and Reynolds, 1999). The effects of socio demographic factors on prior achievement and the effects of this prior achievement on the expectations are shown in the Figure 52.

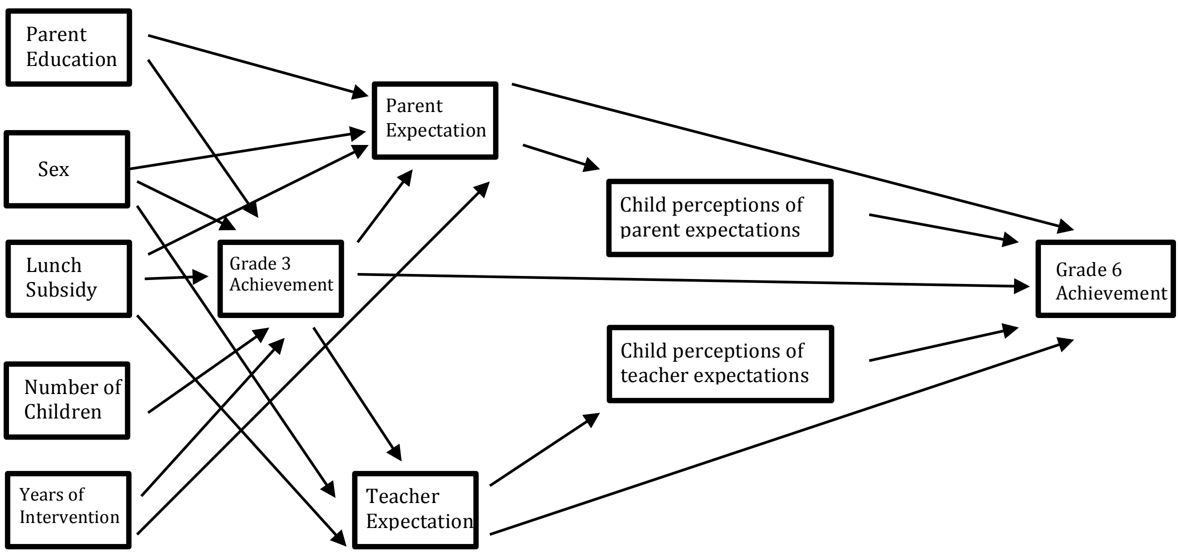


Figure 52 - Model of mediated effects on sixth-grade reading and math outcomes (Gill and Reynolds, 1999).

There are strong relations between the constructs; Parent background, race, the level of parent involvement, current and previous achievement. Family background is an important phenomenon to decide student's academic gains. Some researchers have also focused on how these family characteristic variables affect the students' academic gains. In another study, "the effects of family background together with parent involvement on students' high school grade" are modeled in the Figure 53 (Keith et al., 1998).

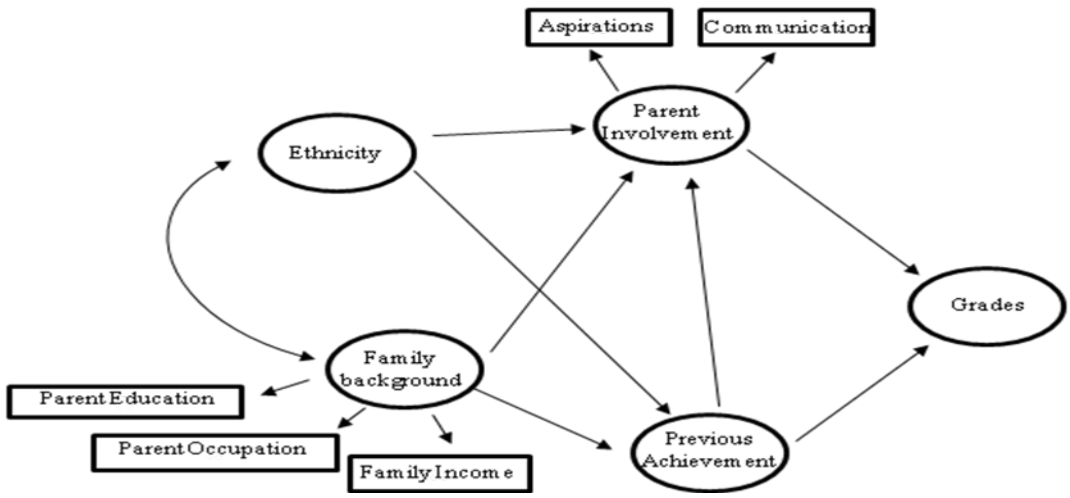


Figure 53 - Model of the effects of parent involvement on students' high school grade (Keith et al., 1998).

"Researchers have not only related parent expectations to children's academic achievement, but also have found parents' beliefs about children's abilities to have an even greater influence on children's academic achievement" (Keith et al., 1998). Positive beliefs create a learning environment at home and considerable effect on the academic achievement.

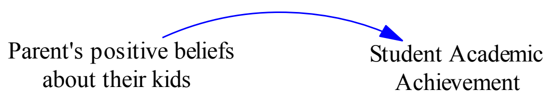


Figure 54 - The effect of parent's positive beliefs about their kids on the student academic achievement (drawn from Keith et al., 1998).

Another research in the literature emphasizes the linear relations between parenting, "goal orientations, behaviour and school success. The model that shows the relation between the parenting, goal orientation, behavior and success" are given in the Figure 55 (Bruyn, Dekovic and Meijnen, 2003).

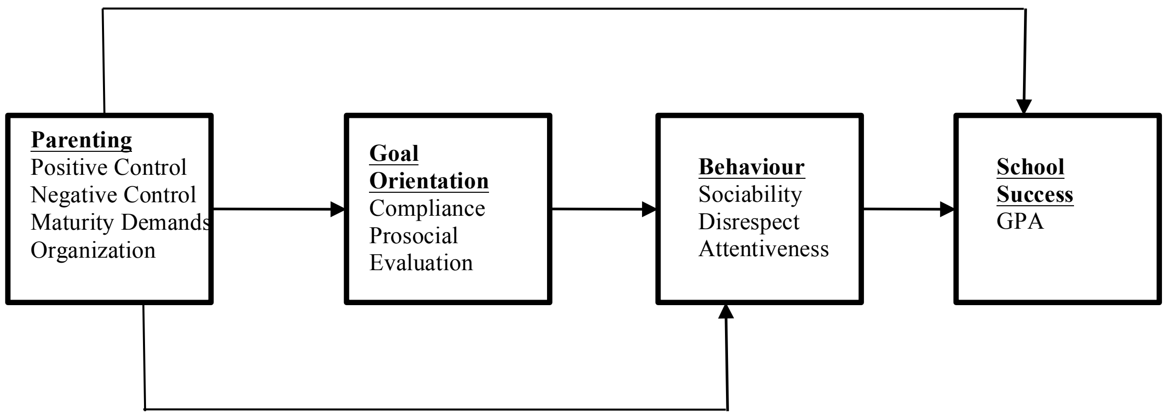


Figure 55 - Path model that shows "relationships among parenting, goal orientations, classroom behavior and GPA" (Bruyn, Dekovic and Meijnen, 2003).

"An important question for researchers and educators is how these individual social cognitive (i.e., goal orientations) and behavioral (i.e., classroom behavior) characteristics conducive to school success come about" (Bruyn, Dekovic and Meijnen, 2003). Most of the studies in the literature mainly focus on the role of parenting on school success looking at student GPA and they couldn't work on parent's effect on a student's social, cognitive and affective progress.

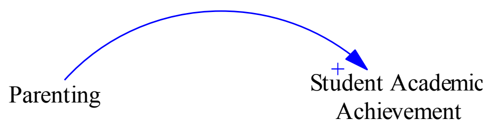


Figure 56 – The effect of parenting on student academic achievement (drawn from Bruyn, Dekovic and Meijnen, 2003).

Another issue that affects the learning environment at home is the parents' attitudes towards to students' certain outputs. Parents sometimes may prefer strict type of behavior to enforce the kids to academic achievement. But there are some negative evidences about this type of behavior. In the literature, "the use of negative authoritarian control, and frequent use of punishment are negatively associated with academic success. They may inhibit positive goal orientation and instrumental competence. This kind of strict control is an increasingly developmentally inappropriate way of disciplining adolescents. Adolescents who are exposed to coercive and hostile parenting are more likely to develop external rather than internal motivation and to show less competent behavior in the classroom" (Pettit, Bates, & Dodge, 1997).

Instead of using punishment feedback more among parents, "parents of well adjusted adolescents tend to use more democratic means of control and allow their adolescents to make their own decisions, but at the same time tend to carefully supervise and monitor their child's activities" (Bruyn, Dekovic and Meijnen, 2003).

"Lack of clear rules, consistent discipline, and supervision have been linked to lower academic performance, as well as school motivation and behavioral competence in the classroom" (Aunola, Stattin, & Nurmi, 2000).

Therefore, "it is expected that more positive ways of providing guidance would be associated with increased levels of academic and social goal orientation and academic success. Parenting would directly affect children's individual characteristics (goal orientation and behavior) and adolescents' academic achievement in the first year of secondary school. In addition, we expected part of ''parenting effects'' upon school success to be indirect, mediated by children's goal orientations and classroom behavior" (Bruyn, Dekovic and Meijnen, 2003).

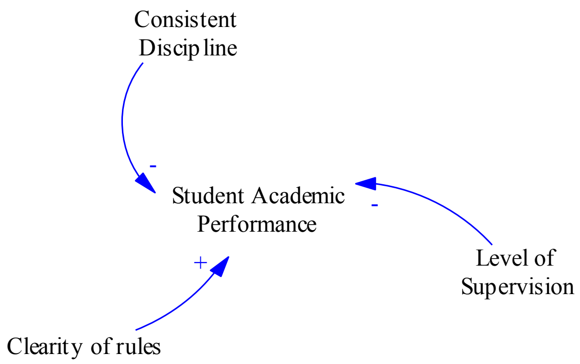


Figure 57 - The negative effect of clearity of rules, consistent discipline and level of supervision on student academic achievement (drawn from Aunola, Stattin and Nurmi, 2000).

3.3.2. Parent involvement

Since the parent contribution is important for academic achievement, "factors affecting the level and content of parent involvement are of particular importance" (Rosenblatt and Peled, 2002). "Numerous studies have documented the increasing parent involvement and participation in the schools and educational activities of their children. Global educational views of parents are likely to be reflected in their expectations regarding school goals" (Tatar and Horenczyk, 2000). There is a strong relation between the rise in the parent involvement and the rise in the parent expectations from their kids.

Parental involvement gains so much importance that especially for "high poverty schools to improve student academic achievement is a focus on efforts to involve parents in helping students meet standards. This is considered as prime strategy. Changing instructional practice and monitoring student progress regularly are considered as other strategies" (DiPaola et al., 2005).

"Parent involvement in the early years has been associated with children's academic performance and greater social competence" (Kohl, Lengua and McMahon, 2000; Fantuzzo, Perry and Childs, 2006). "Family environment and parents' involvement in educational activities of their children had a positive impact on their academic achievement" (Salfi and Saeed, 2007). However, parental beliefs and expectations about their children's learning are strongly related to children's beliefs about their own competencies, as well as their academic achievement" (Fantuzzo, Perry and Childs, 2006).

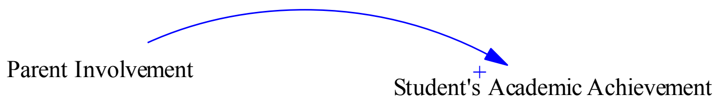


Figure 58 - The effect of parent involvement on student academic achievement (drawn fromKohl, Lengua and McMahon, 2000; Fantuzzo, Perry and Childs, 2006; Salfi and Saeed, 2007).

"Research supports the contention that bridging strategies that actively engage parents in the life of the school have positive consequences for the school" (Rosenblatt and Peled, 2002). Parental involvement is related to student achievement. Therefore, "parent involvement has been one of the most prominent indicators of school effectiveness.

Parental involvement contributes to educational outcomes such as improved student academic achievement and motivation” (Salfi and Saeed, 2007).

Furthermore, “parent empowerment is expected to contribute to the effectiveness of parental involvement and has been reported to contribute to better parent-school relationships. If parents perceived their school’s climate as positive, being empowered by school led to increased involvement. A study conducted in Israeli schools similarly showed that parent empowerment led to higher involvement and contributed to higher parent satisfaction with school. Parents’ trust in school is likely to lead to cooperation-based involvement. Trust is less likely to lead to conflict-based involvement” (Rosenblatt and Peled, 2002).

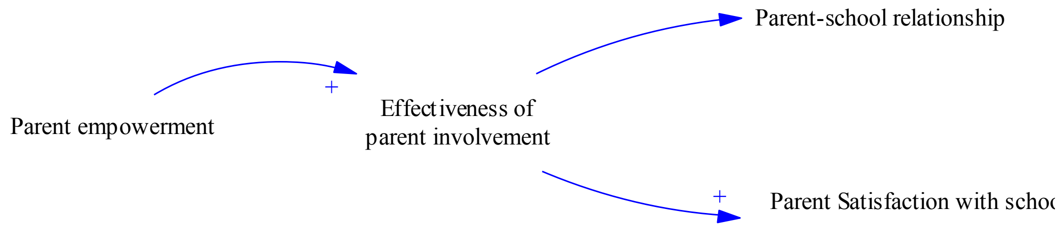


Figure 59 - The effect of parent empowerment on parent-school relationships and parent satisfaction (drawn from Rosenblatt and Peled, 2002).

As an extensive focus on parent involvement, we see the effects of father involvement on student academic achievement in the literature. The findings partially supports for “a model outlining father involvement in school activities as a mediator of the relationship between contextual factors and children’s school achievement” (McBride, Sullian, and Ho-Ho, 2005). Simplified model is given in the Figure 60.

“Due to the increased attention and interest by policymakers in parent participation and educational outcomes, more recent studies have focused on understanding the factors that predict and shape the extent and quality of parent involvement” (McBride, Sullian, and Ho-Ho, 2005).

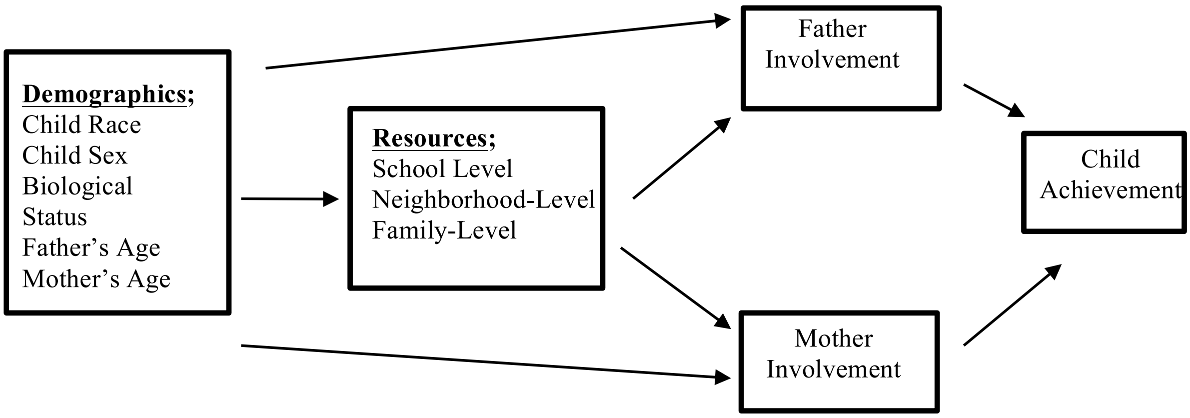


Figure 60 - Simplified Model (McBride, Sullian and Ho-Ho, 2005).

A programmatic research (Fantuzzo, Perry and Childs, 2006) on parent involvement has focused on understanding:

a) “the nature of home and school contacts”;
b) “challenges and risks to parent involvement efforts”;
c) “school practices that encourage parent involvement”.

“Empirical research investigating the nature of contact between families and schools has primarily emphasized home involvement and school involvement; both have been shown to have positive associations with child outcomes. Home involvement refers to providing a learning environment for the child at home and encouraging educational activities at home and in the community” (Fantuzzo, Perry and Childs, 2006).

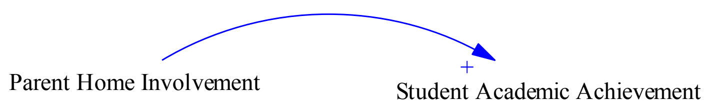


Figure 61 - The effect of parent home involvement on student academic achievement (drawn from Fantuzzo, Perry and Childs, 2006).

Based on empirical researches, school involvement directly affects school outcomes. “Children whose parents show high levels of involvement at the school demonstrate greater levels of social competency, higher levels of adaptive behavior and early basic school skills, greater academic achievement in math and reading and higher rates of school completion” (Fantuzzo, Perry and Childs, 2006).

“Students whose families are more knowledgeable, supportive, and involved in their education performance better academically and exhibit more positive attitudes toward school, have higher expectations, and exhibit more positive behaviors” (Seitsingeret.al., 2008). At the same time, “parent involvement in school is an important component in early childhood education to help promote long-term effects” (Barnard, 2004).

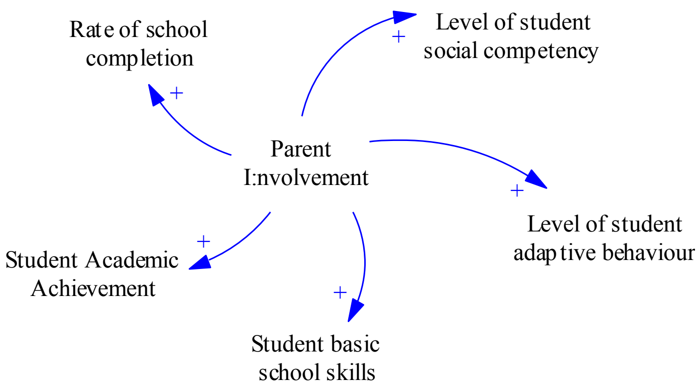


Figure 62 - The effect of parent involvement on some parameters regarding with student dimension (drawn from Fantuzzo, Perry and Childs, 2006).

Furthermore, a research has shown that “parent involvement and collaboration efforts are most important in schools serving culturally diverse and low-income populations” (Fantuzzo, Perry and Childs, 2006). “Cultural differences have been recognized in terms of what families expect of schools. For example, one study found that African American and Hispanic parents tend to believe that school involvement efforts should be initiated by school staff” (Fantuzzo, Perry and Childs, 2006).

“School, principal, and teacher practices are more important than parent characteristics (e.g. poverty level, minority status, education level) in getting families involved at school and in influencing levels of family–school contact” (Fantuzzo, Perry and Childs, 2006). “School administrators have an opportunity to create bi-directional communication to foster genuine parent involvement” (Christenson and Sheridan, 2001).

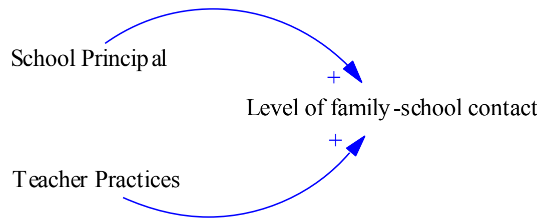


Figure 63 - The effect of school principal and teacher practices on the level of family-school contact (drawn from Fantuzzo, Perry and Childs, 2006).

“Our prior research indicated that students who reported higher frequency of family rewards for their school studies received lower grades than their classmates. This may be due to a tendency of middle schools to more often contact parents of students who may be having difficulty in school. However, academic performance was positively and moderately associated with school efforts to contact parents” (Seitsinger et al., 2008).

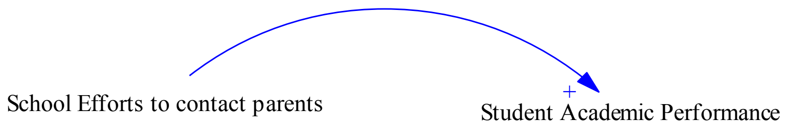


Figure 64 - The effect of school efforts to contact parents on the student’s academic performance (drawn fromSeitsinger et al., 2008).

“Teacher attitudes toward parent involvement at the middle school level as well as their practices were more similar to teachers at the elementary school level than to high schools. When middle school teachers do more often reach out to parents, students' levels of academic adjustment were significantly better as reflected by students reporting higher levels of academic efficacy, aspirations and expectations. They also reported their families were more engaged in supporting their education” (Seitsinger et al., 2008).

“Teachers also reported viewing those students who self-reported higher levels of academic adjustment as having higher academic potential. Knowledgeable and involved parents are critical to student success. By providing families with information about their children, ways to engage with the students in schooling and about the availability of health and social services, teachers and schools can help parents better support their student's learning. The use of this measure as part of a school improvement assessment may lead to a better understanding of schools' current efforts to engage parents and progress in this area” (Seitsinger et al., 2008).

3.3.2.1. Dimensions of parent involvement

Grolnick and Slowiaczek (1994) have emphasized “parent involvement in three different ways”:

1) “behavioral”
2) “cognitive intellectual”
3) “personal”

Behavioral involvement means parent participation whether at home or at school such as helping homework at home or meeting with teachers at school. Cognitive intellectual means to discuss the topics with their children. Personal involvement is to be always informed about the progress of children socially or academically.

Eccles and colleagues (Eccles & Harold, 1996) “delineated five dimensions of parent-initiated involvement in their Michigan Childhood and Beyond Study”:

a) “monitoring (how parents respond to the teacher’s requests for helping their children with school work such as checking homework or listening to them read)”;
b) “volunteering (parents’ level of participation in activities at school)”;
c) “involvement (parents’ involvement in their children’s daily activities related to homework)”;
d) “contacting the school about their children’s progress”; and
e) “contacting the school to find out how to give extra help”.

Epstein (1995) “outlined six dimensions of parent–school partnerships that focus on the school’s role in fostering these relationships”. These are:

a) “parenting (helping families provide home-based support for learning)”;
b) “communicating (designing effective school–home communication about schoolprograms and progress)”;
c) “volunteering (recruiting and organizing parents to support school goals and child development)”;
d) “learning at home (providing information to families to help students at home for their homework)”;

e) “decision making (including parents in school decisions, developing parent leaders andrepresentatives)”; and
f) “collaborating with the community (integrating community resources and services to strengthen school programs, family practices, and student development)”.

In addition to them, “a number of factors may influence parental motivation for involvement in their child's education” (Hoover-Dempsey et al., 2005), for example

a) “their belief that they should be involved and that such involvement will positively effect their child's learning”
b) “life contexts allow for involvement”
c) “responses to outreach efforts from teachers and schools”

According to the model created by Kohl, Lengua and McMahon (2000), there are six parent involvement factors:

a) “Parent–Teacher Contact”
b) “Parent Involvement at School”
c) “Quality of Parent–Teacher Relationship”
d) “Teacher’s Perception of the Parent”
e) “Parent Involvement at Home”
f) “Parent Endorsement of School”

“The relations among 3 specific family and demographic risk factors—parental education level, maternal depression, and single-parent status—and these 6 Parent Involvement factors” were shown in the Figure 65.

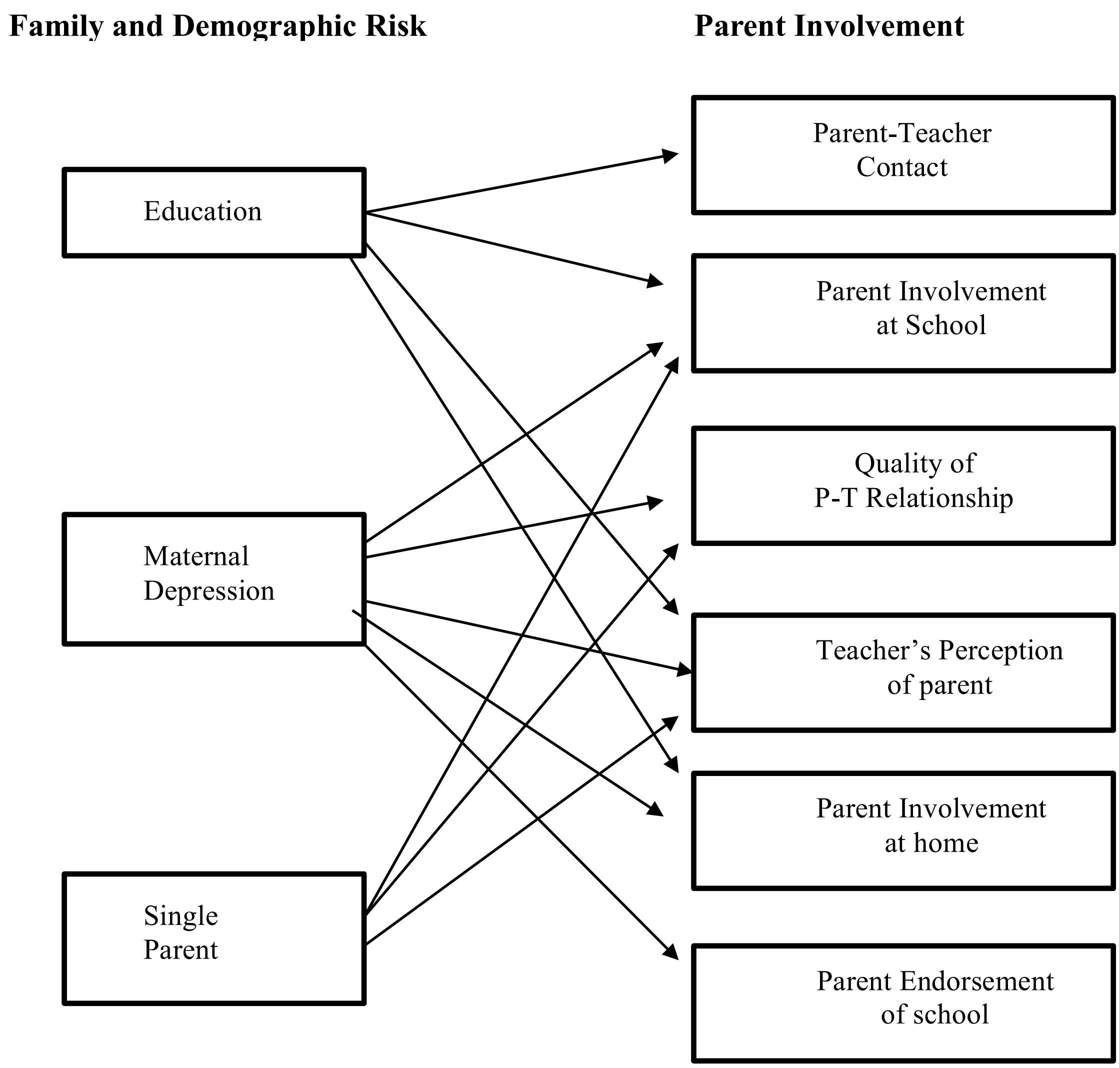


Figure 65- Model that illustrates "differential pattern of prediction between family and demographic risk factors and parent involvement factors" (Kohl, Lengua and McMahon, 2000).

3.3.2.2. Reasons for parent involvement

Hoover-Dempsey and Sandler (1995) suggest that "parents become involved for three major reasons";

a) "their personal construction of the parental role";
b) "their personal sense of efficacy for helping children succeed in school"; and
c) "their reaction to the opportunities and demand characteristics presented by both theirchildren and their children's schools".

Self-efficacy is the strong one among them. In the literature, there is a correlation found between self-efficacy beliefs and student's effort. So, "parents who feel that they might have a positive impact on their children's school experience would more readily become involved and implement strategies to help their children succeed. Conversely, those parents who have a low sense of efficacy might feel that their involvement would have no effect on their children's success in school, resulting in minimal involvement" (Hoover-Dempsey and Sandler, 1995).

3.3.2.3. Factors that affect the parent involvement

"Current studies have identified and documented a range of factors that influence parent involvement "(McBride, Sullian, Ho-Ho, 2005), including

1. "Family factors such as socioeconomic status, race and ethnicity, family structure, level of parent education, maternal employment etc."
2. "School factors such as school setting, the size, academic focus, climate, school governance, school characteristics and policies, teacher practices etc."
3. "Community factors such as families living in low-income communities, cultural traditions etc."

3.3.2.3.1. Family factors

"Many family and demographic factors such as ethnicity, family composition, income, education level, and work status are associated with Parent Involvement" (Kohl et al., 2000). "Parents' education, as well as other socioeconomic and demographic factors, such as marital status, employment, and income level, predicted their amount of participation in their children's educational experiences" (Parker et al., 2001).

a) **Parent Education:** Kohl et al. (2000) emphasized that "better-educated parents are more involved at school and at home". "Mothers with higher intellectual confidence and achievement motivation were more involved in their children's education" (Parker et al., 2001). "Parents with a higher income and more education maintain tighter relations with school than lower-class parents" (Telem and Pinto, 2006).

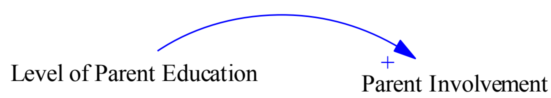


Figure 66 - The effect of parent education on parent involvement, drawn from (Kohl et al., 2000).

b) **Income: "**Greater family income was associated with greater involvement in all aspects of children's schooling for both fathers and mothers, as well as with greater academic achievement for children" (McBride et al, 2005). "High SES parents tend to be more involved in school. It is related to parents' resource availability and accessibility" (Rosenblatt and Peled, 2002). Huang (2010) also emphasized that: "It is known that socioeconomic factors bear a strong relation to academic achievement. SES remains as probably one of the most commonly used contextual variables in education research. SES is a strong predictor of student academic achievement" (Hoy, 2012).

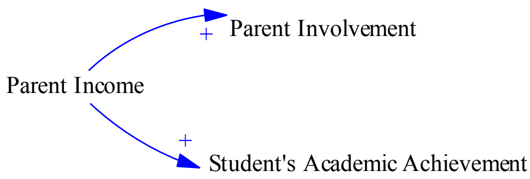


Figure 67 - The effect of family income on parent involvement and student academic achievement (drawn from McBride et al., 2005).

c) **Hours of Employment:** More hours of employment have negative effects on level of involvement. However, "changes in family composition, such as having a baby or getting divorced, also were perceived barriers to parent involvement" (Parker et al, 2001).

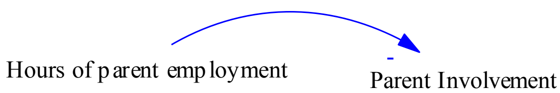


Figure 68 - The effect of hours of parents' employment on their involvement (drawn from Parker et al., 2001).

d) **Single Parent: "**Single-parent status is also important for parent involvement. In several studies, teachers reported lower levels of school involvement for single parents" (Kohl et al, 2000). Single parents naturally have fewer resources such as money, social support, and time to invest in their child's education and development. Therefore, "single-parent status is a marker of multiple risks that may influence a parent's likelihood of being involved in school or with the child directly" (Kohl et al., 2000).

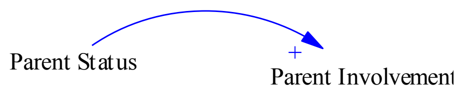


Figure 69 - The effect of parent status on the parent involvement (drawn from Kohl et al., 2000).

e) **Maternal Depression: "**Depressed mothers often view their parenting roles less positively and may have less energy, motivation, and confidence to be involved either with their children directly or with school personnel" (Kohl et al., 2000).

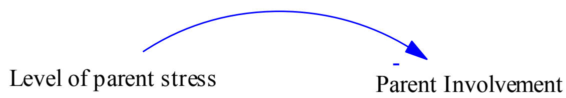


Figure 70 - The effect of maternal depression of parents on parent involvement (drawn from Kohl et al., 2000).

f) **Ethnicity:** Ethnic or racial minority status causes lower level of parent involvement. Kohl et al. (2000) found that "minority status was associated with a decrease in the amount and quality of Parent Involvement by teacher report. Moles (1993) wrote of "disadvantaged parents"—those with low income and minority status—having less involvement in school by teacher report".

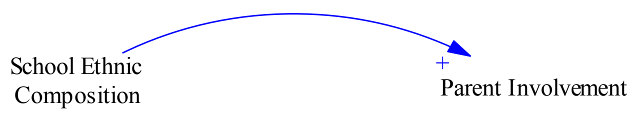


Figure 71 - The effect of school raciality and ethnicity on the parent involvement (drawn from Kohl et al., 2000).

g) **Satisfaction:** Under closer home-school relationships, "parents may be more committed to schools they have chosen. Typically, parents are highly satisfied and tend to be involved in their children's education" (Hausman and Goldring, 2000).

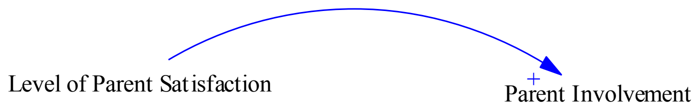


Figure 72 - The effect of parent satisfaction on parent involvement (drawn from Hausman and Goldring, 2000).

3.3.2.3.2. School factors

Parent involvement is linked with the school climate. There are five ethical climates such ascaring, instrumental, rules, law-and-code and independence. “The caring climate was most related to high effectiveness. A school climate characterized by caring for parents as well as students was related to increased parental involvement. Conceptual model of the associations among ethical climate, parent influence, trust and parent involvement” (Rosenblatt and Peled, 2002) is given in the Figure 73.

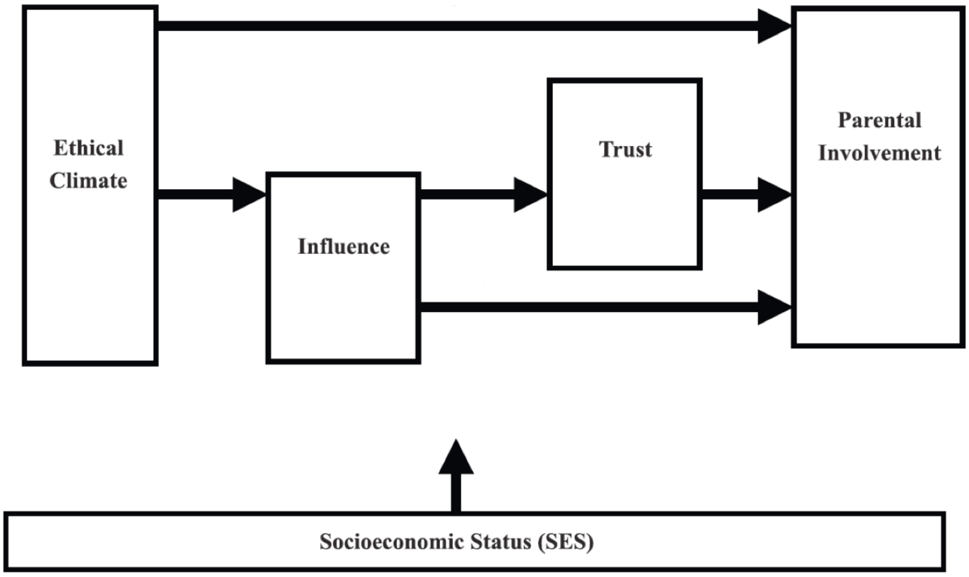


Figure 73 – “Conceptual model of the associiations among ethical climate, parent influence, trust and parent involvement” (Rosenblatt and Peled, 2002).

In addition to school ethical climate, “school characteristics and policies have also proved to shape parent involvement. Issues associated with the type of school setting (urban, rural, suburban, private or public), the size, academic focus, climate, school governance, teachers” and sense of community affect the ways in which parents participate (McBride, Sullian, Ho-Ho, 2005).

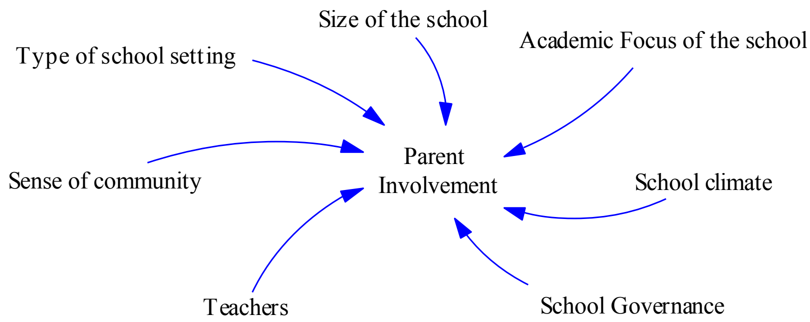


Figure 74 - The effect of school climate, school characteristics and policies on the parent involvement (drawn from McBride, Sullian and Ho-Ho, 2005).

Raccah and Ainhoren (2009) "suggested a classification of four types of school governance based on parents' and teachers' empowerment and affect the effectiveness of parent involvement":

1) **"Bureaucratic:** Low teacher and parent participation; in this traditional mode ofgovernance, the parents' role in schools is passive while teachers maintain classroom autonomy".
2) **"Teacher's professionalism:** High teacher empowerment and low parent participation; in this type of school governance, teachers' power is based on their expertise, and theyare perceived as knowing what is best for students".
3) **"Parent Empowerment:** It is defined as active parental involvement in school and lowteacher empowerment. As under this mode of governance parents challenge schoolpractice, teachers may lose respectability and credibility, thus weakening their positionin school".
4) **"Partnership:** Parents and teachers are both highly empowered. This last mode isassumed to contribute to school effectiveness and quality. This mode has been foundto contribute to teachers and students alike and improve school attainments".

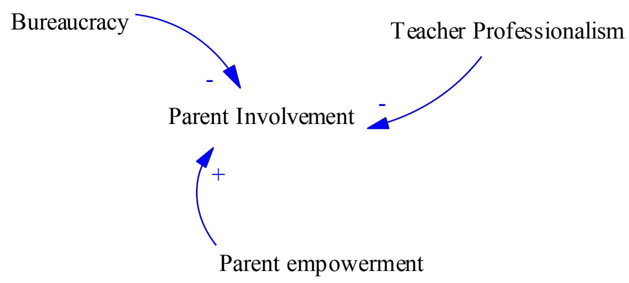


Figure 75 - The effect of school governance mode on parent involvement (drawn from Raccah and Ainhoren, 2009).

As the teachers know, parents contribute to the work of teachers. In the bureaucratic structured school systems, teachers allow parent involvement to some extent but they do not want them to interfere the professional side of the school. At that perspective they show a level of resistace against parent involvement. At the other types of school governance modes, teachers are welcome parents and assess them as an important contributor to the school community.

"Teachers' attitudes toward parents vary according to school governance mode. As expected, the most resistant and negative attitudes to parents surfaced in schools where parents were empowered. Ambivalent attitudes characterized teachers at professional and bureaucratic schools, and positive attitudes were typical of teachers at schools with partnership governance" (Raccah and Ainhoren, 2009).

In addition to the effect of school governance mode on parent involvement, another important factor that encourages parent participation is teacher practices. "The school and teacher's role in facilitating parental involvement and providing a clear understanding of their children's reading achievement and development are critical. Parents in the study had a range of experiences with their children's schools and developed strong opinions regarding the quality of their children's schooling" (Fletcher, Greenwood and Parkhill, 2009).

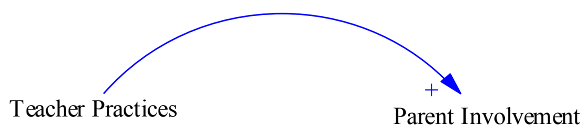


Figure 76 - The effect of teacher practices on parent involvement (drawn from Fletcher, Greenwood and Parkhill, 2009).

“An important policy implication of the research reported here is to look not only at the elements needed for more successful parent-teacher partnerships, but also at how other reforms individually and together, threaten the possibilities for partnership by undermining teachers' sense of professional confidence and security, and by overloading them with other reform obligations” (Lasky, 2000).

As Figure 77 indicates, “each of these elements moves through and impacts the other. Teacher-parent interaction is at the center, as this is the focus of this analysis. The bi-directional arrows indicate that these outer elements shape and frame parent-teacher interaction, yet changes in interaction patterns can also reshape notions of culture, power and moral purpose. These are interconnected, inseparable elements of human interaction” (Lasky, 2000).

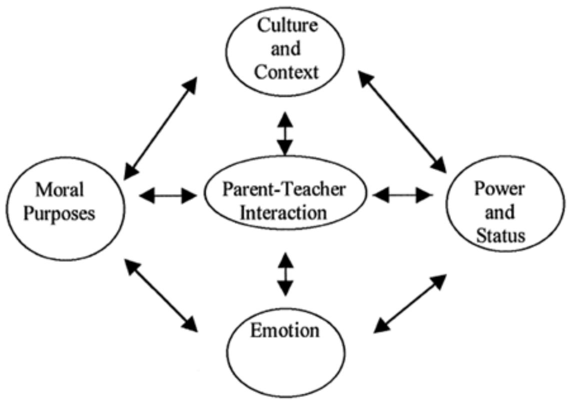


Figure 77 – “Cross-correlational model for emotional influences on parent-teacher interactions” (Lasky, 2000).

On the other hand, “parental involvement in children's academic achievement and in schooling in general, and their expectations of teachers in particular, seem to affect the teachers themselves, as reflected in their reports on work-stress. A study of Australian teachers revealed differences between teachers working in primary and secondary schools; the former reported greater stress in their interactions with parents as compared with secondary-school teachers, this discrepancy being attributed to the greater involvement of parents in lower grades" (Tatar and Horenczyk, 2000).

Salfi and Saeed (2007) took "an approach arguing that a culture of respect between parents, students, and teachers was necessary for parental involvement. This culture comes from parents and teachers knowing each other personally, and is, therefore, more likely to develop in smaller schools".

"Administrators in small schools relied more heavily on verbal communications and held more conferences with parents than administrators in large schools. The findings of this study also support this claim of researchers as parents were frequently involved in school activities and they could check their children's progress easily in smaller schools as compared to larger schools" (Salfi and Saeed, 2007).

The efforts to integrate the parents with the education process can be thought as important bridging attempt to the external environment. Managers want to know parents expectations and benefit them for the academic achievement of their kids.

"When guided by open systems theory however, principals view the elements of their external environment quite differently. They recognize the interdependence that schools share with their environments and the uncertainty within those environments makes increasing coordination and information flow, thereby creating a symbiotic interdependence. This dependence on the external environment for resources and support creates a milieu in which alliances are critical for goal attainment, student achievement and even survival" (DiPaola et al., 2005).

As a consequence, "they build bridges and attempt to forge alliances with parents and community members. These competing theories impact the behaviors of principals in contrasting ways and shape their attitudes about their external environments. Bridging strategies such as encouraging parents to involve in educational process, appear to be the more productive when it comes to fostering student achievement" (DiPaola et al., 2005).

"Principals use coalition building that is aimed at fostering cooperation between the school and the parents when the principal and parents work together to achieve common goals. Principals view parents as important allies who share similar aims and interests and seek to involve them. Principals also work with groups whoseaims may be incongruent with the schools, and seek to influence them by bringing them into alignment with the school's missions and goals" (DiPaola et al., 2005).

As a result, firstly, "redesigning school governance is a challenge for head teachers to form new patterns of collaboration and empowerment of teachers and the community at large. Second, teachers need to know more about parental involvement and its contribution to students, teachers, and the school organization. They need to modify their attitudes toward parents and learn how to work effectively with them. Third, parents' role in schools should be redesigned to lead to better collaboration with teachers and principals" (Raccah and Ainhoren, 2009).

For that purpose, "parents should be encouraged to learn how to take an active and constructive part in schools. In order to achieve a fruitful collaboration at the school site between parents, teachers, and head teachers, partnership programs and practices should be implemented and developed at schools" (Raccah and Ainhoren, 2009).

3.3.2.3.3. Community factors

"Community conditions can impede parent involvement in school. Families living in low-income communities typically have less access to resources to support their children's educational aspirations and are reluctant to form relationships to school. However, individual family practices and cultural traditions influence the success of some children despite community conditions" (McBride, Sullian, Ho-Ho, 2005).

3.3.2.4. Quality of parent involvement

The quality of parent involvement is an important component of Parent Involvement. Kohl and colleagues (Kohl et al., 2000) found "the quality of the relationship to be more strongly associated with child outcomes than the amount of parent–teacher contact". To measure the quality of Parent involvement, these are three dimensions';

1. "The quality of the relationship between parent and teacher"
2. "The teacher's perception of the parent's value of education"
3. "The parent's satisfaction with the child's school"

3.3.2.5. Parental involvement and student outcomes

"Parent involvement may be a method of improving students' learning" (Keith et al., 1998). "A significant body of research indicates that, when parents participate in their children's education, the result is an improvement in student achievement and student attitude" (McBride, Sullian and Ho-Ho, 2005).

"Increased attendance, fewer discipline problems, and higher aspirations have been correlated with parent involvement. Studies have documented that, when parents are involved in school, they gain a clearer understanding of what is expected of their children and how they can work with their children and teachers to enhance their children's educational experience" (Dauber & Epstein, 1993).

Some researches have indicated that, "when parents are involved in their children's school, they send strong and consistent messages to them that education is valuable and important. Such messages positively impact children's learning and social development" (McBride, Sullian and Ho-Ho, 2005).

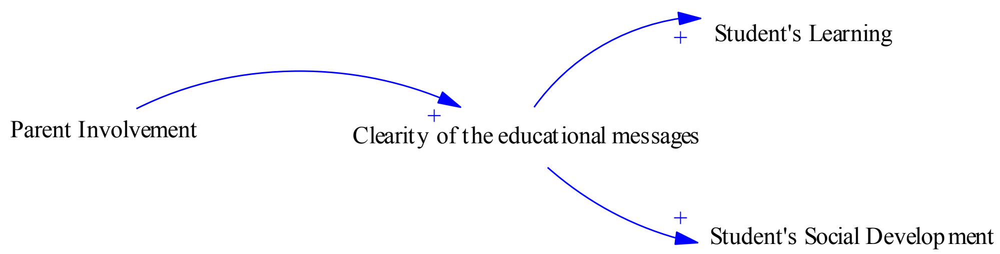


Figure 78 - The effect of Parent involvement on student's learning and social development (drawn fromMcBride, Sullian and Ho-Ho, 2005).

"Greater parent involvement in school-aged children's learning has positive effects on school performance, including greater cognitive development and higher academic achievement. At a young age, children's behavior at home, school readiness, and adaptation to elementary school are positively affected by parents' greater participation" (Parker et al., 2001).

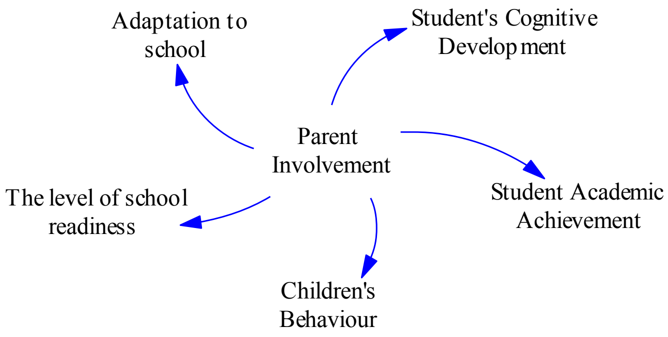


Figure 79 - The effect of parent involvement on student's school performance (drawn from Parker et al., 2001).

"Parental involvement in academic activities is an important contributor to children's school achievement. Parental involvement could thus be promoted by providing parents with opportunities and incentives for engagement in school activities, assuming that this will lead to further involvement through the strengthening of their positive attitudes and expectations" (Tatar and Horenczyk, 2000).

"Parents' attitudes and understanding of reading development play a key role in influencing their children's achievement in and attitude to reading. If educators are trying to tease out the factors that support reading achievement, parents need to be part of the important puzzle. This critical role that parents play in the development of their children's attitudes towards and achievement in reading allow us, by listening to these voices, to gain a better understanding of how we can work together to further enhance children's reading" (Fletcher et al., 2009).

"Parents' reading motivation and attitudes towards reading can impact on their children's attitudes and achievement in reading, reading comprehension and spelling" (Fletcher et al., 2009). Rutter and Maughan (2002) have also emphasized the importance of parental support for children's learning and attaintment.

3.4. SCHOOL DIMENSION

There are so many couples of interactions between students, teachers, and administrators in a school environment. These interactions affect the learning process in school.

Salfi and Saeed (2007) state as "school, teacher, pupil and parent all affect the teaching learning discourse. It is imperative that these factors should properly function for the quality of education. Although educational researchers and policy makers consider a number of variables in operationalizing quality of education, thus the ultimate criterion for assessing the effectiveness of any school is the extent to which it improves the academic achievement of the students".

"Hundreds of empirical studies have investigated the determinants of greater learning and whether school- and teacher-related resources have a measurable impact on student academic achievement" (Huang, 2010). "Previous research on school effects indicates that schools' structures (e.g. size and grade configurations; tracking or other ability grouping, course scheduling), academic organization (e.g. academic norms and expectations, quality of classroom learning experiences and student support mechanisms), policies (e.g. discipline, attendance, and grade retention), and resources contribute in various ways to student academic success or failure" (Heck and Mahoe, 2010).

From the general perspective in the literature, following variables are mentioned as a contributor to student academic achievement;

1) ***School Characteristics*** *(smaller student populations, school size, classroom sizes, teacher–student ratio, teacher education, teacher experience, teacher quality, teacher salary, location, physical resources, school SES composition, school racial composition)*
2) ***School Culture*** *(Positive school culture, school prestige, principal's leadership style, monetary rewards, better working conditions for teacher, parental encouragement, learning environment and culture, principals' and teachers' leadership style)*
3) ***School Climate*** *(open school, humanistic school, collective trust, academic emphasis, collective efficacy, academic optimism)*
4) ***School Quality*** *(Financial resources, pupil quality, teachers' qualifications,*

teacher training, school infrastructure, prior achievements of the school)

5) ***School Structure*** *(flexible or rigid structure)*
6) ***School Leadership*** *(transformational form of leadership, innovative school, supportive leadership, collegial leadership)*
7) ***School Investment*** *(teaching expenditure, expenditure per pupil)*
8) ***School Physical Environment*** *(building quality, newer buildings, improved lighting, thermal comfort, indoor air quality, science laboratories, libraries, building age, climate control, design classifications, overall impression)*
9) ***School Social Environment*** *(teacher attitudes, behaviors, and performance, constructive relationship with the community)*

We will discuss the effect of those on student academic achievement in more detail.

3.4.1. School characteristics

"School structural characteristics, such as smaller student populations, classroom sizes, and student-faculty ratios, have been associated with more effective learning environments and higher student achievement" (Stockard and Mayberry, 1992).

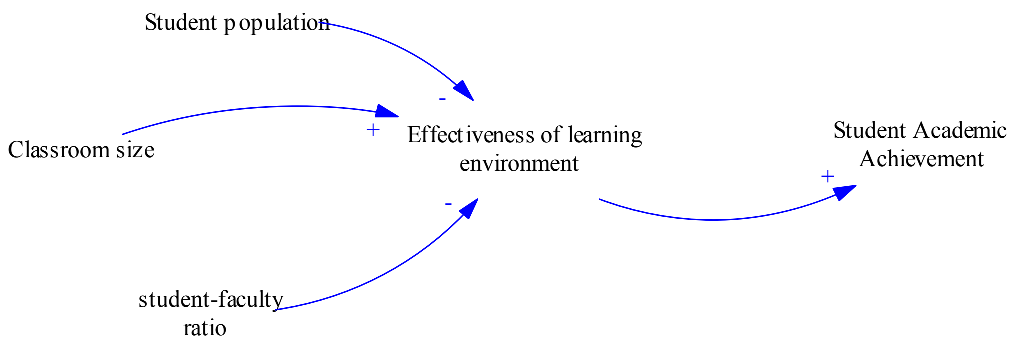


Figure 80 - The effect of school structural characteristics on student academic achievement (drawn from Stockard and Mayberry, 1992).

"Numerous studies have attempted to identify the importance of different school characteristics including student/teacher ratio, teacher education, teacher experience, teacher quality, teacher salary, expenditure per pupil, facilities in the production of cognitive achievement. Most of the school effects are correlated with student exposure to teachers, as indicated by teacher student ratios, and with teacher quality" (Behrman et al., 1997).

"The linear combination of family, student and school characteristics is significantly related to academic achievement. Teacher–student ratio, in-service teacher training and teacher's level of education independently had significant effects on academic achievement, whereas school facilities and class size have significant effects on achievement" (Demir, 2009).

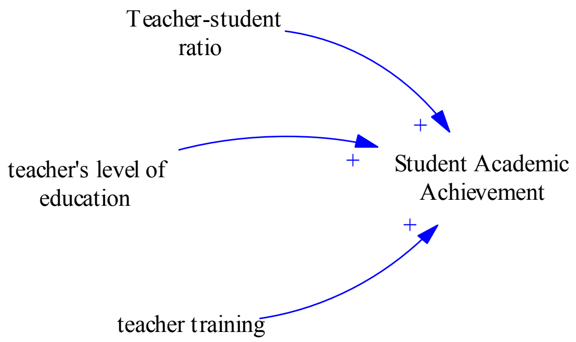


Figure 81 - The effect of teacher characteristics in school context on student academic achievement (drawn from Demir, 2009).

School size is the mostly mentioned one of the most important school characteristics in the literature. There was a significant correlation between school size and student success.

"Small schools revealed positive school culture and performed better than medium and large schools. The smaller schools had better and positive school culture in comparison to medium or average and larger schools. This may be due to this fact that in smaller schools teachers were well prepared to teach their subjects; their behaviour was more caring with the students; they shared ideas and material; respect and support each other" (Salfi and Saeed, 2007).

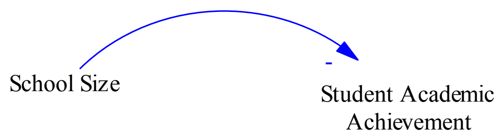


Figure 82 - The effect of school size on student academic achievemet (drawn from Salfi and Saeed, 2007).

In addition, "Pittman and Haughwout (1987) found that smaller school size is to be strongly correlated with a composite measure of school climate including student participation, interaction with faculty, sense of cohesion and infrequent discipline problems". Tucker (1997) has claimed that "small schools have a better learning climate than large schools because in smaller schools there is a greater likelihood that faculty and students know each other".

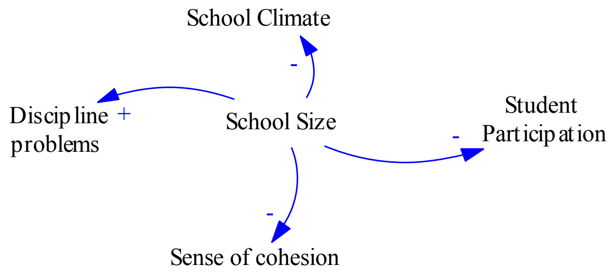


Figure 83 - The effect of school size on school climate and activities (drawn from Pittman and Haughwout, 1987).

Moreover, Silins and Murray (2000) have emphasized "the importance of school sector, type and size of school, along with the more dynamic or contextual influences of leadership (transformational and transactional), school organisation (related to curriculum, teacher development and school climate) on student's academic achievement".

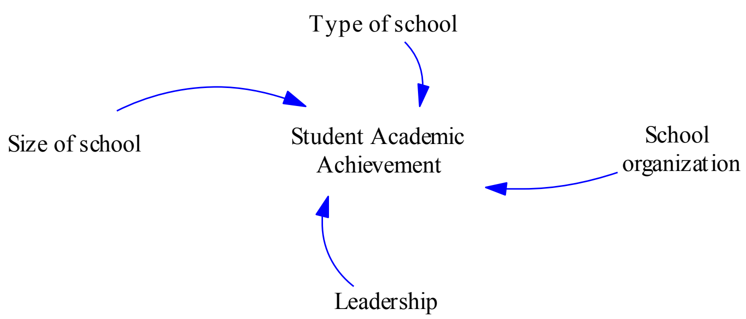


Figure 84 - The importance of school sector on student academic achievement (drawn from Silins and Murray, 2000).

On the other hand, Teacher–student ratio is linked with student academic achievement. It also indicates the school and relationship quality. Since educational process is a dynamic process, focusing only on teacher-student ratio would be confusing about deciding the variables that affect the student's academic achievement.

“Teacher quality has much greater affects on variations in achievement than differences in class size and smaller teacher-student ratio. Students performed significantly better in schools where teachers had a higher than average level of education (Demir, 2009). However, without denying the importance of a lower student-teacher ratio, our results suggest that an equally effective policy could rely on improving teacher quality rather than increasing the number of teachers” (Bedi, 1997).

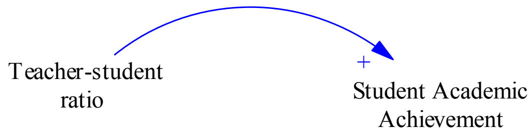


Figure 85 - The effect of teacher-student ratio on student academic achievement (drawn from Demir, 2009).

Additionally, “school characteristics such as location, resource differences and endogenous social interactions have an impact on the school environment, student educational norms and goals, which in turn influence both student achievement and eventual educational attainment” (Huang, 2009).

School structural composition also affects the students’ achievement and growth. “Parents from middle- and high-socioeconomic backgrounds are more likely to participate in their children’s education than parents from low socioeconomic backgrounds” (Ryabov and Hook, 2007). Academic achievement is associated with school SES and minority composition

“As expected, academic achievement in schools increases with average school SES and decreases with the percentage of minority enrollment. The results show that the average SES in a school is a stronger predictor of GPA” (Ryabov and Hook, 2007). School racial composition have littleeffect on academic achievement, but socioeconomic composition does.

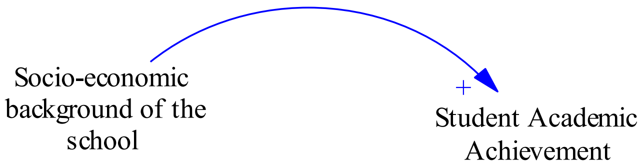


Figure 86 - The effect of socio-economic background of the school on student academic achievement (drawn from Ryabov and Hook, 2007).

3.4.2. School culture

The term culture is generally considered as the combination of shared values, symbols and beliefs among society members. Deal and Peterson (1990) includes in culture “deep pattern of values, beliefs, and traditions that have been formed over the course of the school’s history”. In view of McBrien and Brandt (1997), “school culture and climate refers to the sum of values, culture, safety practices, and organizational structures within a school that cause it to function and react in particular ways”.

Salfi and Saeed (2007) define school culture as “the commonly held beliefs of teachers, students and principals”. They implied that “school culture is the beliefs, attitudes, and behaviours that characterize a school”. They state also “a school culture is a complex pattern of norms, attitudes, beliefs, behaviours, values, ceremonies, traditions, and myths that are deeply ingrained in the very core of the organization”.

In different words, “Culture is very important for an organization as it affects significantly every aspect of it, such as stability, cohesion, unity and ability for adjustments in an organization. In particular, researchers have accumulated some compelling evidence in support of the proposition that school culture influences school outcomes” (Kythreotis et al, 2010).

Motivated teachers can contribute more to the positive environment of a school. Salfi and Saeed (2007) mentioned that “students’ performance is better than other schools that had no such positive school culture characteristics”. In addition, Erpelding (1999) and Hirase (2000) found that “schools with a positive climate had higher academic achievement of students”.

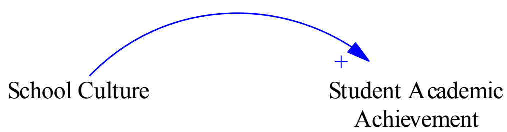


Figure 87 - The effect of school culture on student academic achievement (drawn from Salfi and Saeed, 2007; Erpelding, 1999; Hirase, 2000).

“Other studies have also reported great positive effects of school climate, especially the teacher–student relationship, on student achievement and attitude towards school” (Demir, 2009; Silins and Murray, 2000). So many school culture factors have a strong relationship with student academic achievement. Deal and Peterson (1999) state “school’s culture is one of the important factors that influences academic achievement of students”.

Bulach et al. (1995) have implied the importance of school culture on academic achievement that “a significant difference in students’ achievement between schools with a good school climate and those with a poor school climate”. Saeed (1997) has found that “school prestige, principal’s leadership style, monetary rewards, better working conditions for teacher, and parental encouragement were major predictors for secondary school teachers’ job satisfaction which in turn had a positive impact on students’ learning”.

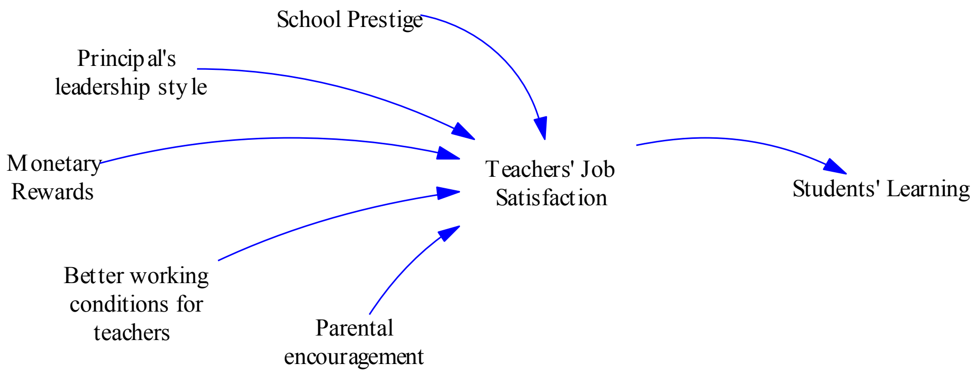


Figure 88 - The effect of school climate on students’ Learning (drawn fromSaeed, 1997).

“The schools with better facilities, learning environment, in other words, schools with positive culture, performed better than schools in which culture was average or below average. It was most probably due to better physical facilities, teachers’ individual attention upon them, head teachers’ good management and supervision, parental encouragement, or other such factors that promote school culture” (Salfi and Saeed, 2007).

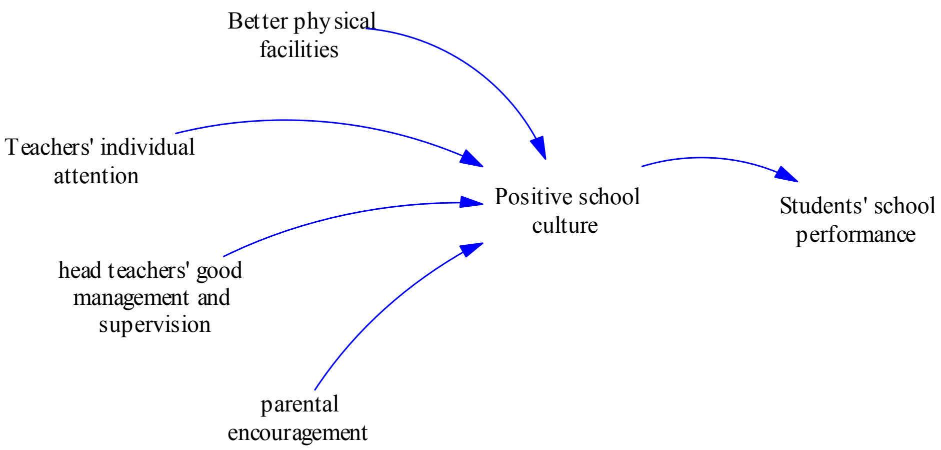


Figure 89 - The effect of school positive culture on students' school performance (drawn from Salfi and Saeed, 2007).

"The existence of several cultures at the school level has already been recognized" (Maehr and Midgley, 1996). The most important aspect of the school culture is the one which relates with learning. In other words, school learning culture is one of the important factors among school parameters to enhance academic achievement. But, there are less studies on it in the literature.

Barnett et al. (1999) is the one researcher to shot the effect of social learning culture on academic achievement. According to them, "this study used a model proposed by Midgley et al. (1996), who developed an instrument measuring school learning culture and student motivation. Learning culture is the particular set of perceptions, thoughts and beliefs that have been found to be critical in determining motivation and student learning".

"There are many dimensions in their model that were related to school learning culture such asacademic emphasis, academic efficiency, academic novelty, cheating behavior, disruptive behavior and success" (Maehr and Midgley, 1996).

Five factors are mentioned about creating school learning culture effectively (Silins and Mulford, 2002). These are;

1. "the level of teacher learning in teams or whole staff"
2. "the extent to which their work is valued"
3. "the level of leadership satisfaction"
4. "the extent to which transformational leadership practices are evident"; and
5. "the extent that resources are perceived as sufficient for learning to occur".

“Learning is enhanced when the work of staff is recognised and their contributions valued. Teacher satisfaction with the school leadership team is a significant predictor of the extent of teacher involvement and engagement with the school and learning” (Silins and Mulford, 2002). Learning atmosphere enourmously encourages teachers work hard in the class.

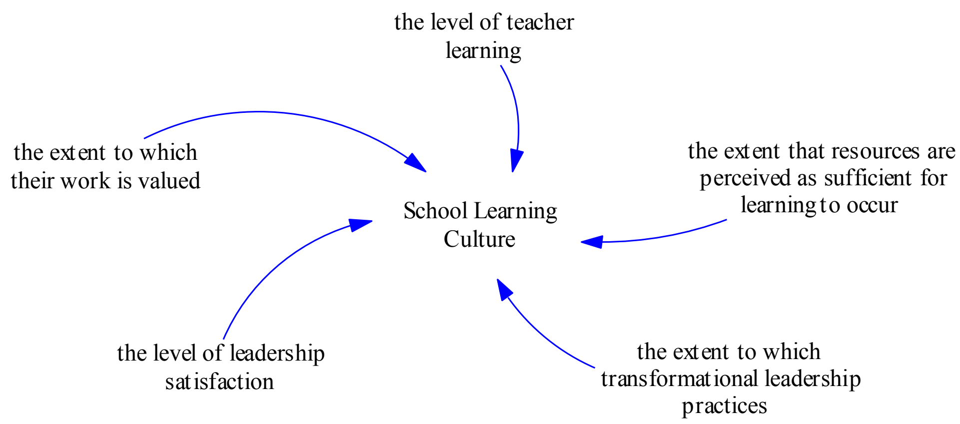


Figure 90 - The effect of factors necessary to create school learning climate (drawn from Silins and Mulford, 2002).

Moreover, principals’ and teachers’ leadership style have effects on students achievement. Principal’s Leadership Style creates an organizational culture in the school and teacher’s leadership style creates a learning culture in the classroom. Together with students’ characteristics (student’s prior knowledge, gender and SES), they have an influence on student’s academic achievement. “The model of the relationships among leadership, culture and student achievement” (Kythreotis, Pashiardis and Kyriakides, 2010) is shown in the Figure 91.

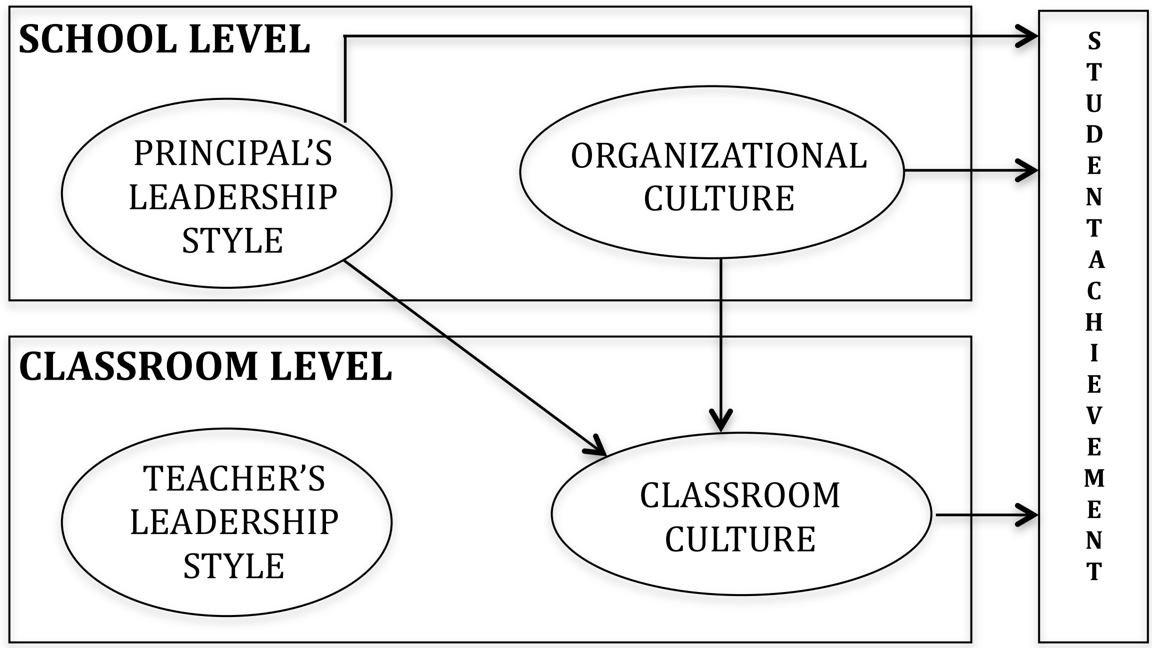


Figure 91 – "The model of the relationships among leadership, culture and student achievement" (Kythreotis, Pashiardis and Kyriakides, 2010).

Figure 92 reveals that "the principals' structural frame, the principals' effectiveness as managers and the teachers' commitment are the three variables at the school level that affect the three variables at classroom level, which are the personal achievement goal orientations, the classroom performance-goal structure and the academic emphasis. Commitment to the school, which is one variable of organizational culture, has a positive effect on academic emphasis in the classroom" (Kythreotis, Pashiardis and Kyriakides, 2010).

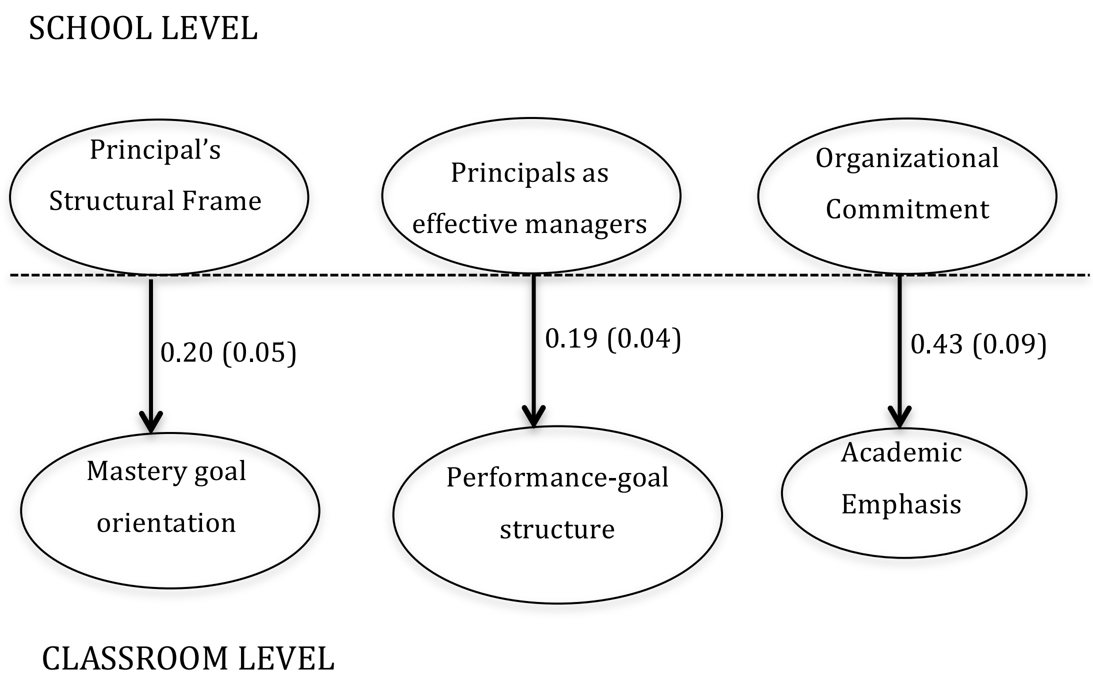


Figure 92 – "The relationships between the school level and classroom level variables that affect the student achievement" (Kythreotis, Pashiardis and Kyriakides, 2010).

"The principal's structural frame affects classroom mastery goal orientation. Thestructural frame emphasizes goals, planning, and coordination at school level" (Bolmanand Deal, 1997). "Mastery goal orientation emphasizes classroom purpose to develop its competence" (Maehr and Midgley, 1996).

Consequently, "the principal's perceived effectiveness as a manager affects classroom performance-goal structure. Classroom-performance and goal structure approach refers to classroom perceptions that the purpose of engaging in academic work in the classroom is to demonstrate competence" (Maehr and Midgley, 1996).

3.4.3. School climate

"An open school climate, one that focused on authentic interactions among members, in fact facilitates a humanistic pupil control perspective. Further, humanistic schools had principals who led by positive example, were considerate, personal, avoided close supervision, were engaging, friendly, and had faculties with high morale" (Hoy, 2012).

Hoy (2012) also describes the important dimensions of school climate as "academic emphasis and collective trust in clients (parents and students) also have their strong effects on the student achievement. These are identified two characteristics of schools that made a difference in achievement for all students regardless of SES –academic emphasis and collective trust in clients”.

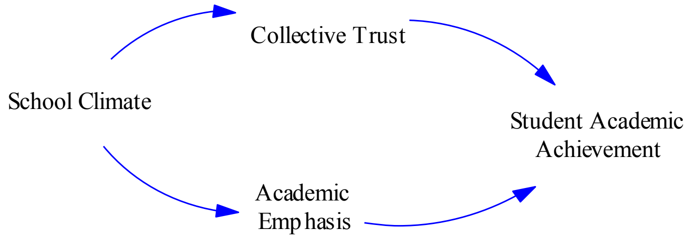


Figure 93 - The effect of school climate on student academic achievement (drawn from Hoy, 2012).

Academic emphasis means how much a school gives importance to the academic quality. In such schools, learning environment becomes serious and high mastery goals are set up. Students are supposed to be highly academic achievers. According to Hoy (2012), “academic emphasis of school was positively related to school achievement even after controlling for SES”.

Forsyth et al. (2011) and Tschannen et al. (1998) have defined the collective trust as “Collective trust is a state in which groups are willing to make themselves vulnerable to othersand take risks with full confidence that others will respond in positive ways, that is, withbenevolence, reliability, competence, honesty, and openness”.

“Collective faculty trust in students and parents is substantially and significantlyrelated to student achievement in elementary schools. Collective trust in the organization, faculty trust in the principal, and faculty trust in colleagues were not related to achievement aftercontrolling for SES; however, collective trust in students and parents did explain asignificant amount of student achievement even after controlling for SES” (Goddard et al., 2001).

Similarly, Tarter and Hoy (2004) have mentioned in the same way that “faculty trust in students and parents was related to student achievement regardless of SES.

On the other hand, According to Bandura (1997), “Social cognitive theory is a general framework for understanding motivation and human learning. Self-efficacy, an essential element of the theory, is a person's belief about his or her capacity to organize and execute actions required to produce a given level of attainment. Efficacy beliefs are basic mechanisms in human agency. Without a positive sense of efficacy, individuals are hesitant to initiate action; in fact, asense of self-efficacy affects choices and plans for the future".

Bandura (1997) has emphasized that "schools have a sense of collective efficacy, which is positively related to student achievement; in fact, he concluded that the relationship between collective efficacy and achievement was stronger than the relationship between SES and student achievement".

Collective efficacy is the key variable explaining student achievement. "Collective efficacy was more important than either academic emphasis or SES. It is found that collective efficacy was especially potent when academic emphasis was high. The findings led us to theorize that academic emphasis works through collective efficacy; when collective efficacy is strong, academic emphasis directs teachers' behaviors, helps them persist, and reinforces social norms of collective efficacy" (Hoy, 2012).

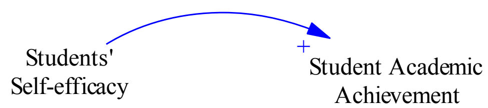


Figure 94 - The effect of students' Self-efficacy on student academic achievement (drawn from Tschannen-Moran et al., 1998).

Taken as a whole, "collective efficacy has a positive influence on achievement and academics, and such academic emphasis reinforces the development of collective efficacy. In sum, the elements of academic optimism have transactional relations with each other as they interact to form a school culture of academic optimism" (see Figure 95) (Hoy, 2012).

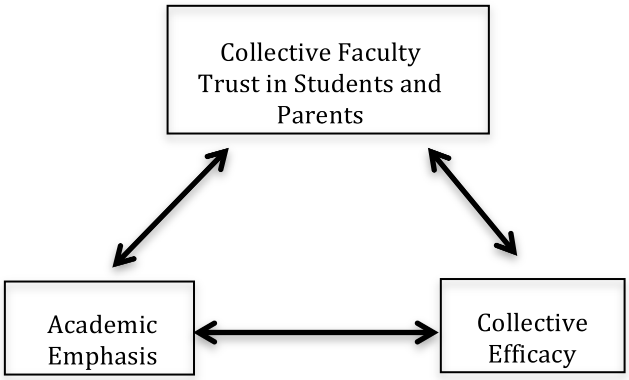


Figure 95 – "Triadic reciprocal relations of elements of academic optimism" (Hoy, 2012).

We need to analyze the dynamics of academic optimism for student academic achievement. Academic optimism promotes student learning and it is an integral part of a school culture.

Bryk and Schneider (2002) have made a research about the indirects effects of trust on achievement. They suggested that "trust fostered a set of organizational conditions, which in turn directly promoted higher student achievement. In particular they concluded that the following organizational conditions fostered high student academic achievement":

1. "positive orientation to innovation—a teacher "can do" attitude and internalized responsibility";
2. "outreach to parents and cooperation with parents";
3. "professional community—collaborative work practices and high academic expectations and standards"; and
4. "commitment to school community".

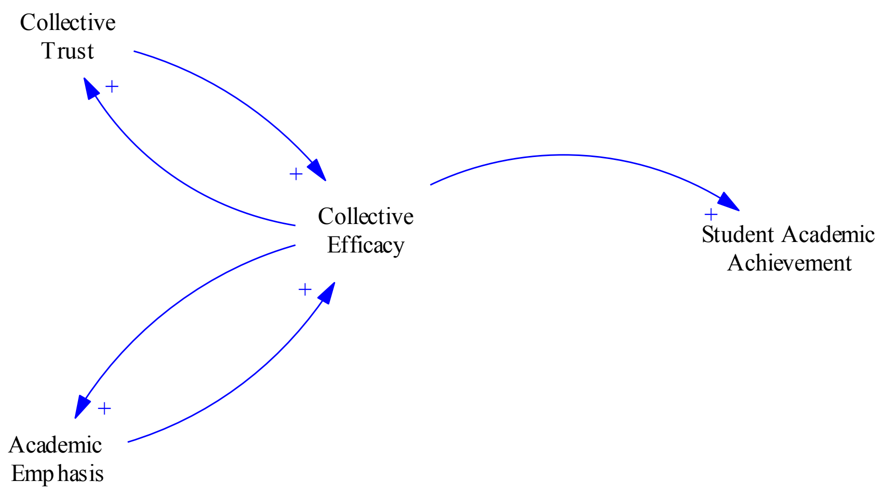


Figure 96 - The effect of academic optimism on student academic achievement (drawn from Hoy, 2012).

“What is striking about Bryk and Schneider’s school conditions that promote learning is that in large part they are remarkably similar to the elements of our latent construct ofacademic optimism. Notice how the organizational conditions identified by Bryk and Schneider map the elements that compose academic optimism. The “can do attitude” ofthe group is defined by collective efficacy. The outreach to and cooperation withparents is encompassed by collective trust in parents and students. Professional community in terms of collaborative work practices, and high expectations and academic standards are incorporated into a climate of academic emphasis” (See Figure 97) (Hoy, 2012).

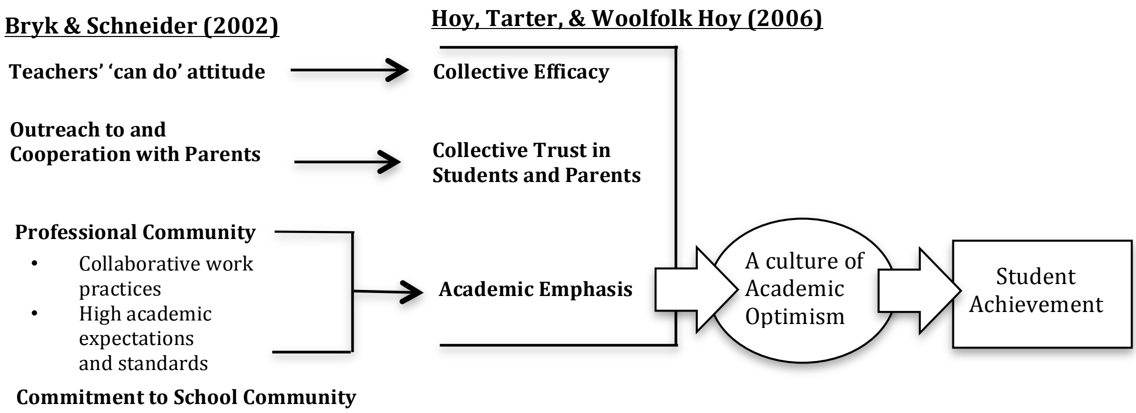


Figure 97 – “School conditions that promote student Achievement” (Hoy, 2012)

"To review and elaborate further, a strong culture of academic optimism is composed of three elements: collective-faculty trust instudents and parents, collective efficacy, and the enactment of academic emphasis. A culture of academic optimism leads teachers and students to set and embrace specific, challenging goals that are attainable, which in turn enhances student motivation" (Hoy, 2012).

"Second, academic optimism and relational trust (working through academic optimism) foster a learning environment in which students and teachers accept responsibility forlearning, are motivated to exert strong effort, persist in difficult tasks, and are resilientin the face of problems and failures" (Hoy, 2012).

"Third, academic optimism encourages cooperation among students, teachers, and parents in matters of student learning, which enhance sstudent motivation. Moreover, relational trust between parents and teachers enhances and supports academic optimism as well as promotes a spirit of this cooperation. Both challenging, attainable goals and cooperation among students, teachers, and parentslead to strong motivation, which in turn leads to high levels of achievement, which inturn reinforces both relational trust and academic optimism" (Hoy, 2012). These interrelationships producing student achievement are summarized and illustrated in Figure 98.

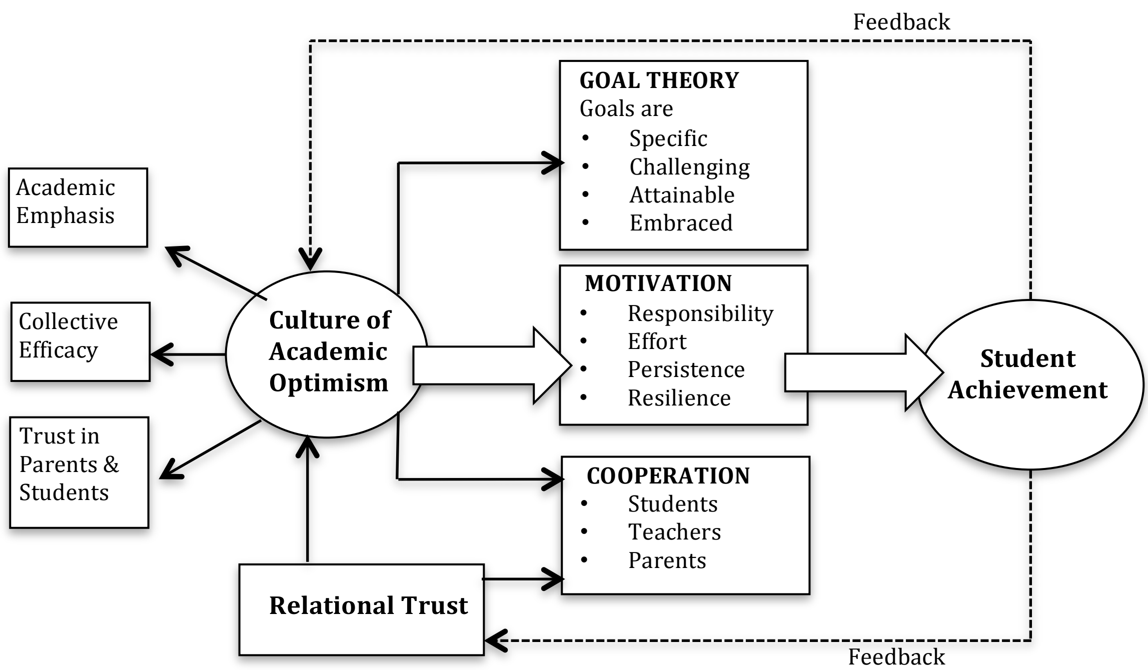


Figure 98 – "A model of the Dynamics of student achievement" (Hoy, 2012)

3.4.4. School quality

The school quality is an important key to create a warm school and learning environment. School quality is linked not only to the infrastructure but also to the learning environment and climate. “This may sound harsh, but it reflects a simple reality: parents want their children to attend schools with other children who are able and highly motivated, even if their own children fall short on these metrics” (Bedi, 1997).

“Another feature of a school system is that, while education itself is both rival in consumption and potentially excludable and therefore not a pure public good, the quality of a local school has some of the characteristics of a public good in that all who attend must consume the same quality of education. So, school quality depends on two factors” (O’Shaughnessy, 2007);

1) “the extent to which the total financial resources available to the school exceed the fixed and per-pupil costs of running a school” and
2) “a peer effect which, in turn, depends on average pupil quality”

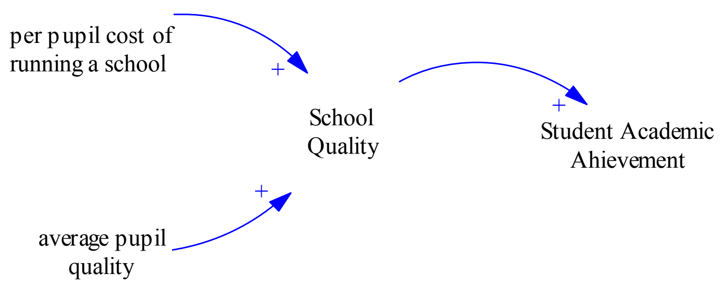


Figure 99 - The effect of school quality on student academic achievement (drawn from O’Shaughnessy, 2007).

On the other hand, some researchers also emphasize that “school quality is strongly associated with teachers’ qualifications, teacher training and school infrastructure” (Bedi, 1997).

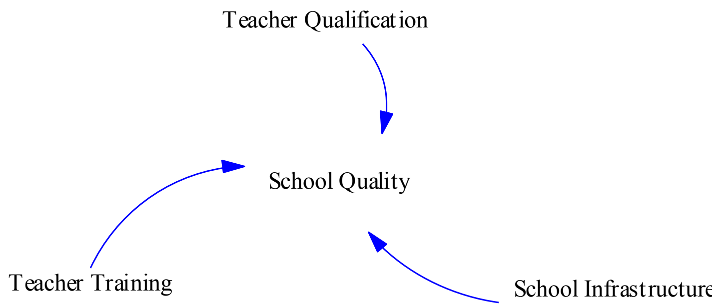


Figure 100 - The effect of some factors on school quality (drawn from Bedi, 1997).

However, “prior achievements of the school also seem to influence parental judgements about school quality just as much as school academic performance as measured by value-added. This reinforces the impression that school quality as measured by test scores tends to dominate parental perceptions of educational excellence, and provides some support for economists to understand what parents value in schools” (Berkowitz and Hoekstra, 2010).

Heyneman and Loxley (1983) described that “the predominant influence on student learning is the quality of schools and teachers to which children are exposed. The phenomenon has come to be known as the Heyneman–Loxley effect (the HL effect) and the poorer the country, the greater the impact of school and teacher quality on science achievement”.

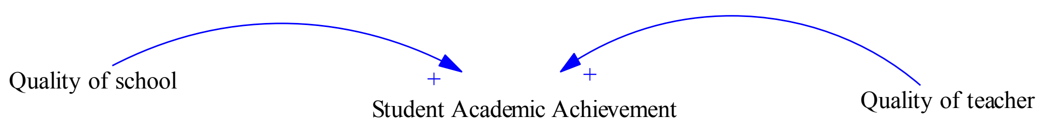


Figure 101 - The effect of quality of school and teacher on student academic achievement (drawn from Heyneman and Loxley, 1983).

3.4.5. School organizational structure

Like school characteristics and school culture, the organizational structure of the school are also important to enhance students’ achievement and teachers’ motivation. School culture and its structure must fit together in order to adopt the changes in education system within a particular school.

“All the indicators of teacher and student learning did vary significantly under different organization structural arrangements. Conditions that were conducive to teachers’ learning and the actual student performance were found to be more favorable under highly flexible structure than those in the medium structure. And conditions for these two types of learning were superior to those in the low and rigid structure” (Lam, 2005).

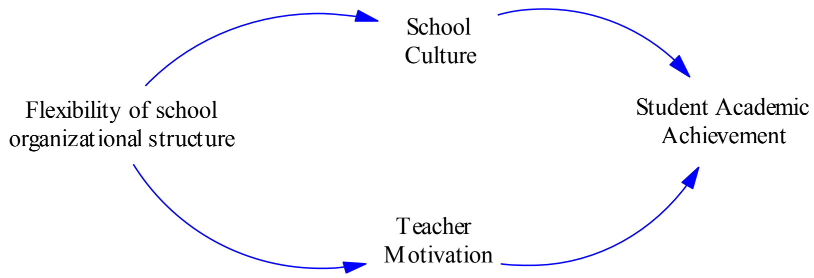


Figure 102 - The effect of schol organizational structure on student academic achievement (drawn from Lam, 2005).

Based on the research done by Lam (2005), “high flexible school structures seemed to liberate teachers from the traditionally narrow confine of their jobs. In so doing, teachers perceived to have greater control over their instructional responsibilities, more motivated to do their jobs and found more time in engage in collegial exchanges and mutual learning. More importantly, when teachers were aroused professionally, they tended to exert more positive effects on their students in multitudes dimensions – skills, attitudes and academic achievement” (Lam, 2005). According to his research findings, “path analysis of relationship of teacher learning and student learning under high flexible structure” is given in the Figure 103.

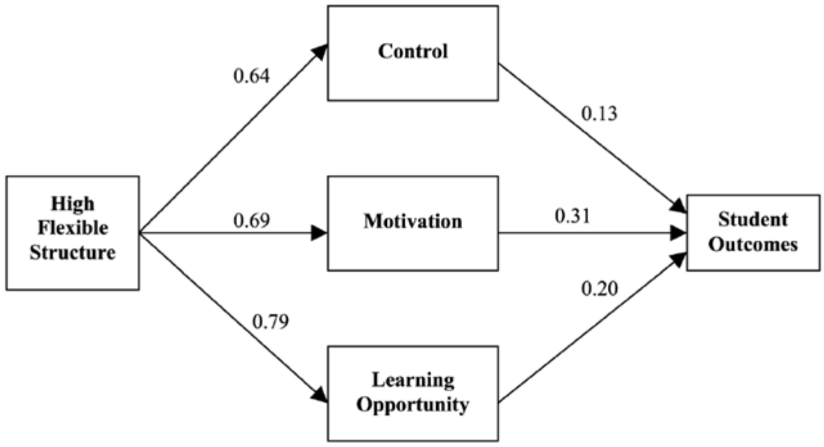


Figure 103 – "Path analysis of relationship of teacher learning and student learning under high flexible structure" (Lam, 2005).

Neither flexible nor rigid school structures can be considered as medium structure and it is shown in Figure 104). In such a school system, "teachers' working conditions and learning are still strongly regulated by the organizational arrangements. When we reviewed how these teachers' conditions affected students' outcomes, it is interesting to note that only teachers' motivation and the amount of opportunities that teachers could utilize influenced their students' development" (Lam, 2005).

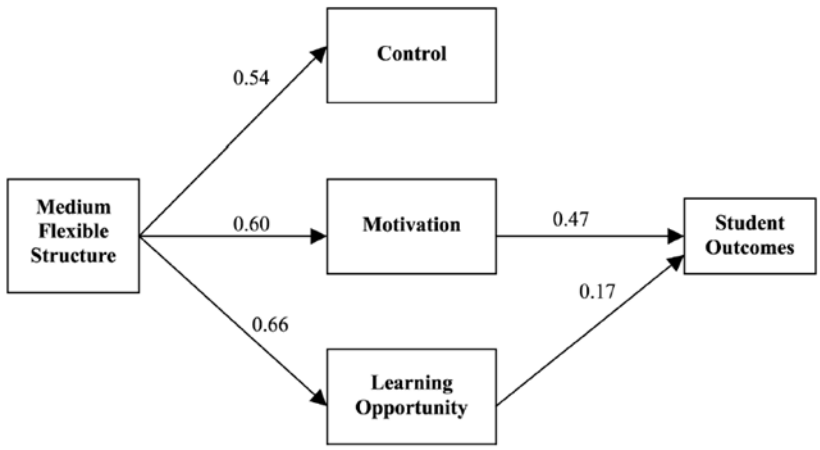


Figure 104 – "Path analysis of relationship of teacher learning and student learning under medium flexible structure" (Lam, 2005).

Whereas in rigid structures, teachers should obey the directions and their behaviour is always monitored. It is shown in the figure 105. In such a school system, "teachers tended to feel that their working and learning conditions were tightly monitored. These perceived conditions in turn impacted on their students' achievements in all aspects of their development. This tightly coupled model which strongly resembled those in the high flexible school, and to a less extent, the medium structure, reinforce the earlier suspicion that structure of the school holds much to explain the performance of teachers and their students. More crucial factors both external and internal need to be explored to understand more comprehensively teachers' potential and students' capacity in school contexts" (Lam, 2005).

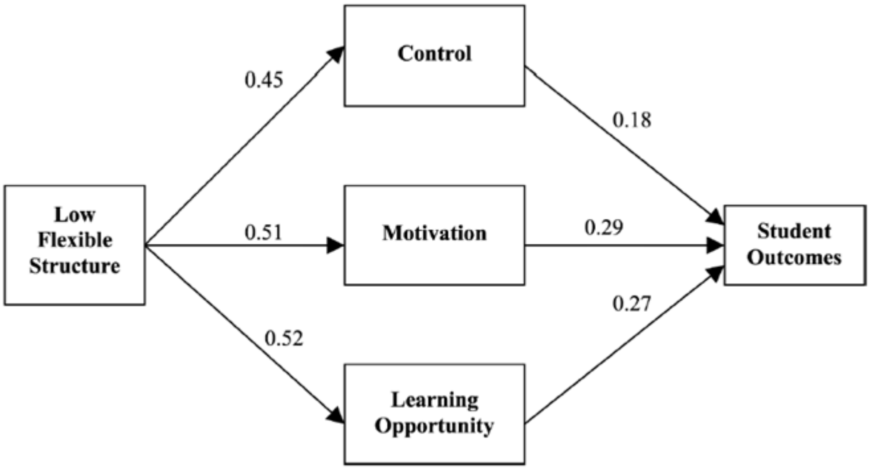


Figure 105 – "Path analysis of relationship of teacher learning and student learning under low flexible structure" (Lam, 2005).

Lam (1993) has concluded three dimensions such as "control, motivation and learning opportunities" which encourage teachers for professional development. They create an environment for teacher growth.

"Evidently, teachers when assuming greater responsibility for their own decision outcomes feel the pressure to do their best in relation to student interests and concerns. Increased responsibility heightened teachers' commitment to do their best in enforcing the decisions that they jointly make with the school administrators. Teachers' control is a natural ingredient of professional autonomy. As is described in the context of motivation theory, autonomy is a basic innate psychological need" (Desi and Ryan, 1985).

"Derived from theories of adult learning, adults are more motivated to learn when organizational conditions favor individuals to work and learn from one another on a continuous basis. Appropriate structural arrangements favor mutual learning through interactions among individuals with whom one works. Collaboration, open communication, free exchange of ideas, and examination of assumptions in collective work under these ideal conditions are believed to promote critical reflection, proactive thinking, experimentation and learning” (Lam, 2005).

“Without the bureaucratic interferences, teachers can capitalize on their acquired knowledge and skills to improve the learning environment of their students, increase interaction with diverse groups of learners, provide more timely and meaningful assessment and feedback for their students so that their students can be more closely engaged and more motivated to learn. Significant improvement should be evidenced in students’ cognitive, affective and psychomotor domains” (see Figure 106) (Lam, 2005).

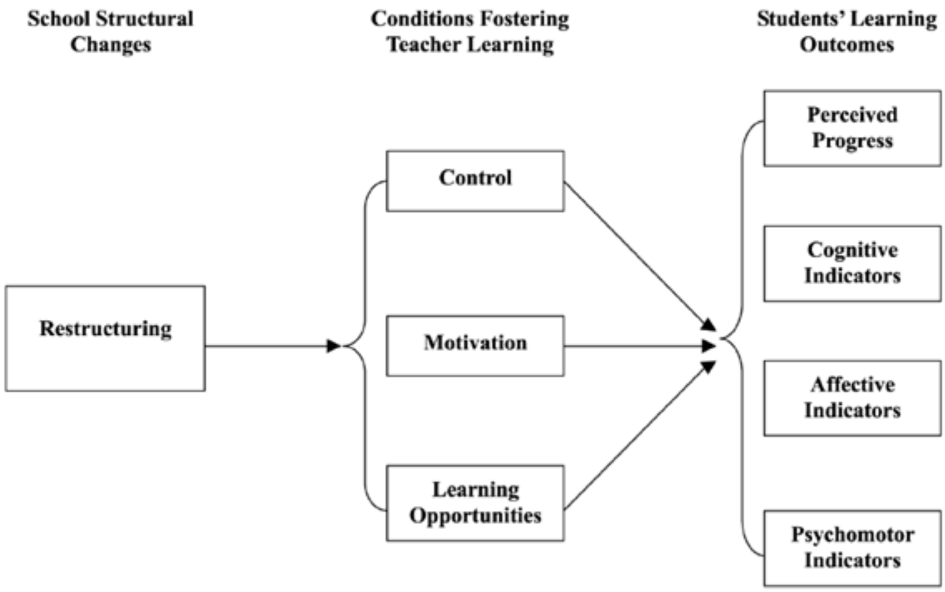


Figure 106 – “A conceptual framework showing teacher and student learning under restructuring” (Lam, 2005).

3.4.6. Schooling, management and leadership

The main goal of schooling is to carry out teaching and learning activities properly. Principals focus mostly on these activities in order to imptove the effectiveness of schooling. Valuable principals put learning and teaching activities at the heart of school activities and they create a vision within the school to promote them. Vision however, gives a certain direction to all school community members to realize the importance of main activities.

“Leaders should provide good models in terms of lesson preparation, subject knowledge, pedagogic approaches, assessment, and learner welfare. They should monitor educators’ practice in a systematic way and provide constructive feedback. They should also evaluate school outcomes and ‘benchmark’ them against schools in similar circumstances. Above all, school climate has to promote a positive approach to learning among all stakeholders, learners, educators, parents and the local community. This provides the best prospect of sustainable school improvement” (Bush et al., 2010).

Hoadley (2007) says that “four management factors have been shown to be significant in improving student outcomes: the regulation of time, Monitoring curriculum planning and delivery, the procurement and management of books and stationery and quality assurance of tests and the monitoring of results. Principals can also impact on classroom teaching by adopting a proactive approach and becoming instructional leaders”.

Rutter and Maughan (2002) have emphasized the several variables and features about the school organization and management system. “The overall school organization or management features that stand out include good leadership that provides strategic vision, staff participation with a shared vision and goals, appropriate rewards for collegial collaborative working, attendance to staff needs and rewards, and effective home–school partnership”.

“The ethos qualities that have been associated with good pupil progress include an orderly atmosphere, an attractive working environment, appropriate well-conveyed high expectations, the involvement of pupils in taking responsibilities, positive rewards with feedback and clear fair discipline, positive models of good teacher behavior, a focus on achievement and good behavior, and good teacher–pupil relationships in and outside the classroom” (Rutter and Maughan, 2002).

However, “a growing number of studies have indicated that the transformational form of leadership has been perceived by teachers to generate the most helpful management practices in the context of educational change and restructuring” (Silins and Mulford, 2002).

According to Rutter and Maughan (2002) findings, “pupil achievements and behavior can be influenced (for the better or worse) by the overall characteristics of the school environment”, such as

1) contextual features;
2) school organization and management;
3) school ethos;effective monitoring;
4) group management in the classroom; and
5) pedagogic qualities.

Leadership is an important administrative ehaviour in order to develop a qualified school environment. According to Crum and Sherman (2008), “the expressed purpose of the new state accountability systems is to raise student achievement and, more generally, to improve the quality of schooling”. Leaders and school managers play a crucial role for raising the quality of schooling.

“Leadership is second only to classroom instruction among all school-related factors that contribute to what students learn at school” and “is widely regarded as a key factor in accounting for differences in the success with which schools foster the learning of their students” (Crum and Sherman, 2008).

Effective school leaders focus on the students and their learning. Crum and Sherman (2008) also emphasize the six attributes of outstanding principals;

1) “external awareness and engagement”;
2) “a bias towards innovation and action”;
3) “personal qualities and relationships”;
4) “vision, expectations and a culture of success”;
5) “teacher learning, responsibility and trust”; and
6) “student support, common purpose and collaboration”.

In addition to them, Collegial leadership has gained so much importance in the field of education. Administrators are open-minded and they accept divergent teacher ideas. They also try to find some ways to promote teacher growth. They are considerate and helpful. Even thought collegial principals do not teach in the class, they set higher level of standards for both teachers and students.

Effective school leaders create a supportive learning environment to increase the students’ academic achievement. To do that, they generally developpersonnel and facilitating leadership, make responsible delegation and empowerment, recognize ultimate accountability, communicate and support, facilitate instruction, and manage change.

As a result, "the principal empowered his teams to make influential decisions about the school improvement plan, climate concerns, and the overall instructional design of the school; all factors that significantly affect student achievement" (Crum and Sherman, 2008).

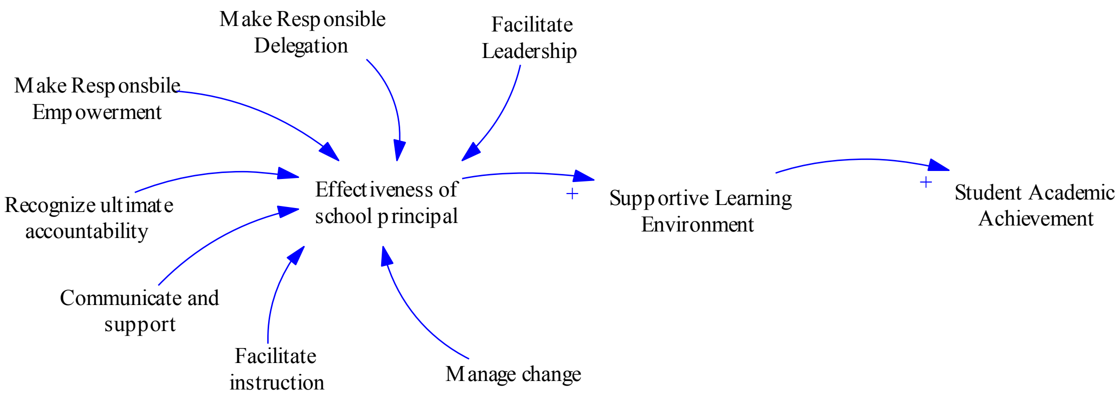


Figure 107 - The effectiveness of school principl to create a supportive learning environment and student academic achievement, drawn from (Crum and Sherman, 2008).

3.4.7. School spending

"A positive correlation between school spending and student performance can be due to unobserved differences in schools. For example, parents that are more concerned about their children may get their children into the better schools" (Hakkinen, Kirjavainen and Uusitalo, 2003).

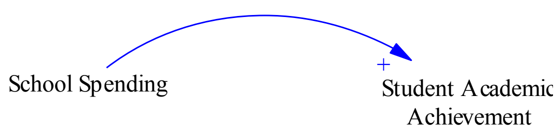


Figure 108 - The effect of school spending on student academic achievement (drawn from Hakkinen, Kirjavainen and Uusitalo, 2003).

3.4.8. School physical environment

McGuffey (1982) told about "the link between a school's physical environmentand student achievement, synthesizing findings across a number of studies that demonstrated a relationship between student academic achievement and building quality, newer buildings, improved lighting, thermal comfort and indoor air quality, as well as specificbuilding features such as science laboratories and libraries".

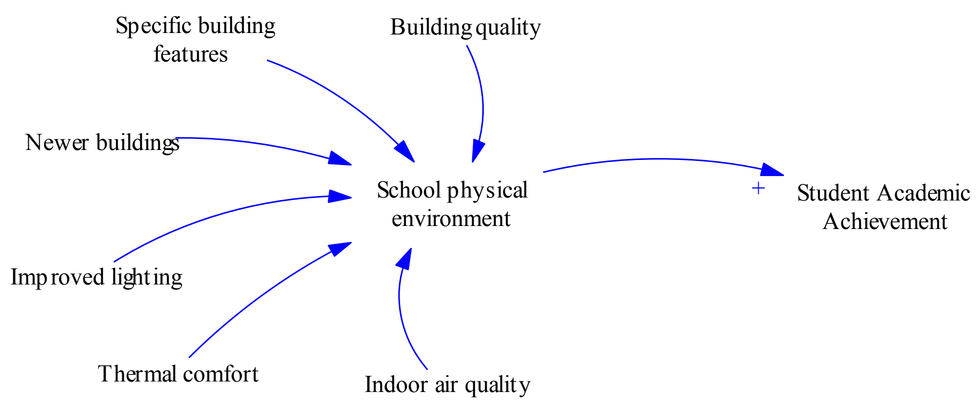


Figure 109 - The effect of school physical environment on student academic achievement (drawn from McGuffey, 1982).

Specific building infrastructure features can have somehow effect on student academic achievement. These include;

1. Building age (O'Neill, 2000),
2. Climate control (Earthman, 2004),
3. Lighting (Heschong Mahone Group, 1999),
4. Acoustical control (Earthman, 2004),
5. Design classifications (Lanham, 1999), and
6. Overall impression (Earthman, 2004; Lanham, 1999).

3.4.9. School social environment

As well as physical environment, the dynamic of social environment also affects student academic achievement. "The quality of interpersonal relationships and dynamics in a school can influence student learning. School climate is an assessment of the social dynamics in a school; and more than four decades of research provides a well-established link between school climate and student achievement" (Uline and Moran, 2008). "Schools and classrooms differ in their perceived social atmospheres or climates and that these differences are related to educational satisfaction and student academic achievement" (Griffith, 1997).

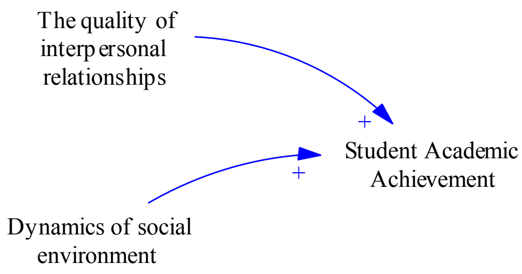


Figure 110 - The effect of social environment in school on student academic achievement (drawn from Uline and Moran, 2008).

Teacher attitudes are directly related with student academic achievement. “Among middle school teachers, teacher affiliation as well as collegial and committed behaviors, were moderately related to student academic achievement” (Hoy and Sabo, 1998).

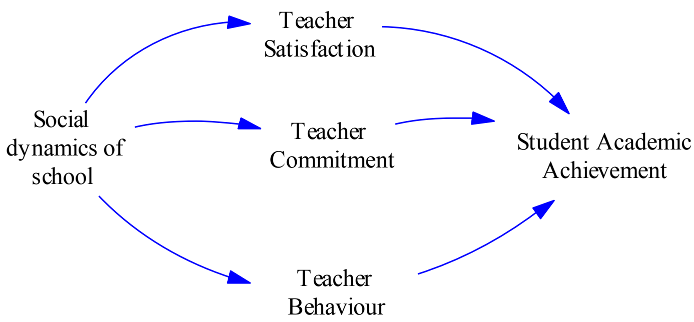


Figure 111 - The effect of social dynamics on student academic achievement (drawn from Hoy and Sabo, 1998).

As achievement criteria, successful schools establish a constructive relationship with its community. Community engagement is so important for those schools. “This construct describes the degree to which the school can count on involvement and support from parents and community members, and the extent to which the school provides the community with information about its accomplishments. A school’s ability to engage its community has been found related to student academic achievement” (DiPaola, 2005).

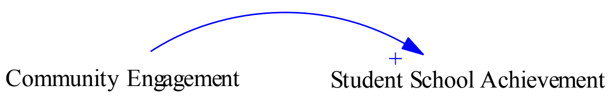


Figure 112 - The effect of community engagemet on student academic achievement (drawn from DiPaola, 2005).

4. LITERATURE REVIEW ON EDUCATIONAL OUTCOMES

The major aim of educational process is to grow up student academically, socially, culturally and morally qualified citizens. Hence, the outcomes of a certain education system are academic achievement and satisfaction from the process. Both academic achievement and educational satisfaction are affected from contextual, individual and environmental dimensions. Academic Achievement and Educational Satisfaction were mentioned before. But here they will be discussed in more detail;

4.1. ACADEMIC ACHIEVEMENT

Academic Achievement is the main output of a school system in addition to sudent and parent satisfaction, personal growth and wellbeing. Academic Achievement is the overall GPA for students at the end of a year or a term. According to this GPA value, students are categorized whether they are achievers or not. During educational process, all the discussions are made about how different dimensions affect the students' academic achievement interchangeably. Educational process that directly affects the academic achievement was analyzed into the four dimensions; school, teacher, parent and student. Additionally, the similar categorization has been also made by Bush et al. (2010).

From the general perspective to the school system, the factors inhibiting learner achievement in the schools can be given as follows:

a) **Contextual Factors: "**The main predictor of learning outcomes is the socio-economic context faced by the school and its learners. Many parents are illiterate in their own language and have little command of English. This makes it difficult for them to reinforce learning at home. Even worse is the situation facing those many learners who have no parents and whose families are headed by grandparents or older siblings" (Bush et al, 2010).
b) **Learner-related factors:** "The social problems discussed above impact on learners' motivation and learning, for example in respect of uncompleted homework, learner absences and a perceived lack of commitment, particularly amongst older learners. There is also a concern that class sizes are too big, making it difficult to address learners' individual needs" (Bush et al., 2010). Some respondents complain about learners being lazy and illdisciplined, although the classroom observations do not support this argument. However, educators are too

ready to ‘blame the learners’ rather than considering what strategies they should adopt to address these problems.

c) **Educator-related factors:** Educators are usually demotivated, by their perceived heavy workload and by the demands of the revised National Curriculum Statement. Some also say that they need additional training, particularly where they are teaching subjects that were not part of their initial training.

Principals and other managers say that some educators lack commitment, evidenced by absenteeism, late arrival to classes, and unwillingness to provide extra classes to help learners to ‘catch up’. Some also criticise educators’ reluctance to work collaboratively. School G is also short of staff. According to the participants, this is because educators do not wish to work at the school and, when vacancies are advertised, no applications are received (Bush et al., 2010).

d) **Management issues:** Educators usually blame school managers for a lack of support. This may be due to the limited time available to Head of Departments for management, because of their own teaching commitments, or because Head of Departments have weak leadership skills and/or lack motivation. There are also fractured relationships within SMTs, making it difficult to develop, and implement an agreed strategy to improve teaching and learning. Fewer management issues were identified at the Limpopo schools, although the principal of school E is critical of one Head of Departments. However, managers at most of these schools have been unable or unwilling to promote teamwork within their learning areas (Bush et al., 2010).

4.2. EDUCATIONAL SATISFACTION

Educational satisfaction is an important output like academic achievement. Families decide whether we send our kids to the same school or not according to their level of satisfaction. If the students are good achievers, probably, parents will satisfy from the educational process. But, however, there are also other factors that affect the level of student and parent satisfaction. These factors also gain so much importance as the academic achievement. Student and parent satisfaction may differ in some areas.

Students satisfaction is mostly related with school and classroom activities, higher quality of classroom learning and social support from the system elements whereas parent satisfaction is particularly related with the school climate and how they are empowered by the school administration. In the following body of the research, student and parent satisfaction will be discussed differently and in detail;

4.2.1. Student satisfaction

"Student satisfaction was found to be moderately and positively related to broader school attributes; specifically, the quality of the school facilities, helpfulness of school staff, and school safety. Student satisfaction was also highly correlated with classroom activities; namely, student perceptions of the quality of classroom instruction and interactions with their teachers. Orderly social environments may lead to higher quality of classroom learning and higher levels of student satisfaction and academic performance" (Gill and Reynolds, 1999).

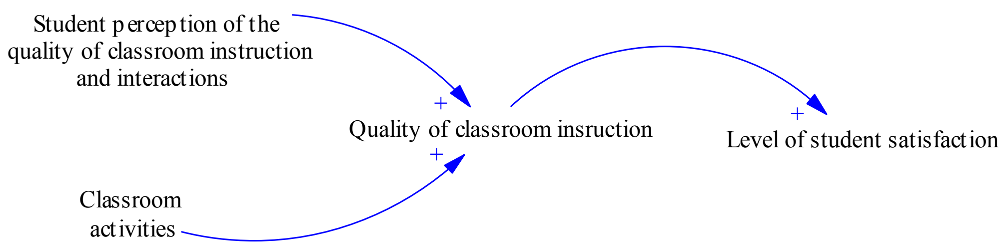


Figure 113 - The effect of classroom learning environment on student satisfaction (drawn from Gill and Reynolds, 1999).

"In relation to children's satisfaction with school, social support has repeatedly been shown to have a positive effect on students' levels of school satisfaction, including parent support, peer support, and especially teacher support" (King et al., 2007). School satisfaction is correlated significantly with the total social support and teacher support. However, there are also other factors that affect school satisfaction among children like demographic variables such as gender, race, grade level etc.

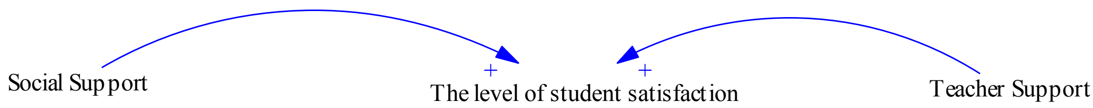


Figure 114 - The effect of total social support on student satisfaction (drawn from King et al., 2007).

Teacher or social support is an important factor for student satisfaction. Teacher support becomes most powerful factor to make students happy with the school. Moreover, "adolescents' evaluations of the positivity of their school experiences play an important role in their behavior. Adolescent levels of school satisfaction are important to understand, monitor and consider in the development, implementation and evaluation of their school experiences" (King et al., 2007).

4.2.2. Parent satisfaction

"Parents of students enrolled in larger schools reported less empowerment and less involvement. Parents also expressed less involvement in schools having larger class sizes. In schools having larger student-teacher ratios, parents felt less informed and students reported lower quality of academic instruction and less satisfaction" (Griffith, 1997). "Relations of parental socio-demographic background, parent-school interaction, school social and structural characteristics and classroom climate to parental with education" (Griffith, 1997) are given in the Figure 115.

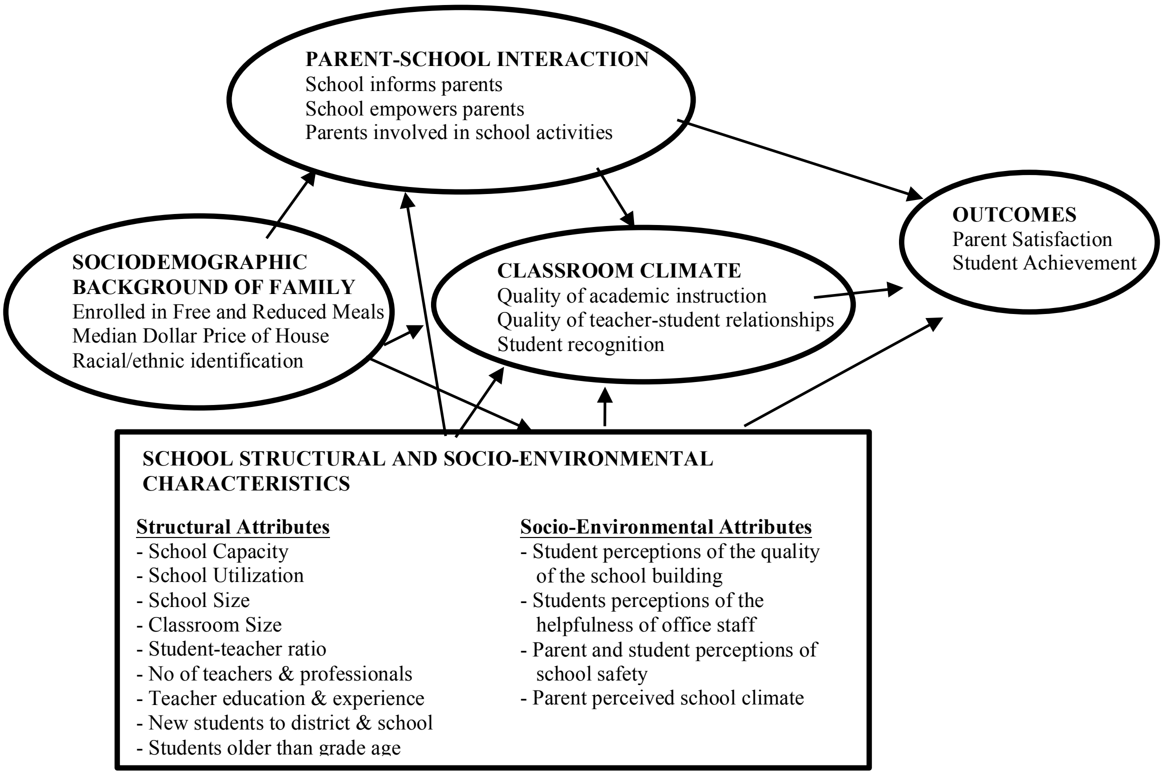


Figure 115 – "Relations of parental socio-demographic background, parent-school interaction, school social and structural characteristics and classroom climate to parental with education" (Griffith, 1997).

The thirteen multi-item indices that are important factors that affect the parent satisfaction with their children's school (Friedman, Bobrowski and Geraci, 2005) are given below;

1) "Facilities and Equipment"
2) "Computer Technology"
3) "School Bus"
4) "School Communication"
5) "Parental Involvement"
6) "Teacher Effectiveness"
7) "Teacher Communication"
8) "Board of Education"
9) "Superintendent and Central Office"
10) "Principal"
11) "Curriculum"
12) "Training"
13) "School Budget"

"A conceptual model of parent school satisfaction" which is presented in Figure 116. "The model indicates that parents evaluate their children's school on a number of variables including teachers, administrators, curriculum, technology, facilities, involvement, transportation, and budget" (Friedman, Bobrowski and Geraci, 2005). Teacher, classroom and school are the important dimensions for the satisfied or unsatisfied parents.

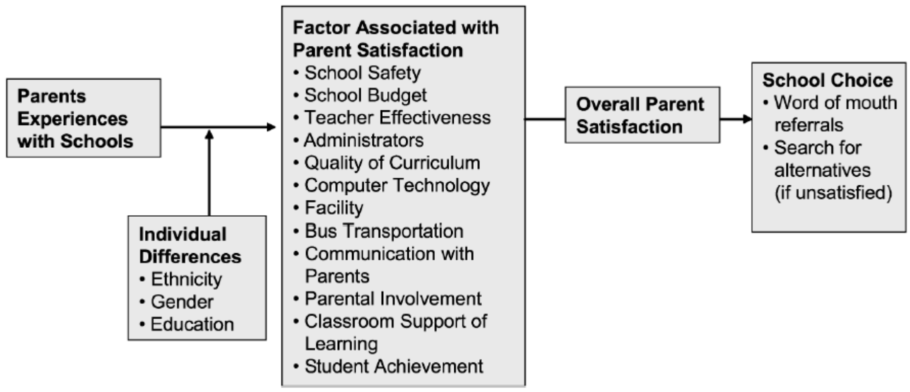


Figure 116 – "A conceptual model of parent school satisfaction" (Friedman, Bobrowski and Geraci, 2005).

Effective school practices and factors of parent satisfaction are classified into five primary areas (Tuk, 1995);

1) "Quality of Staff"
2) "School Climate"
3) "Academic Program"
4) "Social Development and Extracurricular Activities" and
5) "Parent Involvement"

"Parent satisfaction with their children's school is an important element in measuring school effectiveness and identifying opportunities for improvement" (Friedman, Bobrowski and Geraci, 2005). In the following, we will discuss the relationships of these school practices with parent satisfaction in the order of their importance.

4.2.2.1. Parent involvement and parent satisfaction

Among these five primary areas, parent involvement received the highest rating from the parents. Parents can be satisfied with schools' hospitality during their visits. Parents seemed the least satisfied with schools' willingness to accept their opinions and advice.

Parent-school communication and empowerment of parents affect the level of parent satisfaction.

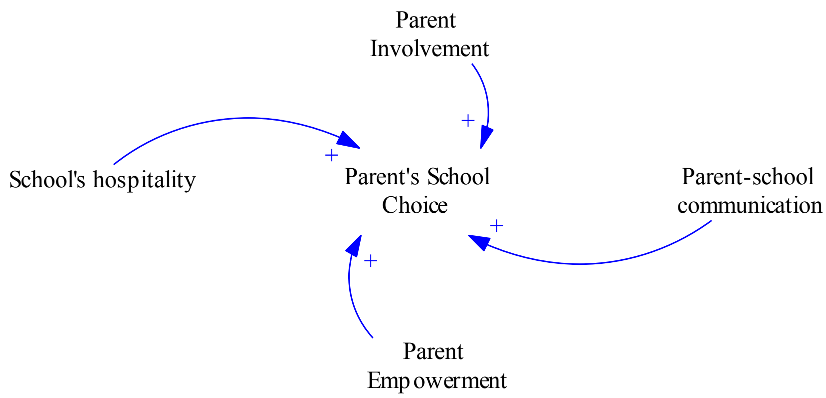


Figure 117 - The effect of parent involvement on parent's school choice decisions (drawn from Tuk, 1995).

4.2.2.2. Quality of school staff and parent satisfaction

The second highest rating was given to the quality of the school staff, where parents were particularly satisfied with the level of commitment shown by teachers and were least satisfied with principals' encouragement of teachers to try new ways of teaching (Tuk, 1995).

"The most effective schools are those with open climates, where principals and school staff are genuine and open in their interactions with parents, with students, and among themselves. Schools having teachers who develop open communication and collaborative working relationships with parents and who have more positive and understanding attitudes toward parents also have high levels of parental involvement and satisfaction" (Griffith, 1997).

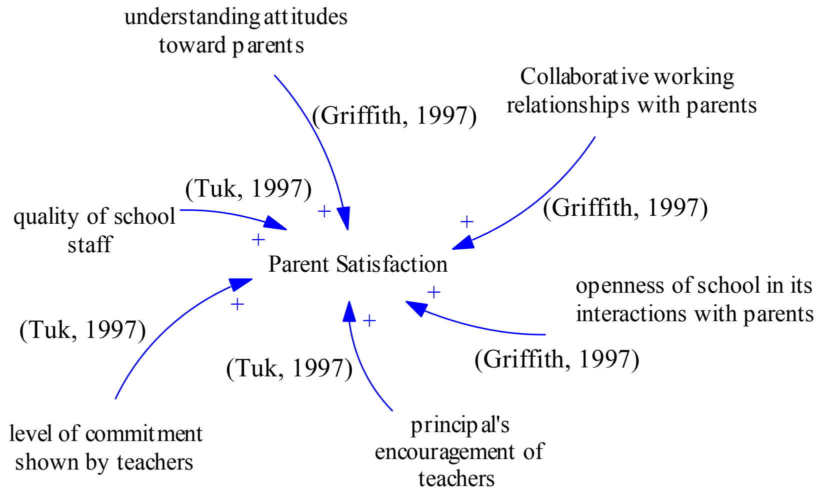


Figure 118 - The level of quality of school staff on parent satisfaction (drawn from Tuk, 1995; Griffith, 1997)

4.2.2.3. School climate and parent satisfaction

The third highest rating was given to the school climate, where parents seemed most satisfied with the maintenance of the school building and grounds and were less satisfied with the orderliness and safety of the schools (Tuk, 1995).

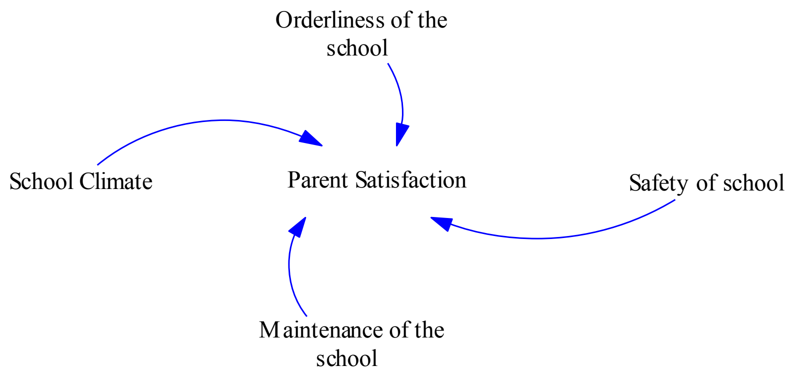


Figure 119 - The effect of school climate on parent satsfaction (drawn from Tuk, 1995).

School climate is also related with school's social environment. Actually, school climate is related with many dimensions that directly affect the parent satisfaction. "Researchers have speculated about the nature of school climate and its relation to the socio-demographic composition of the school student population, school structural characteristics, parental involvement, classroom support in learning, student and parental satisfaction, and student academic achievement" (Griffith, 1997).

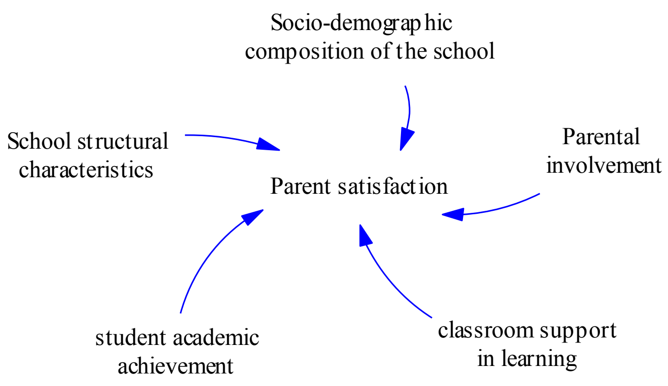


Figure 120 - The effect of school social environment on parent satisfaction (drawn from Griffith, 1997).

"Both parental and student satisfaction are affected by two levels of the school's social environment: (a) school level, and (b) classroom level. At the school level, previous concepts and measurements of school climate have included school-level assessments of parent-school interactions and a safe and ordered school environment. At the classroom level, previous assessments have posited the importance of teacher instructional support and expressive support in student learning and achievement" (Griffith, 1997).

In addition to school climate, "for parents, satisfaction was best predicted by characteristics of the school's general atmosphere that corresponded to the permeability of the school's boundary, specificly, the school's reception of parents (school climate), communication with parents (informed), and incorporation of parents into school activities and governance (empowered)" (Griffith, 1997).

"Parents' experiences of the school as they enter it, the school's output of information to parents regarding the academic progress of their child's education and the school's use of parents as resources through invitations to attend school activities can be considered as boundary characteristics of effective schools" (Griffith, 1997).

4.2.2.4. Social development and parent satisfaction

In the field of social development, which received the fourth highest rating, parents seemed most satisfied with the schools' emphasis on drug awareness and prevention education and were the "least satisfied with the development of their children's special interest and talents" (Tuk, 1995).

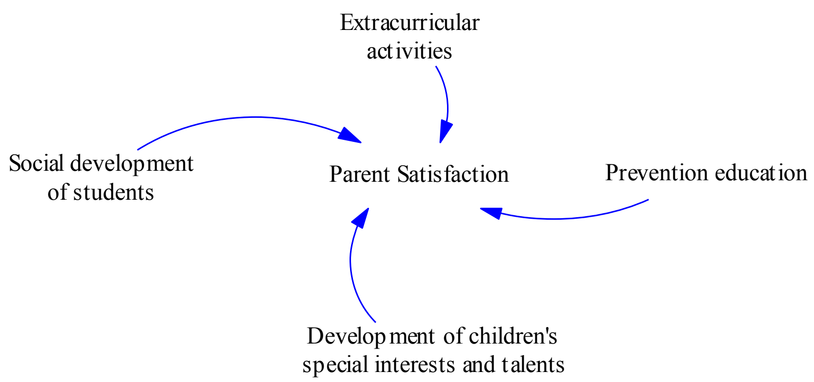


Figure 121 - The effect of social development of children on parent satisfaction (drawn from Tuk, 1995).

4.2.2.5. Academic program and parent satisfaction

The academic program in the literature was rated lowest by parents, although parents did feel that schools had gone a good job of teaching the basic skills and gave this practice one of the highest ratings on the total survey. Also, in the area of academic programs, as well as for the total survey, "parents gave their lowest ratings to students' training in the use of technology and to the helpfulness of guidance counselors" (Tuk, 1995).

However, social and environmental factors also enable some opportunities to the students and lead to parent satisfaction in addition to the academic quality of the school.

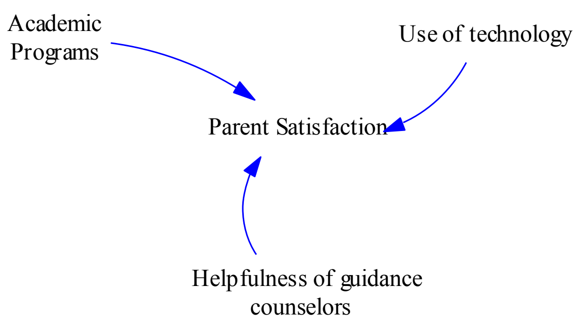


Figure 122 - The effect of academic programs on parent satisfaction (drawn from Tuk, 1995).

On the other hand, parental perceptions of student achievement and efficacy as well as school management, are essential to the success of local school initiatives. The single factor which made a difference in the overall ratings given by parents was the achievement level of their children; the higher the achievement level, the higher parents' ratings of the schools, consistently, across all achievement levels.

Finally, "school climate, school-parent communication, and empowerment of parents are best explained by the relationship of parent satisfaction to social environment. Safety has become an important parental concern because of recent highly publicized incidents of school violence. Student population, school structural characteristics, parental involvement, classroom support in learning, and achievement were examined as predictors of parent satisfaction" (Griffith, 1997).

"Parent satisfaction was best predicted by parental perceptions of a safe school and positive climate, followed by the school's informing parents of their child's educational progress and empowering parents" (Friedman, Bobrowski and Geraci, 2005).

4.2.2.6. Parent satisfaction by student and parent characteristics

"Socio-demographic characteristics of parents and students are individual-level attributes that parents and students bring to the school organization" (Griffith, 1997). Parent satisfaction with the school areas differed further according to characteristics of both students and parents. Parents' satisfaction in the areas of parent involvement, social development and academic programs also differed according to the ethnic group of students and differed further on parent involvement according to the age level of students.

With respect to parent characteristics, parents' levels of education divided them on their ratings for the academic programs and social development practices of the schools, while their household incomes further divided them on their ratings of the academic program and the quality of school staff. Moreover, "significant differences were not found in parents' level of satisfaction based on the gender of their children or the number of years their children had attended the school" (Tuk, 1995).

PART III –METHOD AND MODEL

5. METHODOLOGY

5.1. System Dynamics Modeling

5.1.1. Introduction to system dynamics

"Systems Dynamics was founded in the early 1960s by Jay W. Forrester of the MIT Sloan School of Management with the establishment of the MIT System Dynamics Group. It is a methodology for studying and managing complex feedback systems, such as one finds in business and other social systems like population, ecological and economic systems" (System Dynamics Society, 2009). "It has been used to address practically every sort of feedback system. It is for sure that the word system has been applied to all sort of situations, feedback is the differentiating descriptor here. The definition for feedback is given with an explanation: It refers to the situation of X affecting Y and Y in turn affecting X perhaps through a chain of causes and effects. One cannot study independently the link between X and Y and Y and X, and predict how the system will behave. Only way to do so is to study the whole system as a feedback system, which will lead to correct results" (Sterman, 2000).

5.1.2. Why system dynamics modeling for the research

The reason for choosing system dynamics is the need to model parent satisfaction in secondary and high schools, which is complex and highly dynamic.

System dynamics is suitable for this research because it emphasizes "the multi-loop multi-state, non-linear character of the systems in which we live" (Forrester, 1961, cited in Sterman, 2000). "The decisions of any one agent form but one of many feedback loops that operate in any given system. These loops react to the decision maker's actions in ways both anticipated and unanticipated; there may be positive as well as negative feedback loops, and these loops will contain many stocks (state variables) and many nonlinearities. Natural and human systems have high levels of dynamic complexity" (Sterman, 2000).

Double-loop learning by Argyris (1985, cited in Sterman, 2000), is shown in the Figure 123. "Here information feedback about the real world not only alters our decisions within the context of existing frames and decision rules but also feeds back to alter our mental models. As our mental models change we change the structure of our systems, creating different decision rules and new strategies. The same information, processed and interpreted by a different decision rule, now yields a different decision. Altering the systems thinking is a double-loop learning process in which we replace a reductionist, narrow, short-run, static view of the world with a holistic, broad, long-term dynamic view and then redesign our policies and institutions accordingly" (Sterman, 2000).

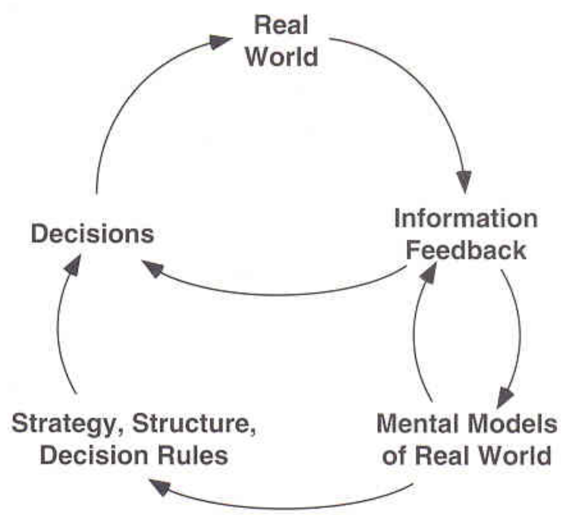


Figure 123 - Double-loop learning. (Argyris 1985, cited in Sterman, 2000)

5.1.3. Characteristics of system dynamics models

What makes system dynamics different from other system theories is the use of feedback loops describing the complex relationships between the parameters. "Stocks and flows help describe how a system is connected by feedback loops that create the nonlinearity found so frequently in modern day problems" (Stearman, 2000).

The methodology of system dynamics is as follows:

1. Identify the problem.
2. Develop a dynamic hypothesis explaining the cause of the problem.
3. Build a computer simulation model of the system at the root of the problem.
4. Test the model to be certain that it reproduces the behavior seen in the real world.
5. Devise and test in the model alternative policies that alleviate the problem.
6. Implement this solution.

5.1.4. Principles for successful use of system dynamics

Stearman (2000) emphasized "a number of principles for effective development and implementation of system dynamics models".

1. “Develop a model to solve a particular problem, not to model the system”
2. “Modeling should be integrated into a project from the beginning”
3. “Be skeptical about the value of modeling and force the ‘why do we need it’ discussion at the start of the project”
4. “System dynamics does not stand alone. Use other tools and methods as appropriate”
5. “Focus on implementation from the start of the project”
6. “Modeling works best as an iterative process of joint inquiry between client and consultant”
7. “Avoid black box modeling”
8. “Validation is a continuous process of testing and building confidence in the model”
9. “Get a preliminary model working as soon as possible. Add detail only as necessary”
10. “A broad model boundary is more important than a great deal of detail”
11. “Use expert modelers, not voices”
12. “Implementation does not end with a single project”

5.1.5. Benefits of a system dynamics model

“System dynamics is a set of techniques for thinking and computer modeling that helps its practitioners begin to understand complex systems—systems such as the human body or the national economy or the earth's climate” (Meadows, Meadows and Randers, 1992).

“Systems tools help us keep track of multiple interconnections; they help us see things whole. Because much of conventional wisdom comes from seeing things in parts and focusing on one small part at a time, system dynamicists tend to have surprising points of view. They generate a lot of controversy. System dynamics consists of four components: system, feedback, level, and rate. A system is a set of elements sharing a particular purpose within a boundary. Depending on its boundary, a system can be a corporation, an environment, an economic entity, a country, an inventory system, etc” (Stearman, 2000).

“Comparison of system dynamics with other methods as a research method, the system dynamics approach can be compared to Management Science. However, the research on system dynamics starts with a different assumption from the traditional assumptions of Management Science” (Richardson, 1986):

1. “Developing models based on numerical figures”.
2. “Analyzing most problems by linear relationship”.
3. “Reflecting a limited number of variables that are influenced by results in a static condition”.
4. “Accuracy of model parameters is more important than the overall problem structure”.
5. “Pursuing optimal support decision-making”.

According to the online documents available at Massachusetts Institute of Technology “as system dynamics attempts to understand the basic structure of a system, and thus understand the behavior it can produce, computers are used to simulate such models. Running ‘what if’ simulations to test certain policies on such a model can greatly aid in understanding how the system changes over time” (MIT System Dynamics Group, 2009).

5.1.6. Tools of system dynamics

Feedback is the heart of the system dynamics modeling. Feedbacks determine the behaviour of a system. Causal-loop diagrams and stock-flow diagrams can be given as some examples to describe a system dynamic model.

5.1.6.1. Causal loop diagrams

“The causal relationship indicates one element affecting another element. In order to model the causality, a causal-loop diagram has been used. Causal-loop diagram has been used to formulate a cognitive model and to hypothesize the dynamic interactions between elements. Representing the feedback of related elements requires additional positive (+) and negative (-) polarity to the causal-loop diagram. The dynamic movement of the system can be caused by a feedback loop, and there are two types of feedback: reinforcing (R) and balancing (B)” (Stearman, 2000).

As illustrated in the Figure 124, “increase in population increases the numbers of birth, which again increases the overall population, that’s reinforcing loop. To the contrary, the greater the population, the higher the number of deaths, and then the population decrease, that’s balancing loop” (Stearman, 2000).

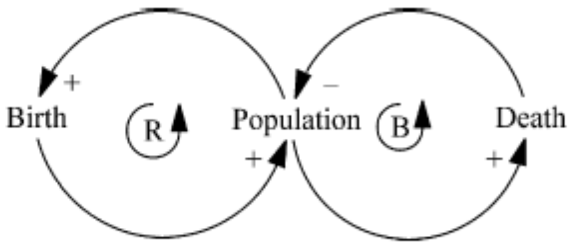


Figure 124 - A sample diagram of causal relationship

"Whilst the simplicity of causal-loop diagram has improved communication and comprehensiveness among its users, it does not reflect all elements for sensitivity testing a target system. There are two variables required for simulating all elements inside a system: level and rate. The 'level' refers to a given element within a specific time interval. Meanwhile, the 'rate' reflects the extent of behavior of a system. Specifically, the differences between the level and the rate depend on whether the element contains a time factor" (Stearman, 2000).

5.1.6.2. Stocks and flows

"The level and the rate can be formulated using the stock-flow diagram for a simulation test. The level can be represented with a stock level; the rate is described as a variable on the flow. Stock is represented as a rectangle while flow can be expressed as a double-direction arrow. In the example shown in the Figure 125, the variable entitled 'population', is only depicted as the stock, whilst both 'birth' and 'death' are presented as the flow" (Stearman, 2000). Additional variables for the simulation are also added to stock-flow diagram. Here, "the birth increases the population, and it also proportionally increases the death. This will lead to the decrease in population, which in turn, decreases birth. Consequently, a non-liner relationship exists among variables, and then the population cannot be calculated through linear equations" (Stearman, 2000).

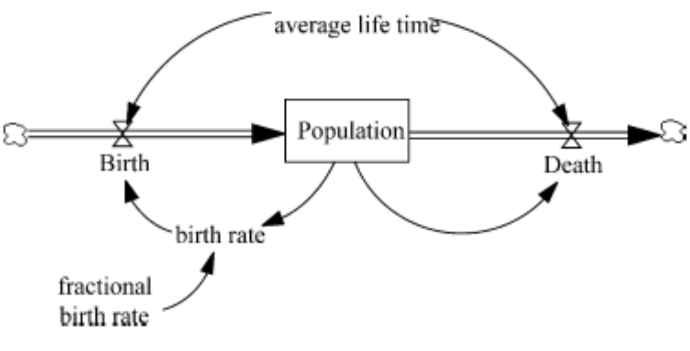


Figure 125 - A sample stock-flow diagram

5.2. Group-Model Building

"Over the last four decades, more and more people have started to use system dynamics, and more and more practitioners and consultants have started to involve clients in system dynamics model building projects" (Rouwette, Vennix and Mullekom, 2002). "Model building or model refinement working directly with a small group of clients has become increasingly common in the field of system dynamics. Many consultants have refined the practice of developing causal loop sketches with direct involvement of client groups to include preliminary model development, refinement, and presentation" (Andersen and Richardson, 1997). "Group model-building here refers to a system dynamics model-building process in which a client group is deeply involved in the process of model construction" (Vennix, 1999).

Sometimes, many managerial or organizational situations are difficult to manage them properly. At that point, group model building projects generate more insights into what is done in the field and therefore help to construct system dynamics modeling effectively.

Lane (1992) has mentioned three reasons why system dynamicists are also interested in model-building process. "First, to capture the required knowledge in the mental models of the client group; Second, to increase the chances of implementation of model results and, finally, to enhance the client's learning process. It is actually modeling for learning as an alternative consultancy methodology for system dynamicists" (Lane 1992).

Bounded rationality is a problem for human beings when they want to understand a complex system. Human beings do not have all the necessary information to process it. On the other hand, system dynamics tools and group model building activities make it easy for human beings by enabling the depth understanding of the system from all the perspectives. Differente types of interpretations are taken into consideration to understand the structure of a system.

Vennix (1999) emphasizes group model building and system dynamics as "making client's mental models explicit and put their problem definitions to the test, by surfacing implicit (causal) assumptions. Group model building practices create the possibility of assimilating and integrating partial mental models into a holistic system description, making participants overcome their local, departmental views. Departmental bias may jeopardise organised action and may even lead to the demise of the organization". Therefore, group members should be aware of the reality of multiple realities. By the help of group-model building, group members have a change to make brainstorming and they involve in all decision-making processes. They benefit from other's cognitive interpretations.

Elicitation, open communication, involvement, critical investigation, reflection, evaluation, consensus and commitment are the important issues to enhance the effectiveness of group-model building. I benefits from inteviews, cognitive mapping and special group process techniques such as brainstorming, Nominal Group Technique, Delphi, Devil's Advocate and Dialectical Inquiry can enable to discuss the structures deeply.

5.3. Applicability of SD to the problem

"The world certainly needs system dynamics now more than ever. It is certainly true that our social systems are more complicated, more interconnected and likely more fragile than at any previous point in the history of humankind. Worse, while we are ever more in need of a fundamentally holistic, systems-oriented perspective, there is good reason to believe that the theories and ideologies dominating social discourse are becoming more shortsighted and individualistic" (Repenning, 2003).

In addition to empirical and quantititave data, the reasons for student academic achievement and parent satisfaction were analyzed also from system dynamics perspective to explain the causalities in a loop rather than only a linear relationship. Reality in a social system can be causally prior to theories and linear relations. Linear relations explain one direction.

Whereas, "the social sciences are in desperate need of an alternative to the growing swell of theories, relations and notions that focus on individual self-interest with little regard for the larger system in which those actions are embedded. However, growing literatures on decision-making, group dynamics, technology implementation, and organizational pathologies all highlight the non-rational elements of social life" (Repenning, 2003).

Throughout the literature, a lot of discussions have been about the reasons behind student academic achievement. General tendency is actually to focus on only one dimension and neglect the other endogenous and exogenous variables. To establish a linear relation between the variables is the most preferable way to study in educational literature. Whereas, educational process is a complex system in terms of not only its inputs but also its outcomes. For inputs, there are more and interactive variables that affect the academic achievement. For outputs, you cannot measure properly the result since the outcomes can be reached in time.

To analyze such a complex system needs nonlinear view by examining all the feedback systems at the same time. At this point, “System Dynamics Modeling is one of the most powerful tools for forecasting in complex structures" (Soydan and Öner, 2012).

System thinking is the tool “to see the world as a complex system in which we understand that you can’t do just one thing and that everything is connected to everything else” (Stearman, 2001).

The challenge facing us all is how to formulate the student’s academic achievement as a result of a certain educational process. Because the system has a dynamic complexity and as a result of interactions of the dimension, the complex educational sysem shows often counterintuitive behaviour. So, “SD helps the modeler understand the underlying structure of the problem by dealing with causalities and nonlinearities. Nonlinearity is often neglected in most of the static analysis” (Forrester, 1961).

SD model is fundamentally interdisciplinary and the more suitable model to understand the complex feedback systems like educational process in secondary and high school. The actual problem is to investigate the nonlinearities between the school choice process, parent’s educational expectations, academic achievement, parent satisfaction, student, teacher, school and parent dimensions. The interchange between the sectors create the dynamic complexity.

Therefore we need to necessary feedback causality loops at the same stage. Because only way to study the whole complex system is to focus on feedback loops with mutual or recursive causality.

5.4. Problem Definition, Scope, Time Horizon, and Purpose

Student’s Academic Achievement is an important output for education system. But, to evaluate the causes behind that achievement has always been more conflicting process for educationalists. The duration for the education is longer and the parameters are dynamic. Therefore, researchers using classical static analysis methods may not analyze properly the reasons that enhance learning and achievement during the educational process. Student together with his environment must be taken into consideration. As a general tendency, student is at the heart of this process.

But according to literature, when controlling student factors, researchers have found the effects of environmental factors on achievement. Hence, environmental factors cannot be neglected in a social system. Peer, parent, teacher, school and their mutual interactions create directions and motivation for the students to attain academic achievement. Sometimes their level may be different and some other times the direction of the relation can create enormous affect on the student achievement. By focusing on a certain school system, you can easily make regression between the parameters.

The general framework of the research includes the relationships between the parent, student, teacher and school dimensions and how school choice process, educational expectations, level of satisfaction affect this system. At the beginning, parents and students choose a school to satisfy their expectations. At the end of the educational process, students and parents will want to be highly satisfied and reach at the maximum academic achievement. Academic, cultural, social and moral growth within the school would be the most preferable result for parent satisfaction.

The correlations between parameters have been taken from the literature and a game design between the parameters has been implemented using system dynamics modeling. The Pearson correlations of the literature findings are also given in the Appendix part. No real data have been used in the model. The greatness of the parameters are converted between 0 and 1 scale since their actual values does not affect on how system works. The behaviour of each parameter (increases, decreases or remain the same) has been searched after simulation has been carried out. At the end, reasoning has been made between the parameters.

The purpose of the model is to find a sustainable academic achievement by making suitable combination of the parameters. To have effective model, system must be thought in terms of internal and external variables together. The model boundary chart is shown in the Figure 126.

So, the model mainly includes the following dimensions;

1) Student Dimension
2) Teacher Dimension
3) Parent Dimension
4) School Dimension

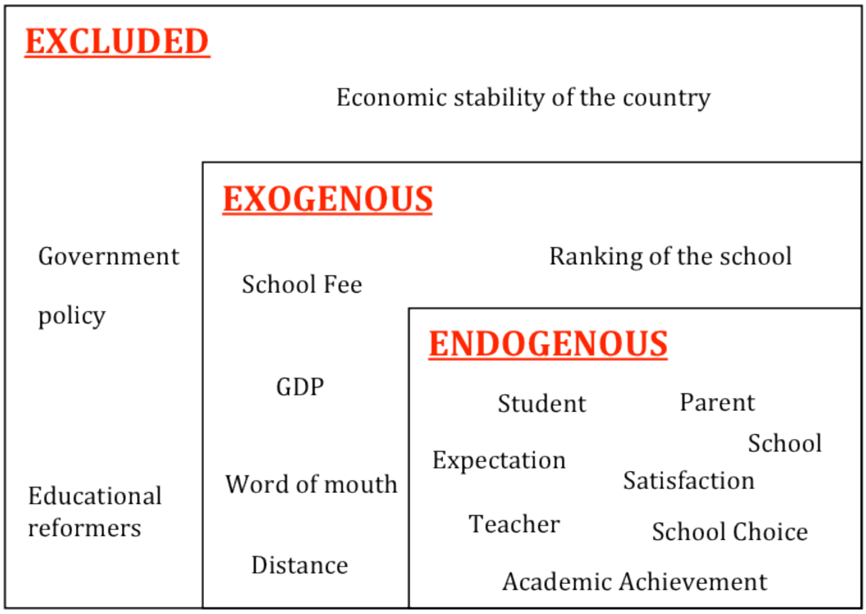


Figure 126 - Model Boundary Chart

These sectors are the main variables to model the educational process. The model boundary chart is useful to see the exogeneous, endogeneous and excluded parameters fort he model in order to decide the scope of the model. The relations between these sectors from an upper view to understand the model structure is given in Figure 127.

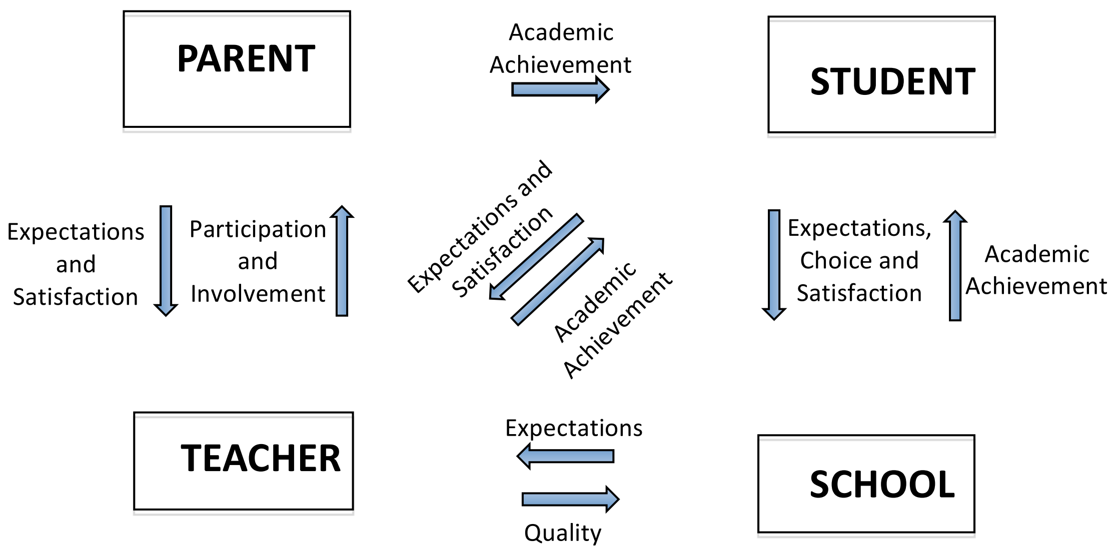


Figure 127 - Bird-eye view of the model combining the dimensions.

The main aim of the model is to analyze the dynamics of the educational system through the interconnection of the parameters and sectors at private secondary schools. By analyzing and specifying the system, we are aimed at showing the reasons behind student academic achievement and parent satisfaction and to structure the system from the rules of interactions. To understand the educational outcomes is a longer process and the system cannot get necessary and immediate feedback from the output or process. It is believed that, the lack of clear understandings between all variables and sector, educational policy makers or administrative staff can not make more precise comments about the educational outcomes.

One way to understand the educational system is to analyze each sector and its variables from system dynamics modeling. Student plays a key role in his or her academic achievement. However, physical and social environmental factors also contribute to his or her academic achievement. Teacher, parent and school itself are the sectors of the education process. At the end of the process, student academic achievement and parent satisfaction are evaluated. One cannot get quick feedback from a certain education system due to its complexity and more dynamic structure. Hence, time delays should be taught carefully at the same time.

To check each step for the formulation of model, MIT Road Maps System Principles (Appendix I) and System Dynamics Model Correctness Checklist (Appendix J) are used to make sure that each step is drawn properly. These are actually some reminders and checklist items for helping the reserchers. They also indicate some tips for model developers.

6. CONCEPTUAL MODEL – CAUSAL LOOP DIAGRAMS

6.1. Conceptual Model of the Research

According to the literature, variables related with the student achievement and parent satisfaction is given in the Figure 128. The model emphasizes the educational system from parent's school choice process to educational outcomes. Variables and sectors are analyzed from the Parent Satisfaction and Student Academic Achievement perspectives. In the following paragraphs the literature that forms the basis for this model is explained. Detailed causal loop diagrams for each sector (student, parent, teacher and school) will be drawn based on this model.

Before starting a secondary school, parents are in dilemma about choosing the most appropritate school in order to gain necessary educational gains at the end of the educational process. Higher parent expectations, parent demographic characeristics, children's prior academic achievement, school physical and social caharacteristics, safety, convenience, disiplin and word of mouth influence the parent's school choice decisions.

When parents pick up a suitable school for their kids, educational process starts and the level of parent satisfaction becomes important because parents have some expectations before choosing a school. Every parent wants to be satisfied with schools. There is a direct relationship between parent expectations and satisfaction with the school.

"Parents with higher educational attainment tend to place emphasis on the importance of education, and they are more likely to seek out information on the varieties of educational choices" (Goldring and Phillips, 2008).

Not only parent satisfaction but also student academic achievement depends on the complex relations between the parameters in the school system. To decide these educational gains, the educationsl system is divided into four sectors as student, teacher, parent and school. The variables under each sector are directly related effects on student academic achievement and parent satisfaction. In Figure 128, these variables are given separately.

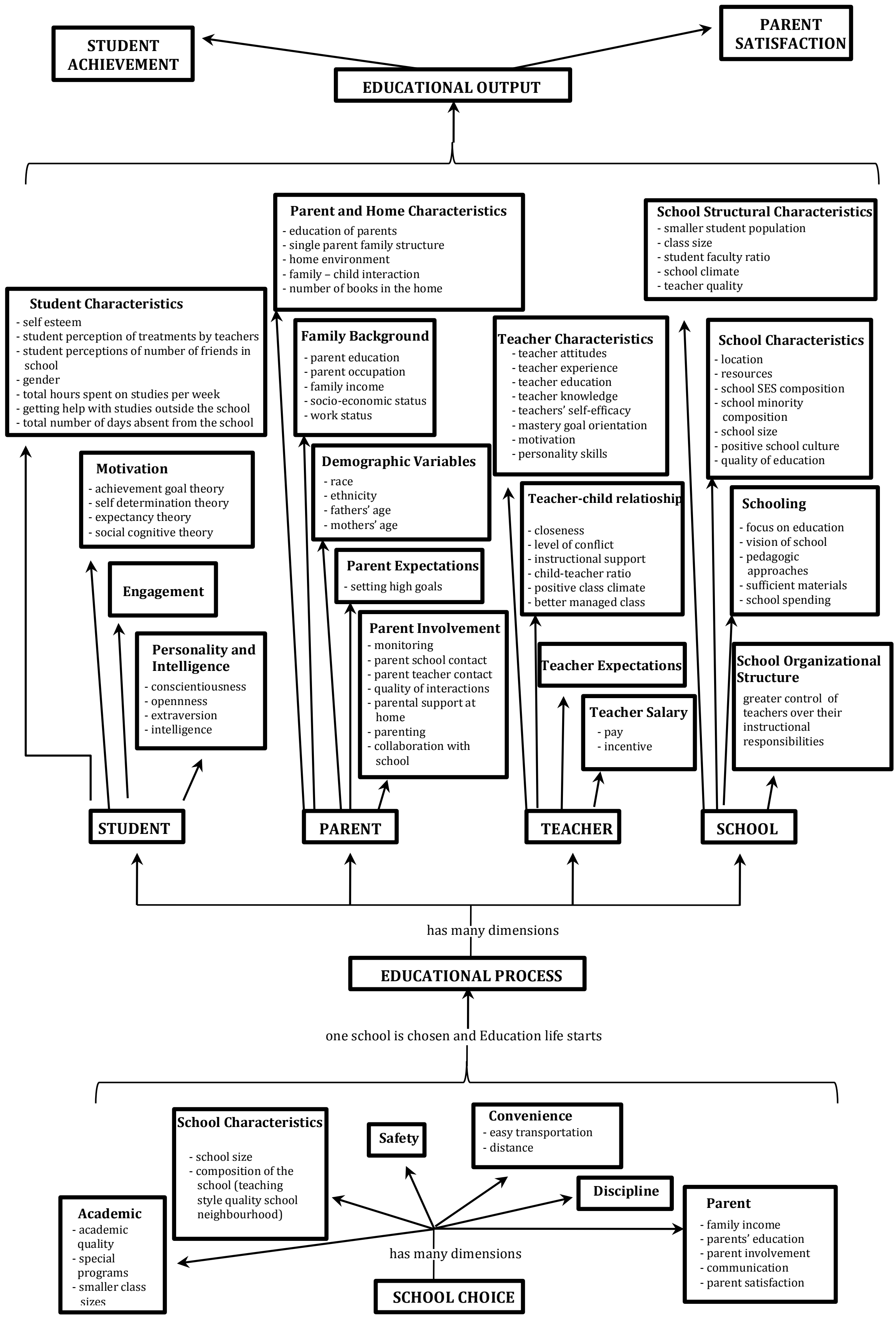


Figure 128 - Relationship between the variables in an education system

6.2. Tentative causal loop diagrams of the research

Tentative causal loop diagrams give the general structure for each sector based on feedback loops. The interpretation of these loops can be recognized easily. Loops are divided into two groups as reinforcing and balancing. The group denoted by ‘R’ is called reinforcing and the group denoted by ‘B’ is called balancing.

There are four sectors as student, teacher, parent and school, containing the major variables of the tentative model.

6.2.1. Tentative causal loop diagram for student dimension

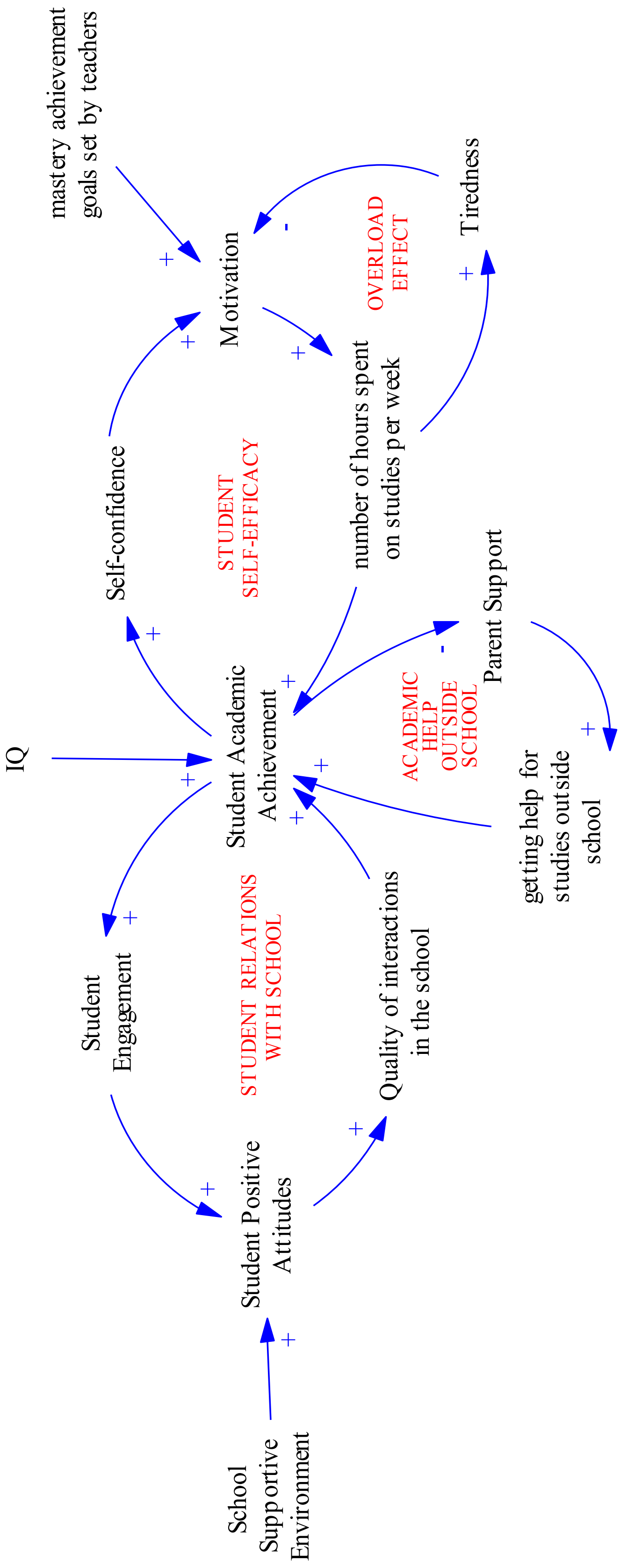


Figure 129 - Tentative causal loop diagram for student dimension

Even though student, teacher, parent and school sectors have a great effect on student academic achievement, student itself is a key player that will show the effectiveness of these sectors on student academic achievement. Student and his learning environment must be thought together to interpret the reasons behind academic achievement. In this part, we'll focus only variables regarding with student itself.

Taken as whole, the student sector is composed of following causal loops;

1. Student Relations with school
2. Student Self-efficacy
3. Overload Effect
4. Academic Help outside school

6.2.1.1. Student's relations with school

There is no doubt that, intelligence is a strong predictor of student academic achievement. If a student has a higher level of **IQ**, the effect of other contextual variables will be less on student academic achievement. However, all children develop a belief about their own IQ level. Some students start thinking of their IQ as something fixed in the brain. Some other students think IQ is something you can develop in suitable learning environments. These students can enhance their IQ capability. Hence, the student's perception about their IQ is more important as well as IQ itself to analyze the reasons behind student academic achievement.

When students become high achievers in schools, they are engaged in educational process. They feel self-confidence and they believe that the success can be reached at the end of a certain period. Success is inevitable outcome if they persist on study. **Student engagement** creates positive emotions among students and they show **positive attitudes** towards school, teacher or academic programs. On the other hand, student behavior is also affected from external environment situations.

School supportive environment affects the behavior of students. When students show positive attitudes in learning environment, they establish quality relationships in the school. The **quality of interactions in the school** supports the **student academic achievement**. The Quality of interactions between teacher and student is an important tool to increase student academic achievement. If student can establish healthy relations with his teacher, probably he or she will show more positive attitudes in learning process.

The quality of relations shows how much students are engaged and involved in educational process. At that point, student's own beliefs about his capacity and environmental support are important to establish such a quality relations in the learning environment.

6.2.1.2. Student self-efficacy

Self-confidence is an important emotion that helps an individual to set up a goal in his life. If someone does not believe himself to be succeeded when they focus on a work, probably, he could not find a necessary motivation at the beginning to start. Self-confidence is gained if students feel a sense of achievement. **Student academic achievement** is therefore is important contributor to emerge **self-confidence**.

Self-confidence motivates the students to work hard. **Motivation** influences how a student chooses to invest his time, how much energy he exerts on a specific task, how he thinks and feels about a task and how long he persists at the task.

So, motivated students increases **the number of hours spent on studies per week**. To study more is an important predictor of academic success. This process makes students have high self-efficacy beliefs. High self-efficact beliefs prevents an emotion of anxity and generates positive emotions that help students to succeed academically.

Self-efficacy is a motivation related factor. Self-efficacy and goal orientation as motivational constructs have an impact on student academic achievement. Students who believe that they can successfully complete a task tend to perform better as compared to those who lack suck a belief.

Therefore, self-efficacy is an important instrument that creates mastery goals, motivation and finally academic achievement. These beliefs are formed in the learning environments. Therefore, it is essential to examine how students' goals and beliefs are formed and maintained in the school learning environment.

6.2.1.3. Overload effect

To **study more hours** can result in **tiredness** among students. This tiredness can affect the **motivation** of students in negative manner. As described above, motivation makes students spent more time on studies.

6.2.1.4. Academic help outside school

Parent Support at home is an important parental initiative that helps children to succeed in the school. Especially better-educated parents want to involve in educational process at home to enhance student's academic achievement. However, sometimes, good GPA makes parents satisfied with the result and can show less support at home. High achievers can be deprived of such a parent support at home.

Parents who are show high involvement, can enable **help for studies outside school**. Parental support and involvement contributes to academic achievement. Parents can monitor their children at home and supply extra help for them. They can help their homework, supply an extra teacher at home, buy necessary educational documents and books to boost their academic achievement.

On the other hand, when students are succeeded, parents can diminish the level of help since the result is acceptable for the family. When students get academic help outside school, their **academic achievement** increases.

6.2.2. Tentative causal loop diagram for teacher dimension

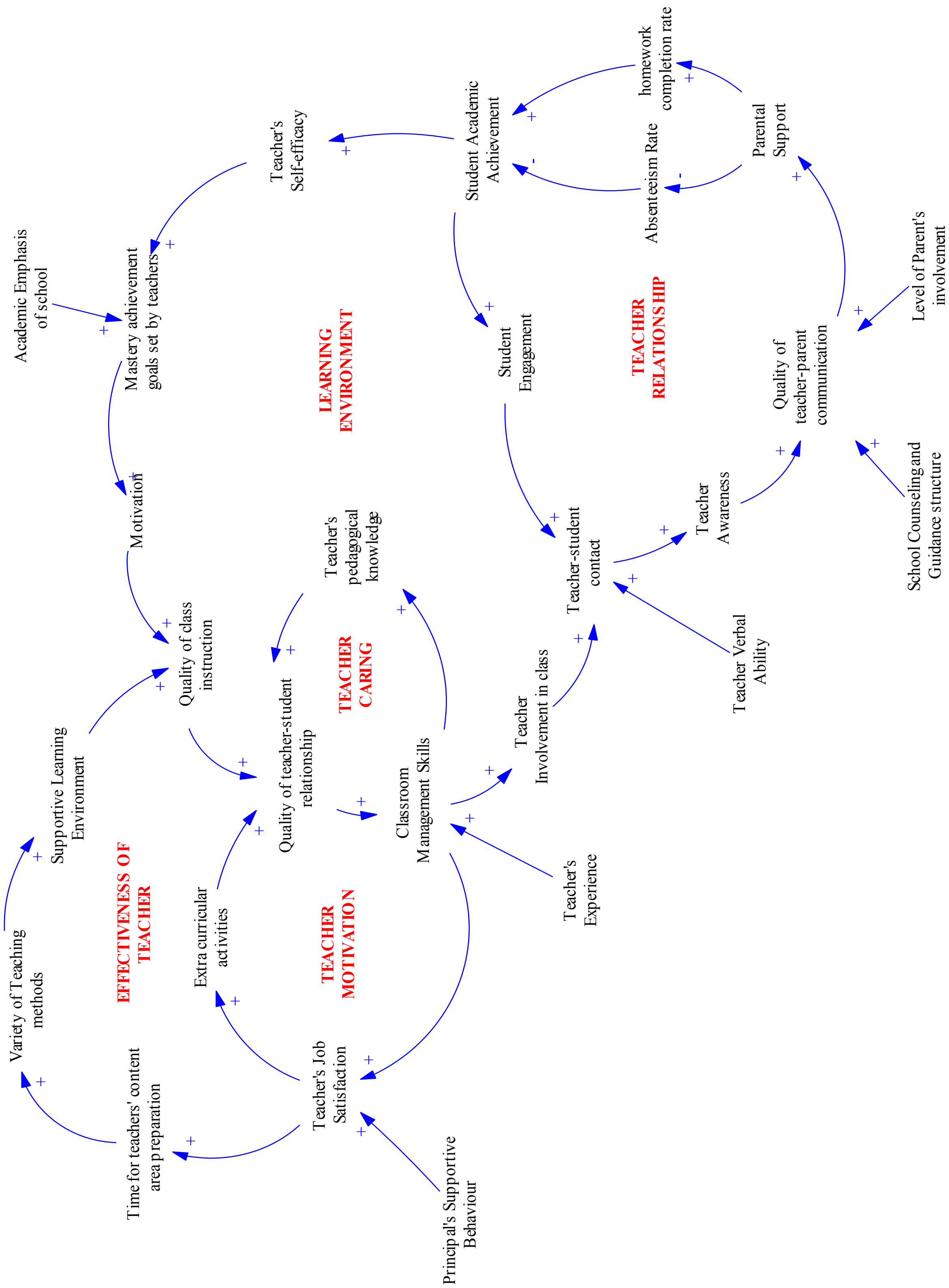


Figure 130 - Tentative causal loop diagram for teacher dimension.

Today, a major educational debate concerns how to recruit, select and train teachers to increase teacher quality in the schools. Many educators, policymakers, and school principals are seeking for the better teacher practices and how these practices are generalized within the school context. Teachers are the key variable to maintain excellent instructional programs that increase student academic achievement and parent satisfaction. Teachers do make a significant difference in student academic achievement.

Teachers are the important school variable that influences the educational outcomes. Teachers play a crucial role about the skill and the positive attitude of students in school. They play a crucial role for student's growth and prepare them for their future life. They are also role models for students. Therefore, they can contribute directly to student academic achievement and satisfaction about the school and hence parent satisfaction.

Taken as whole, the teacher sector is composed of following causal loops;

1. Teacher Relationship
2. Learning Environment
3. Teacher Caring
4. Teacher Motivation
5. Effectiveness of Teacher

6.2.2.1. Teacher relationship

Once a teacher develops a **contact with students**, he easily realizes the social and academic needs of students. The **awareness** of student's needs changes the behavior of teachers in a positive manner. By mastering all the needs of students, teachers can make their parent meeting effectively and deliver meaningful information to parents. The valuable information linkage between teachers and parents increases the **quality of teacher-parent communication** and gives feedback to parents how to start a course of action to increase academic achievement.

Parent is the important main factor that can increase student effort at home. By this fact, teachers choose a quality relationship with parents to control student's effort at home. Educationalists believe that teacher, student and parent actually form a communication triangle that boosts the social and academic gains of students. The needs of students stimulate teachers to communicate effectively with parents. This increases the quality of teacher-parent contact. Teachers prefer e-mail, phone calls or face to face talking to inform parents.

Apart from teacher initiatives, other school and family structures like **school policies about guidance and counseling** and **level of parent's involvement** also increase **quality of teacher-parent communication**. School encourages the teachers to communicate effectively with parents and parents have some academic expectations from their children and talk frequently with teachers to understand how the school meets those expectations.

The **quality of teacher-parent communication** increases the **parental support** since it increases parent awareness about children's academic results and situations in school. Parents encourage the students to study hard at home by giving advice, monitoring their behavior, creating discipline atmosphere at home and helping directly to their studies. Parental support increases the **homework completion rate** for students.

However, parents send their kids to school on time and monitor **rate of absenteeism**. To follow all the courses and to complete all the assignments increase the student academic achievement.

The academic success of students makes them happy and they develop a sense of 'can do' attitude. Student academic achievement is critical to promote **student engagement** with school and learning. Previous achievement is the main motivator for students to engage in other learning activities. They gain self-confidence and they have more desire to actively participate in next educational activities in school. Active participation requires for a close relationship with their teachers.

Student engagement increases the rate of **teacher-student contact**. Moreover, there is no doubt that, **teacher's verbal skills** and abilities make them more comfortable about the communication with students and increase also the rate of teacher-student contact.

6.2.2.2. Learning environment

Teachers' self-efficacy beliefs are affected by student academic achievement. Teacher's self-efficacy is defined as "the extent to which teacher believes he or she has the capacity to affect student performance" (Caprara et al., 2006). If teachers have high level of self-efficacy beliefs, they will more likely help students to actively engage in learning process. Teachers with high self-efficacy may affect a student's academic achievement in several ways. Use of classroom management approaches, adequate teaching methods, encouraging students, taking responsibility for students with special learning needs, to manage classroom problems, keep students on task, to effectively handle various tasks, fostering student involvement in class activities are the main behaviors of teachers who have high self-efficacy beliefs.

Teacher self-efficacy beliefs make them set **mastery achievement goals** for students in the class. This provides a positive classroom environment in the class and motivates them. Mastery achievement goals for students are the important factors in preventing the decline in performance and motivation. Probably, mastery achievement goals promote student academic achievement and social behavior for desired learning outcomes in the class context.

On the other hand, school policy can also enforce setting mastery achievement goals in classroom. **Academic emphasis of school** changes the behavior and attitude of teachers in the class environment. “Academic emphasis is the degree to which a school is driven for academic excellence, high achievable goals are stressed, the learning environment is serious and teachers believe in the ability of all students to succeed” (Hoy, 2012). So, the school system and principal affect classroom performance-goal structure. Academic emphasis of school has a positive relation with student academic achievement.

Setting mastery goals by teachers increases the **student and teacher motivation**. Students and teacher know where they are going. Specific, measurable, attainable, realistics and time specific mastery goals increase the motivation.

To set up higher academic objectives in the learning environment regulates teacher’s behavior and teaching tactics in the class. Teachers beliefs and academic expectations play a important role to create a **quality of class instruction**. Teachers design the learning environment effectively in order to help students for attaining higher achievement goals. Higher motivated students also encourage teachers to create a positive learning environment.

High quality of class instruction requires students’ active participation in learning process. Teachers design the learning environment and they are only facilitator to arouse student’s curiosity and engage them in the process. Teacher’s role is more that of a facilitator. There is no doubt that, quality of class instruction requires a **quality of teacher-student relationship**.

Frequent instructional dialogue between teachers and students makes their communication more qualified. Teachers should establish quality relationships with students in order to encourage students to involve in learning process all the time. Teachers who have a high self-efficacy and higher expactations do not prefer only didactic teaching style in the class.

The quality relationship between teacher and students decreases the discipline problems and creates more positive learning climate in the class. The quality of teacher-student relationship also increases the **classroom management skills** of teachers. Teachers who manage the class effectively tend to focus on individual needs of each student. This also enables a high quality of interactions between teacher and student. Moreover, teachers become more effective and well prepared in well-managed classrooms. Students realize the potential of teachers and they perceive them productive.

The effective classroom management also encourages **teacher involvement** in educational process. Active participation increases the number of contact between teachers and students. Teachers are more productive in the class when they establish good relationships with all the students in the class. Sometimes, teachers can have some problems in the class. If they cannot solve the problem immediately, this will affect their attitudes in the class and therefore student academic achievement. Teacher involvement is the important part of **teacher-student contact**.

6.2.2.3. Teacher caring

Teacher experience is important variable that affects the **classroom management skills** of teachers. Actually, experience means learning within the time. Teachers learn how to behave in the class environment both to stimulate student’s curiosity about learning and to solve their social and individual problems in the class. Experienced teachers know how to behave in the class. They have higher level of pedagogical knowledge. Although there is no strong relationship between teacher’s pedagogical knowledge and student academic achievement, **pedagogical knowledge** helps teacher to establish **quality relationships with students**. When the teachers use their pedagogical knowledge more actively in the class, they face with less management problems in the class since they establish a quality relationship with students.

6.2.2.4. Teacher motivation

Highly effective teachers in the class environment have higher level of **job satisfaction**. Since they believe the value of their job, they show higher level of satisfaction. However, school structure and leadership style also affect teacher's job satisfaction. Principal's supportive behaviour also increases the job satisfaction and commitment of teachers.

Satisfied teachers have higher motivation. Teacher Motivation is the important prerequisite to create an effective learning environment. When the students show good academic results and teachers can establish better relationship with students, teachers are satisfied with their job. Satisfied teachers try to produce more educational activities for the student's social and academic gains.

Highly motivated teachers also spend more time to design some **extra curricular activities** in the school to attract students' curiosty. Extra curricular activities take extra time for teachers. When teachers do not believe their students to gain the desired learning objectives, they probaby will not produce extra learning opportunities.

Extra curricular activities are sometimes neglected by teachers since they focus mainly on class activities. Teachers who have higher job satisfaction allocate time to design their educational curriculum not only at knowledge and comprehension level but also at application or more higher levels. They give more importance to use classroom information for solving real life problems.

Theoretical ideas are converted to practical situations and also connections between the concepts are important for them. Learning environment is not limited within the class and satisfied teachers are more willingly ready to plan extra curricular activities in the curriculum. So, this helps to increase the **quality of teacher-student relationship**.

6.2.2.5. Effectiveness of teacher

Highly satisfied teachers spend more time for their **content-area preparation**. They want to offer more exercises, real-life situations, teaching tactics and ways in the class to effectively teach in the class. This requires more preparation for teachers. Teachers who show more commitment to their job feel a necessity of such a preparation. There is no doubt that, such a preparation work makes teachers more knowledgeable about the various teaching tactics.

The use of **variety of teaching methods** creates a positive and supportive learning environment for students. Actually, traditional didactic teaching methods do not require an extensive preparation work for a good teacher. But a good teacher needs to explore the ways of how students are stimulated to learn in the class environment. This is the integral part of teaching process. Preparation work is configured according to the needs of students. To satisfy the needs of each student is the main objective of teachers who wants to be effective in the learning environment.

Various teaching methods create a **supportive learning environment**. They listen to students, understand their abilities, skills and knowledge and teach them accordingly. It helps the **quality of class instruction**.

6.2.3. Tentative causal loop diagram for parent dimension

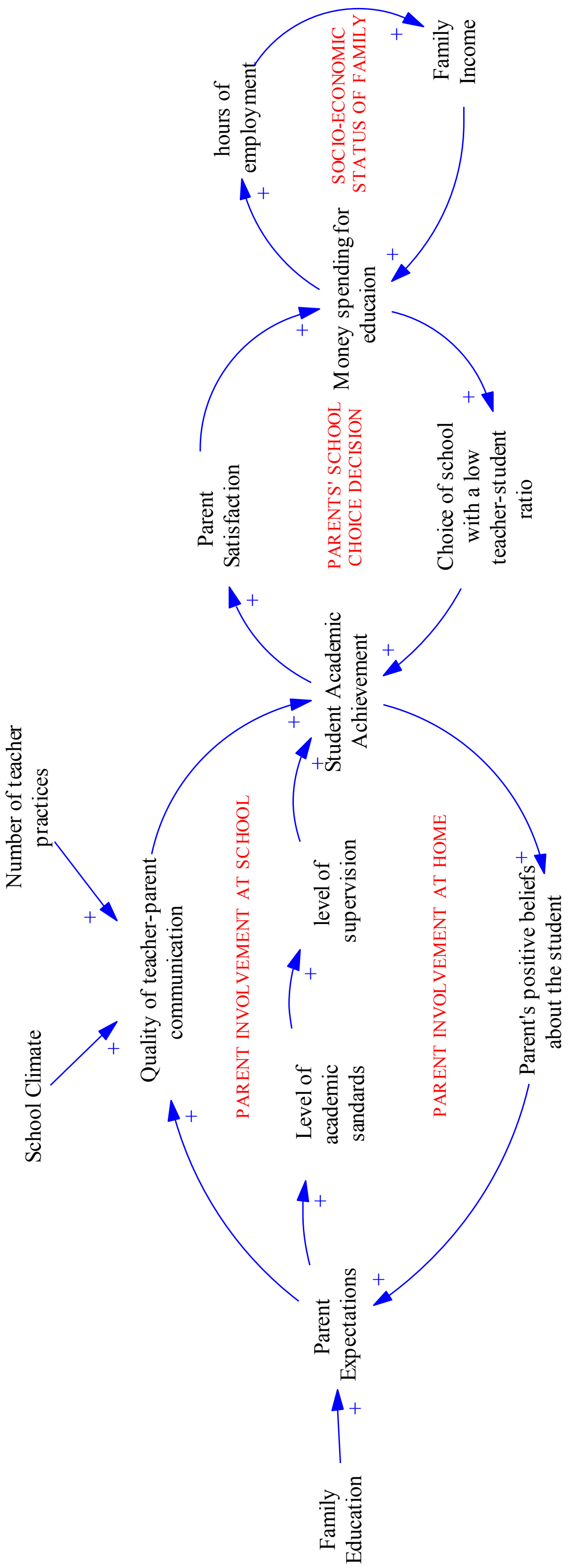


Figure 131 - Tentative causal loop diagram for parent dimension.

The home has a great influence on the students' psychological, emotional, social and academic growth because parents are the first socializing agents in an individual's life. Although, the school is responsible for the academic and social growth of students, yet parents at home play enormous roles in building the personality of the child and making the child what he is. Families create a learning environment at home. The acquisitions from this learning environment affect the student's later school performance and academic achievement.

Family background and characteristics are therefore are important former variables that influence the child's school success. In the literature, major findings show that parents are critical for the success of students.

Taken as whole, the parent sector is composed of following causal loops;

1. Parent Involvement at school
2. Parent Involvement at home
3. Parent's School Choice Decision
4. Socio-economic Status of family

6.2.3.1. Parent involvement at school

Every parent has some level of expectations from the schools. Even though **parent expectations** vary on the structure of each family, it determines also the level of involvement in educational process both at home and at school.

Family education among family characteristics is the important predictor about how high expectations they have about their children. Parents' level of education influences student educational outcome, expectancy beliefs and hence their academic achievement. Education gains much more importance especially for better-educated families. However, better-educated families are much more involved in educational process and support their kids at home. Knowledgeable parents are mostly interested in their children's education.

Higher parent expectations encourage children to reach at a higher academic achievement level. As a result of high parent expectations, children set high level of academic standards themselves. Families higher expectations make them actively involve in educational process. In the literature, there is a strong positive relation between the parent involvement and student academic achievement. If a student has guidance of his or her parent, he or she will probably show higher achievement.

Parent involvement can be both at home and at school. Quality of parent involvement is directly related with the **quality of teacher-parent communication**. The quality of teacher-parent communication influences **student academic achievement**. In addition to parent variables, other sectors like school and teacher also affect the quality of teacher-parent communication.

School climate and **teacher practices** can encourage parents actively to involve in educational process at school. School and teacher initiatives encourage parents to involve in the school activities.

6.2.3.2. Parent involvement at home

Parents also involve in educational process at home. Home involvement menas helping homeworks and providing assistance at home. Parents set higher **level of academic standards** if they have some level of educational **expectations**. Parents also need to monitor and evaluate the academic progress of the children. More knowledgeable parents show supportive attitudes and **supervision** at home. Like others, home-based support also directly affects the **student academic achievement** at school.

Student academic achievement is actually main motivator for all the sectors. Students feel self-confidence and show higher engagement in educational process, teachers can have higher self-efficacy beliefs and sets more mastery achievement goals in the learning environment, parents have more **positive beliefs about the students** and therefore their educational **expectations** increase.

6.2.3.3. Parent's school choice decision

Student Academic Achievement is an important predictor about the quality of school. Parents whose children are academically successful are satisfied with the schools. Academic achievement is an important parental concern. Student educational outcomes are important factors that affect parent satisfaction. Parents choose schools or their kids as result of the outcomes at the end of a certain educational process. Especially private school parents want to get their money worth. This is important decision criterion for next year's school choice.

Parent Satisfaction means to continue with the same school next academic year. Satisfaction and achievement are effective in parent's school choice decision. When they are satisfied with their schools, the tuition of the school would be second consideration if there is no serious financial problem at home. Parents try to pay school tuition for the next year. Private schools have lower teacher-student ratio classes. Among public schools, lower teacher-student ratio classes are mostly preferred schools. For those schools, parents pay extra school fee to the administration of those schools. To spend extra money for education requires **a school with low teacher-student ratio**.

Teacher- student ratio is the most important predictor of **student academic achievement**. Therefore, parents prefer private schools because they can offer more appropriate teacher-student ratio. The less number of students in the class, the more teacher-student interactions in the class. Low teacher-student ratio contributes to student academic achievement.

Private schools offer this advantage. Some public schools try to lower its number of students in order to enhance student's academic achievement. The classes in some pilot public schools are designed with the minimum number of students. Lower teacher-student ratio increases the effectiveness of learning environment and hence student academic achievement.

6.2.3.4. Socio-economic status of family

Socioeconomic status of the family is one of the best predictors of student academic achievement. Many low socio-economic families lack education themselves, therefore do not encourage their children to receive a quality education and can not set higher expectations for their children. This will probably cause a lower academic achievement. If a family spends a certain amount of money for their children's education, family members need to work harder to earn money. This increases the **hours of employment** and finally the **family income**.

When the family income increases, it would be easy to decide whether they spend so much money for their children's education or not. They can **allocate more money for education**. A family without a financial problem, can want to send their children to a private school with a lower teacher-student ratio.

6.2.4. Tentative causal loop diagram for school dimension

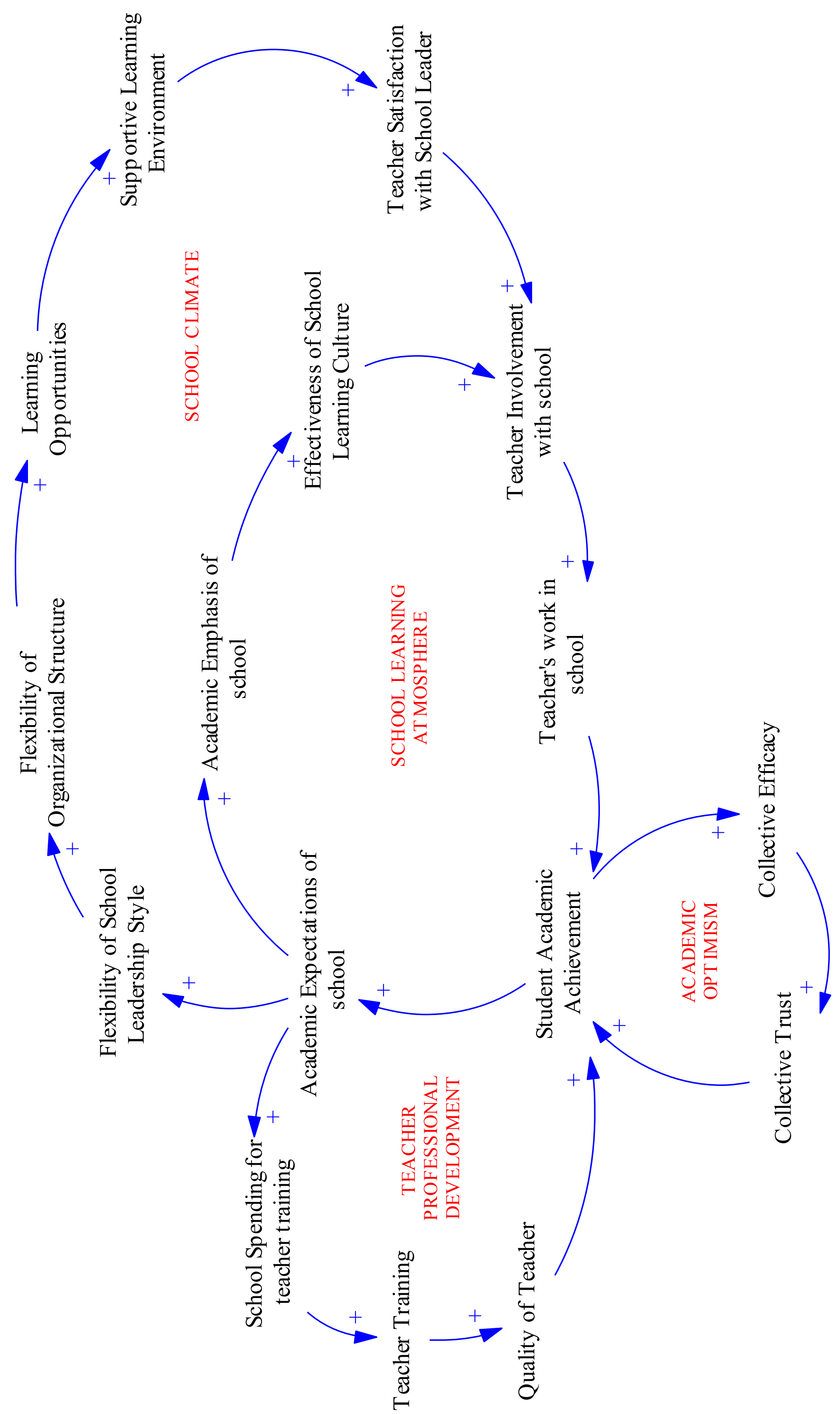


Figure 132 - Tentative causal loop diagram for school dimension.

No two schools are alike. Every school has its own characteristics and learning environment. Schools have a significant effect on the academic and social development of students. School climate, learning environment, structure, staffing and resources are the most influential factors on student academic achievement.

School dimension that influences student academic achievement and parent satisfaction is composed of following causal loops;

1. School Learning Atmosphere
2. School Climate
3. Academic Optimism
4. Teacher Professional Development

6.2.4.1. School learning atmosphere

Academic expectations of the school are the important variables that regulate the behavior of all stakeholders in school system. Academic expectations create a direction to the school. All staff emphasizes academic achievement. **Academic Emphasis of school** members is important to enhance student academic achievement.

So, the **effectiveness of School Learning Culture** increases and learning culture is accustomed to the academic achievement at the end of a certain process. School Learning culture is the commonly held beliefs, values and symbols of teachers, students and principals towards the academic standards. This academic emphasis characterizes the school and school learning culture becomes more effective. Teachers, important part of the school system, highly involve in educational process. Their work capacity is at maximum and they work for only the achievement of all students.

Teacher involvement and hence **teacher's work** in the school result in **student academic achievement** at the end. So, academic emphasis of the school leads student academic achievement since it creates an effective learning environment and culture. Organisational learning atmosphere encourages teachers to work hard in the classroom and then it leads to student achievement. It is critical for student's learning.

6.2.4.2. School climate

Academic Expectations of the school influences all the staff in the school. Especially, school leaders set higher mastery goals and change their leadership styles accordingly.

School administration role changes from management role to leadership role to effectively motivate teachers and students. Principals' leadership style has effects on student academic achievement. Principal's Leadership Style creates a learning organizational culture. The principal's leadership style affects the school's organizational structure which indicates goals, planning, and coordination at school level.

School structure and leadership style provide learning opportunities for the students. But structures alone do not improve a school or student academic achievement. Supportive learning environment, effective school climate, leadership style and flexible organizational structure must be taken into consideration at the same time to understand the effective school systems that promote student academic achievement and parent satisfaction.

The flexibility of School Leadership Style is the advantage to have a flexible organizational structure. Leadership style, organizational structure and culture must fix with each other in order to manage change in the school. The transformational and servant types of leaderships in the school affect the organizational structure. School structure turns from bureaucratic to organic type of structure to fit with the school leader's style.

Organic school structure offers flexibility for all staff. With the help of flexible school structure, teachers and school managers establish good communication channels. Structure implements innovation and teachers involve in decision-making processes. Teachers can control over their practices. A principal's leadership style and ability to monitor and develop instructional practice within the school enhance teacher satisfaction and student academic achievement.

The flexilibity of organizational structure creates many **learning opportunities** for both teachers and students. In flexible school organizational structure, teachers have a chance to participate in decision-making processes. Teachers are satisfied and motivated in this type of school context. They have a sense of belonging and this creates commitment to the organization and satisfaction. Since the interaction is encouraged, teacher and students actively communicate with each other. There is a supportive learning environment due to dynamics of social environment. This learning environment has a positive effect on teacher satisfaction and student academic achievement.

Such a **supportive learning environment** increases the **effectiveness of school climate**. Positive school climate has an effect on student academic achievement. School climate that shapes the behavior of teachers that either facilities or constrains classroom instruction and student learning. Good school climate has a significant effect on student academic achievement when compared with a poor school climate. Under such a climate, learning is enhanced, the work of staff is recognised and their contributions valued.

So, **teacher satisfaction with the school leader** is an inevitable outcome. Teacher satisfaction with the school leadership team is a significant predictor for the extent **of teacher involvement** and engagement with the school and learning. Teacher involvement is directly related with educational outcomes like **student academic achievement**.

6.2.4.3. Academic optimism

One of the important school characteristics is collective trust in parents and students. **Collective trust** has strong effects on student academic achievement. Collective trust is defined as "a state in which groups are willing to make themselves vulnerable to others and take risks with full confidence that others will respond in positive ways, that is, with benevolence, reliability, competence, honesty, and openness" (Tarter and Hoy, 2004).

Academic achievement enables **collective efficacy** that is a group of beliefs and expectations. Collective trust is also an affective response to collective efficacy. There is a reciprocal causality among these elements. There is a "set of interactions with the components functionally dependent on each other. Collective trust in students and parents encourages a sense of collective efficacy, which reinforces and enhances trust" (Hoy, 2012).

6.2.4.4. Teacher professional development

Even though teacher experience, skill, subject knowledge and teacher level of education are the important indicators that show teacher quality, **training** for professional development increases the **teacher quality**. Training helps teachers to increase their subject and pedagogical knowledge, to improve their abilities and skills, to be aware of new teaching methods and tactics. So teacher training or workshops increase their quality as well as their effectiveness.

Quality of teacher is an important predictor of **student academic achievement**. In schools, when students are high achievers, the **academic expectations** of all school staff increases. Academic achievement increases expectations. So, school leaders want to improve school's success by sending their teachers to different types of seminars, workshops and **training** programs.

6.3. Research Data

"To build a system dynamics model from a causal or cognitive map, two kinds of task are required. First, some operational structure should be added. Second, lots of quantification should be introduced into the original map. To make the simulation of the causal or cognitive map, additional data and information to build a system dynamics model has to be collected. But, often it is difficult to collect enough data. Usually additional data and complication of the map to make a simulation drives away the original insights" (Kim, 2000).

"Abstract simulation means a simulation of a model that is built from abstract or conceptual variables and causal relationships. It is different with econometric model or statistical model in that abstract model will be based on the causal relationships among variables presented in the causal map and cognitive map. Abstract simulation provides an environment where causal map or cognitive map can be simulated without requiring additional data on structure and parameters. The causal map cannot be simulated without introducing additional assumptions on structures and parameters. Abstract simulation environment is supposed to provide these assumptions automatically" (Kim, 2000).

"These features of abstract simulation are required for at least three reasons. First, abstract simulation will help in preserving generic nature of causal map. Sometimes causal map is built with highly abstract variables to maintain its generic nature. Second, abstract simulation is required to preserve the purity of cognitive maps. If one introduces additional assumptions into the cognitive map for simulation purpose, the purity of cognitive map will be destroyed. Third and last, abstract simulation will increase the honesty of system scientists. If one cannot know the concrete structures and parameters, one need not hide his ignorance to build a simulation model. Rather, by using abstract simulation approach, he can simulate without introducing his own assumptions" (Kim, 2000).

System Dynamics Modeling gives the chance of modeling a complex system without the need to use actual data. The resulting model of this study will be calibrated with a selected bank. No actual data has been used in the model and reasoning has been made.

7. STOCK-FLOW DIAGRAMS AND SIMULATION MODEL

7.1. Stock and Flow Diagrams

Educational process is affected by four dimensions as student, parent, teacher and school dimensions. The study of these dimensions and interrelationships between them has become more complex social system to describe educational outputs. In this study, only parent and teacher dimensions would be taken into consideration in order to analyze the effect of those dimensions on student academic achievement. For further studies, the other dimensions (student and school) and other educational outcomes (parent and student satisfaction, social and behavioral growth of students) can be studied using system dynamics modeling.

In the model, parent and teacher dimensions are taken into consideration. Regarding with these dimensions, four stocks are formed. The main idea behind the dynamics system of the model is to understand how parent and teacher related variables affect student academic achievement.

1. Parent Expectation (PE) Stock-flow
2. Parent Involvement (PI) Stock-flow
3. Student Academic Achievement (SAA) Stock-flow
4. Teacher-parent Contact (TPC) Stock-flow

Even though you can analyse the factors that affect student academic achievement, the output and effects of an educational process cannot be realized in a short time interval. That's why, the studies in the field of education has deprived of reasonable feedbacks for education policy-makers in order to systematize the educational process. It includes more complex dimensions and interrelationships between them. However, the use of system dynamics modeling to understand an educational process has given understandable and reasonable results for all stakeholders.

7.1.1. Parent expectation (PE) stock-flow

"To increase the incidence and quality of model assessment and reproduction studies", following information regarding with Parent Expectation Stock is provided in the model as it is mentioned by Barlas (2000).

- "Units of measurement for all variables and parameters."
- "Sources of data (qualitative and quantitative) for different equations and algorithmic rules."
- "Definition of all the variables used in the model and the logic behind their formulation."

The preferred model reporting requirements for Parent Expectation stock flow is shown in the table-1.

Table 1: Parent Expectation (PE) model documentation reporting definition of all the variables, units of measurement and their formulation.

<table>
<tr><th>Caus. Loop</th><th>No</th><th>Variable</th><th>Formulations and Comments</th><th>Units</th></tr>
<tr><td>1</td><td>1.1</td><td>Parent Expectation (PE)</td><td>$PE(t) = PE(0) + \int_0^t \left(IPE(t) - DPE(t)\right) * dt; PE(0) = 50$</td><td>grade</td></tr>
<tr><td colspan="5">Parent Expectation (PE), accumulates the increase in parent expectation (IPE) and declines as the decrease in parent expectation (DPE) increases. It is the expected grade by parent about his child’s academic performance measured by written assessments. The initial value for parent expectation is given by PE(0), assumed to be 50 out of 100 since the passing grade is 50. Every parent is assumed that their children should get at least passing grade. Maximum amount of parent expectation is assumed to be 100 since the marking scale is between 0 and 100.</td></tr>
<tr><td>1</td><td>1.2</td><td>increase in parent expectation (IPE)</td><td>$IPE = \ IF\ THEN\ ELSE\ (PE > 85, \frac{(100 - PE) * pel * crpe}{utpe}, \frac{PE * pel * crpe}{utpe}$</td><td>grade/ month</td></tr>
<tr><td colspan="5">The increase in parent expectation (IPE), is the rate at which family expectation increases. Parent Expectation (PE) is affected by parent education level (pel), total parent expectation (PE) and changing ratio in parent expectation (crpe). The actual increase in parent expectation is the multiplication of parent expectation, parent education level and the changing ratio of parent expectation. The level of an increase in parent expectation also affects the increase in parent educational practice rate (IPP). When the parent expectation reaches at the level of 85, the amount of increase in parent expectaton starts to decline.</td></tr>
<tr><td>1</td><td>1.3</td><td>decrease in parent expectation (DPE)</td><td>$DPE = \frac{PE * (fs + ms) * crpe}{utpe}$</td><td>grade/ month</td></tr>
<tr><td colspan="5">The decrease in parent expectation (DPE), is the rate at which family expectation decreases. Parent Expectation (PE) decreases depending on size of the family (fs), and the marital status (ms). The actual decrease in parent expectation is the multiplication of parent expectation with the changing ratio in parent expectation and the addition of family size and marital status.</td></tr>
<tr><td>1</td><td>1.4</td><td>parent education level (pel)</td><td>$pel = 0.4$</td><td>dimens ionless</td></tr>
<tr><td colspan="5">The parent education level (pel), is the highest level of schooling that a parent has reached. It results in some level of parent expectation (PE). Parent education level is between 0.1 and 0.8 where 0.1=no education, 0.2=primary school, 0.3=middle school, 0.4=high school, 0.5=two-year degree, 0.6=undergraduate, 0.7=master, 0.8=doctorate and above. Since the compulsory education is for 12 years in Turkey, the initial value for parent education level is taken as 0.4</td></tr>
<tr><td>1</td><td>1.5</td><td>marital status (ms)</td><td>$ms = 0.0$</td><td>dimens ionless</td></tr>
<tr><td colspan="5">The marital status (ms), is a parent's state of being single, married, separated, divorced, or widowed. If parents are divorced, the marital status is taken as 0.2 and if not, it is taken as 0.0 since it has no negative effect on parent expectation (PE). The initial marital status value is taken as 0.0 since couples are assumed to be married.</td></tr>
<tr><td>1</td><td>1.6</td><td>family size (fs)</td><td>$fs = 0.3$</td><td>dimens ionless</td></tr>
<tr><td colspan="5">The family size (fs), is considered as the number of members in family. The more number of children has negative effect on parent expectation (PE). Each member is represented by 0.1 and for ideal family size is considered as 0.3 (father, mother and one child). Hence, the initial value for the family size is taken as 0.3.</td></tr>
<tr><td>1</td><td>1.7</td><td>changing ratio in parent expectation (crpe)</td><td>$crpe = \frac{PE}{maxpe}$</td><td>dimens ionless</td></tr>
<tr><td colspan="5">The changing ratio in parent expectation (crpe) is the conversion of Parent Expectation (PE) between 0 and 1.</td></tr>
<tr><td>1</td><td>1.8</td><td>maximum parent expectation (maxpe)</td><td>$maxpe = 100$</td><td>grade</td></tr>
<tr><td colspan="5">The maximum parent expectation is the maximum grade that a student can take it.</td></tr>
<tr><td>1</td><td>1.9</td><td>unit time for parent expectation, utpe</td><td>$utpe = 1$</td><td>month</td></tr>
<tr><td colspan="5">The unit time for parent expectation (utpe) is taken as one month since the time step is in months.</td></tr>
</table>

Parents contribute significantly to student academic achievement and affect the educational process. Parent Expectation is the starting point of the educational process. Parent expectations change the level of parent achievement standards and hence affect student academic achievement. Therefore, parent expectation is taken as a stock and which factors affect the level of parent expectation is considered as rates. The increase in parent expectation is the inflow that increases parent expectation and the decrease in parent expectation is outflow that decreases parent expectation as shown in the Figure-133.

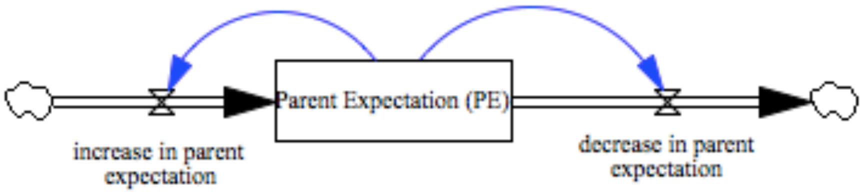


Figure 133 – The stock flow diagram of Parent Expectation.

In figure 134, the parent expectation affects its own increasing rate and decreasing rate both directly and indirectly. Indirect feedback loop of Parent Expectation is linked by the variable of changing ratio in parent expectation that represents intervening variables in feedback loops.

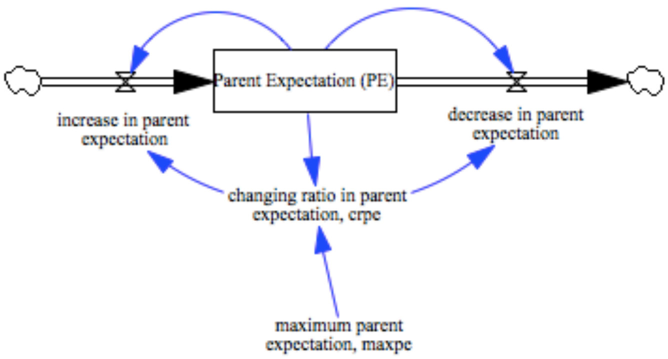


Figure 134 – Elementary relationship between Parent Expectation (PE) and rate variables.

Figure 134 shows equations that will preserve value of parent expectation between 0 and 100. Parent expectation is considered as student’s grade at the end of a certain time interval. That’s why maximum parent expectation must be same as the maximum grade that is 100. Maximum parent expectation (maxpe) variable is considered as 100 grades. Changing ratio in parent expectation is the division of Parent Expectation to maximum parent expectation. By doing that, changing ratio in parent expectation becomes between 0 and 1. If the changing ratio in parent expectation is 1, that means parent expectation takes its maximum value and vice versa. Depending on the changing ratio, rates are also subject to change accordingly. In order to ensure this, increase in parent expectation is defined to converge towards zero as the value of the parent expectation passess 85 and comes near 100. On the other hand, decrease in parent expectation is defined to converge towards zero as the value of parent expectation goes to zero. The formula that describes this relation is given in figure 134.

The level of parent education is an important contributor for parent expectation. It directly affects the level of parent expectation and hence indirectly parent involvement. Better-educated parents have more expectations about their children's academic achievement. The level of parent education affects the increase in parent expectation as shown in the figure-135.

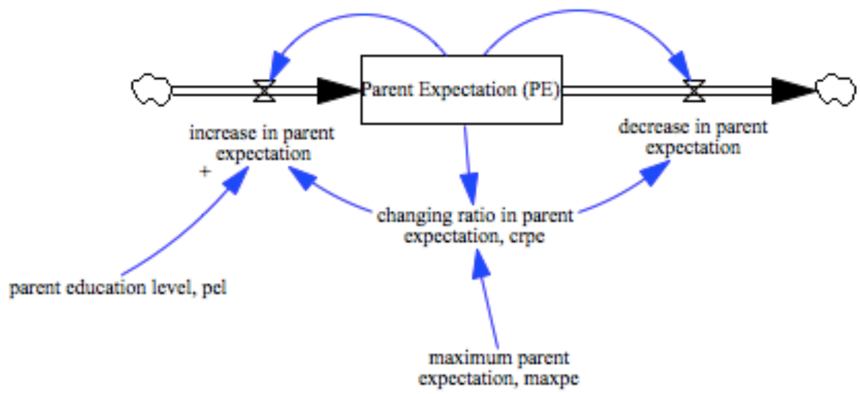


Figure 135 – Elementary relationship between Parent Expectation (PE) and rate variables / the effect of parent education level (pel) on increase in parent expectation.

The parent education level (pel), means that the level of parent education results in some level of parent expectation (PE). In this study, parent education level is considered between 0.1 and 0.8 where 0.1=no education, 0.2=primary school, 0.3=middle school, 0.4=high school, 0.5=two-year degree, 0.6=undergraduate, 0.7=master, 0.8=doctorate and above. Since the compulsory education is for 12 years in Turkey, the initial value for parent education level is taken as 0.4 in the model.

Another important family factor that changes the level of their expectation is the family size. When family size increases, parent start to spend less time for each child due to the time limitation. Family size is inversely proportional to the level of parent expectation. It increases the decrease in parent expectation rate as shown in the figure-136.

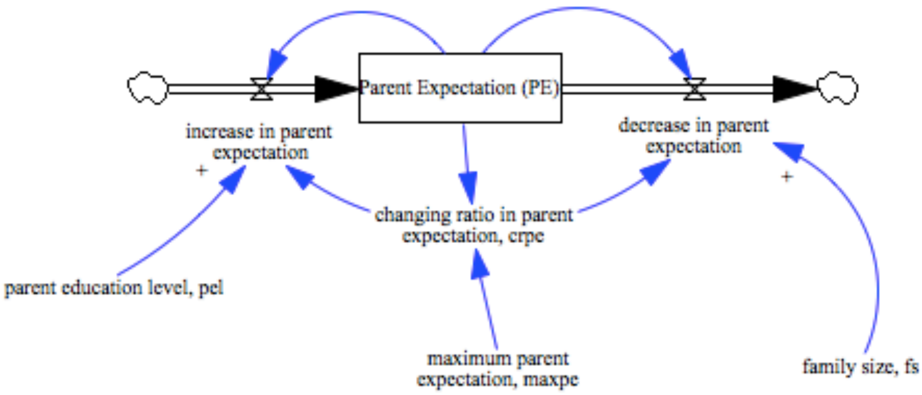


Figure 136 – Elementary relationship between Parent Expectation (PE) and rate variables / the effect of parent education level (pel) and family size (fs) on rate variables.

In the model, for each additional member of family, the family size is taken as 0.1. For example, family size value for a family of father, mother and one child is 0.3. Additional number of children increases its value by 0.1.

The last constant that affects the level of parent expectation is marital status of family. Single-parent status is also important for the level of parent expectation over the child's academic achievement. The effect of marital status together with other constants on rate variables is added to the model and shown in figure-137.

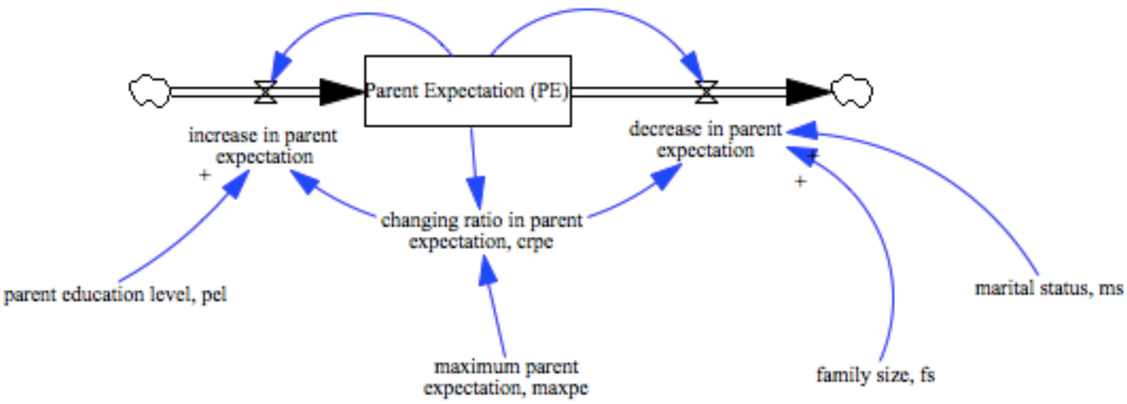


Figure 137 – Elementary relationship between Parent Expectation (PE) and rate variables / the effect of parent education level (pel), family size (fs) and marital status (ms) on rate variables.

The values of marital status are considered as 0.0 for coupled and 0.2 for single parents. The addition of marital status and family size affects the decrease in parent expectation rate. If the couples are not divorced, marital status has zero effect on the rate variable and only family size is taken into consideration. If they are divorced, 0.2 is added to the value of family size.

Time Step for parent expectation stock is in months. Hence the unit time for parent expectation is taken as one month. The final model together with its formulations for Parent Expectation (PE) is shown in figure 138.

- *Parent Expectation = INTEG (increase in parent expectation – decrease in parent expectation)* (1)

- *Increase in parent expectation = IF THEN ELSE (PE > 85,* $\frac{(100-PE)*crpe*pel}{utpe}$, $\frac{PE*crpe*pel}{utpe}$*)* (2)

- *Decrease in parent expectation =* $\frac{PE*crpe*(fs+ms)}{utpe}$ (3)

- *changing ratio in parent expectation =* $\frac{PE}{maxpe}$ (4)

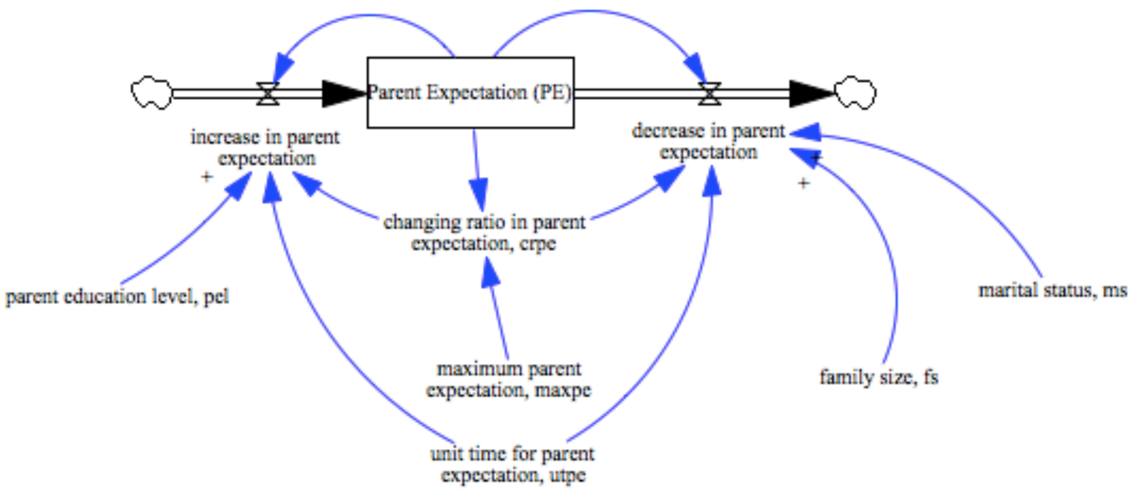


Figure 138 – Parent Expectation (PE) stock, rate variables, all the variables and the necessary formulations between them.

7.1.2. Parent involvement (PI) stock-flow

"To increase the incidence and quality of model assessment and reproduction studies", following information regarding with Parent Involvement Stock is provided in the model as it is mentioned by Barlas (2000).

- "Units of measurement for all variables and parameters."
- "Sources of data (qualitative and quantitative) for different equations and algorithmic rules."
- "Definition of all the variables used in the model and the logic behind their formulation."

The preferred model reporting requirements for Parent Involvement stock flow is shown in the table-2.

Table 2: Parent Involvement (PI) model documentation reporting definition of all the variables, units of measurement and their formulation.

<table>
<tr><th>Caus. Loop</th><th>No</th><th>Variable</th><th>Formulations and Comments</th><th>Units</th></tr>
<tr><td>2</td><td>2.1</td><td>Parent Involvement (PI)</td><td>$PI(t) = PI(0) + \int_0^t (\mathrm{IPP(t)} - \mathrm{DPP(t)}) * \mathrm{dt}; \mathrm{PI(0)} = 10$</td><td>hour</td></tr>
<tr><td colspan="5">Parent involvement (PI), is the participation of parents in school activities or helping students at home. It is the commitment of time, energy, and good will to promote success for students. It accumulates the increase in parent educational practices (IPP) and declines as the decrease in parent educational practices (DPP). It is the time dedicated by parent for his child's educational activities. Parent Involvement has been considered in three dimensions such as behavioral (participation in both school and home activities such as parent–teacher conferences, helping with homework), cognitive intellectual (connecting children to intellectually stimulating activities such as going to the library and discussing current events) and personal (keeping informed of what is happening with the child in school). The assumed initial value is taken as 10 hours per month.</td></tr>
<tr><td>2</td><td>2.2</td><td>increase in parent educational practices rate (IPP)</td><td>$\mathrm{IPE} =$
$\mathrm{DELAY\ FIXED\ (IF\ THEN\ ELSE}\ \Big(\mathrm{totpi} > \mathrm{maxpi}, \frac{\mathrm{maxpi} * (1-\mathrm{crpi}) * \mathrm{lpe} * \mathrm{spis} * \mathrm{pepi}}{\mathrm{utpi}}, \frac{\mathrm{totpi} * (1-\mathrm{crpi}) * \mathrm{lpe} * \mathrm{spis} * \mathrm{pepi}}{\mathrm{utpi}}\Big), 4, 0)$</td><td>hour/ month</td></tr>
<tr><td colspan="5">The increase in parent educational practices rate (IPP), is the rate at which parent educational practices increase. Parent educational practices are the practice time dedicated for the education of his child both at home and at school. The increase in parent educational practices is measured in hours that show how much time spent on educational activities by parent per month. The increase in parent educational practices rate is affected by increasing parent expectation (IPE), total needed parent involvement due to the academic gap between real academic achievement and parent expectation (totpi), maximum parent involvement (maxpi), the level of parent satisfaction from the school and the educational process (ps), the level of school parent involvement support for encouraging parent practices (spis) and the changing ratio in parent involvement (crpi).</td></tr>
<tr><td>2</td><td>2.3</td><td>decrease in parent educational practice rate (DPP)</td><td>$\mathrm{DPP} = \frac{\mathrm{PI} * \mathrm{crpi} * \mathrm{pw}}{\mathrm{utpi}}$</td><td>hour/ month</td></tr>
<tr><td colspan="5">The decrease in parent educational practice rate (DPP) is the rate at which parent educational practices decrease. Parent Expectation decreases depending on fraction of parent workload time to total time (pw), the total time for parent involvement (PI) and changing ratio in parent involvement (crpi).</td></tr>
<tr><td>2</td><td>2.4</td><td>total needed parent involvement (totpi)</td><td>$\mathrm{totpi} = \mathrm{ag} * \mathrm{pipg}$</td><td>hour</td></tr>
<tr><td colspan="5">Total needed parent involvement is the total number of hours needed for parents to make educational practices with their children in order to decrease the academic gap.</td></tr>
<tr><td>2</td><td>2.5</td><td>maximum parent involvement (maxpi)</td><td>$\mathrm{maxpi} = 46$</td><td>hour</td></tr>
<tr><td colspan="5">The maximum parent involvement (maxpi) is the maximum time that a parent will be able to dedicate it for educational practices in a month. In order to calculate the maximum parent involvement time per month, 1 hour per day for weekdays and 3 hours per day for weekends are thought. So, total maximum parent involvement time is calculated as 1x22 + 3x8 = 46 hours per month.</td></tr>
<tr><td>2</td><td>2.6</td><td>academic gap (ag)</td><td>$\mathrm{ag} = \mathrm{IF\ THEN\ ELSE\ (daa} > \mathrm{SAA}, \mathrm{daa} - \mathrm{SAA}, 0)$</td><td>grade</td></tr>
<tr><td colspan="5">Academic gap (ag) is the difference between desired student academic achievement (dsaa) and Student Academic Achievement (SAA).</td></tr>
<tr><td>2</td><td>2.7</td><td>needed parent involvement per grade (pipg)</td><td>$\mathrm{pipg} = 2$</td><td>hour/ grade</td></tr>
<tr><td colspan="5">The needed parent involvement per grade (pipg) is how many hours are needed for parents to spend for educational practices in order to increase their student's academic achievement by 1 grade. It is assumed that 2 hours of parent involvement can increase student academic achievement by 1 grade.</td></tr>
</table>

Table 2: Parent Involvement (PI) model documentation reporting definition of all the variables, units of measurement and their formulation.

<table>
<tr><th>Caus. Loop</th><th>No</th><th>Variable</th><th>Formulations and Comments</th><th>Units</th></tr>
<tr><td>2</td><td>2.8</td><td>effect of PE on PI (pepi)</td><td>$\mathrm{pepi} = \frac{\mathrm{pipg} * \mathrm{PE}}{\mathrm{upi}}$</td><td>dimens ionless</td></tr>
<tr><td colspan="5">Effect of PE on PI is the effectiveness of Parent Expectation on Parent Involvement. The magnitude of effect is considered in terms of total needed parent involvement as unitless.</td></tr>
<tr><td>2</td><td>2.9</td><td>unit parent involvement, upi</td><td>$\mathrm{upi} = 1$</td><td>hour</td></tr>
<tr><td colspan="5">Unit parent involvement is taken as one hour. That is the smallest piece of parent involvement.</td></tr>
<tr><td>2</td><td>2.10</td><td>level of parent engagement (lpe)</td><td>$\mathrm{lpe} = 0.050$</td><td>dimens ionless</td></tr>
<tr><td colspan="5">Level of parent engagement (lpe), is the categorization of parent's desire to engage in school and educational activities. It is categorized between 0.000 and 0.100 (0.000=not at all engaged, 0.025=not engaged, 0.050=partially engaged, 0.075=engaged and 0.100=highly engaged). The initial value is taken as partially engaged (0.050)</td></tr>
<tr><td>2</td><td>2.11</td><td>school parent involvement support effectiveness (spis)</td><td>$\mathrm{spis} = 0.050$</td><td>dimens ionless</td></tr>
<tr><td colspan="5">School parent involvement support effectiveness (spis) is the level of support that a school makes to encourage parent involvement. It is categorized between 0.000 and 0.100 (0.000=not at all supported, 0.025=not supported, 0.050=partially supported, 0.075=supported and 0.100=highly supported). The initial value is taken as partially supported (0.050)</td></tr>
<tr><td>2</td><td>2.12</td><td>changing ratio in parent involvement (crpi)</td><td>$\mathrm{crpi} = \mathrm{PI} * \mathrm{crm}$</td><td>dimens ionless</td></tr>
<tr><td colspan="5">The changing ratio in parent involvement is the conversion of Parent Involvement (PI) between 0 and 1. The level of parent involvement exceeds a certain limit, the rates starts to change accordingly. The changing ratio is parent involvement is taken between o and 1. it is assumed to be '1' for maximum parent involvement (46 hours), and '0' for minimum parent involvement (0 hour).</td></tr>
<tr><td>2</td><td>2.13</td><td>changing ratio multiplier (crm)</td><td>$\mathrm{crm} = 0.0217$</td><td>1/hour</td></tr>
<tr><td colspan="5">The changing ratio multiplier is the conversion of parent involvement into a scale between 0 and 1. It is assumed to be 0.0217. When parent involvement takes its maximum value (46 hours), the changing ratio in parent involvement becomes '1' using chaging ratio multiplier.</td></tr>
<tr><td>2</td><td>2.14</td><td>unit time for parent involvement (utpi)</td><td>$\mathrm{utpi} = 1$</td><td>month</td></tr>
<tr><td colspan="5">The unit time for parent involvement (utpi) is taken as one month since the time step is in months.</td></tr>
<tr><td>2</td><td>2.15</td><td>fraction of parent workload time to total time (pw)</td><td>$\mathrm{pw} = 0.5$</td><td>dimens ionless</td></tr>
<tr><td colspan="5">Fraction of parent workload time to total time (pw), means the percentage of parent's non educational activities (hours of employment, sleeping time and the time for daily activities) to total time. It is between 0 and 1. %0 and %100 percentages are represented by 0 and 1 respectively. The initial value is assumed to be 0.5.</td></tr>
</table>

Parent Involvement stock is an important contributor to Student Academic Achievement stock. Different variables can affect Parent Involvement and that's why, it is difficult to analyse the effect of each variable on parent involvement separately. The level of parent involvement is affected by student academic achievement, School attitude towards parent involvement and engagement and parent itself. In order to understand such a complex dynamic system, parent involvement is taken as a stock and which factors affect the level of parent involvement is considered as rates. The increase in parent involvement is the inflow that increases parent involvement and the decrease in parent involvement is outflow that decreases parent involvement as shown in the Figure-139. The unit of parent involvement is considered as hours.

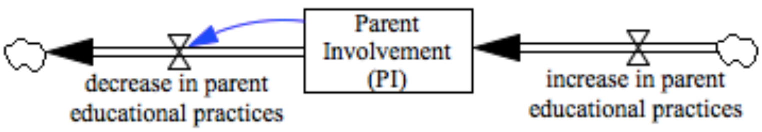


Figure 139 – The stock flow diagram of Parent Involvement.

In figure 140, the parent involvement affects its own increasing rate and decreasing rate both directly and indirectly. Indirect feedback loop of Parent Involvement is linked by the variable of changing ratio in parent involvement that represents intervening variables in feedback loops.

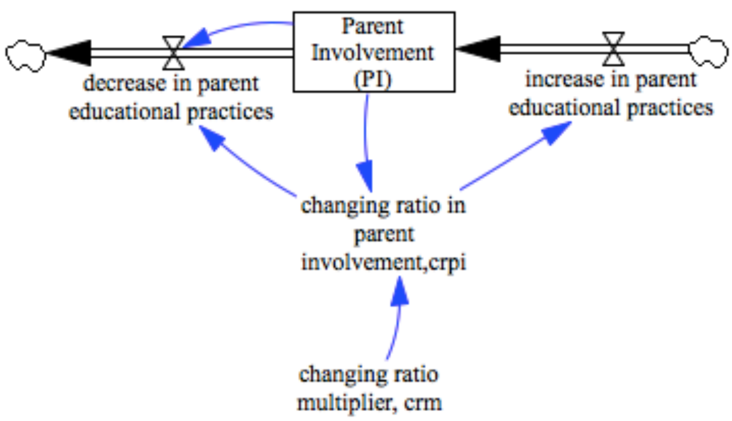


Figure 140 – Elementary relationship between Parent Involvement (PI) and rate variables.

In Figure 140, changing ratio in parent involvement is calculated by the multiplication of Parent Involvement (PI) and changing ratio multiplier (crm). In other words, the changing ratio in parent involvement is the conversion of parent involvement between 0 and 1.

Parent involvement is considered as parent's time dedicated to his child's educational activities. Parent Involvement can vary between 0 and 46 hours. The maximum value for parent involvement is assumed to be 46 hours per month. In order to calculate the maximum parent involvement time per month, 1 hour per day for weekdays and 3 hours per day for weekends are thought. So, maximum parent involvement time is calculated as 1x22 + 3x8 = 46 hours per month.

When Parent Involvement increases from 0 to 46, changing ratio in parent involvement also increases from 0 to 1 accordingly. Depending on the changing ratio in parent involvement, rates are also subject to change accordingly. In order to ensure this, increase in parent involvement is defined to converge towards zero as the value of the parent involvement passess the midpoint between the range of 0-46. On the other hand, decrease in parent involvement is defined to converge towards zero as the value of parent involvement goes to zero.

The parent involvement affects its increasing rate indirectly. In the further explanations, Parent involvement will affect the student academic achievement and as a result of comparison between student academic achievement and parent expectation, there will be an academic gap. In order to reduce academic gap, there will be a need for further parent involvement to encourage the student study hard. This relation between the variables will be discussed in Student Academic Achievement Stock (7.1.3.). Finally, total needed Parent Involvement will affect Parent Involvement.

Total needed Parent Involvement (totpi) is the total number of hours for parent involvement to eliminate academic gap. Total needed Parent involvement is limited to maximum parent involvement (maxpi) and it is already calculated as 4 hours per month as mentioned above. So, total needed parent involvement cannot exceed this limit in that model. The effect of maximum parent involvement and total needed parent involvement are added to the model and shown in figure 141.

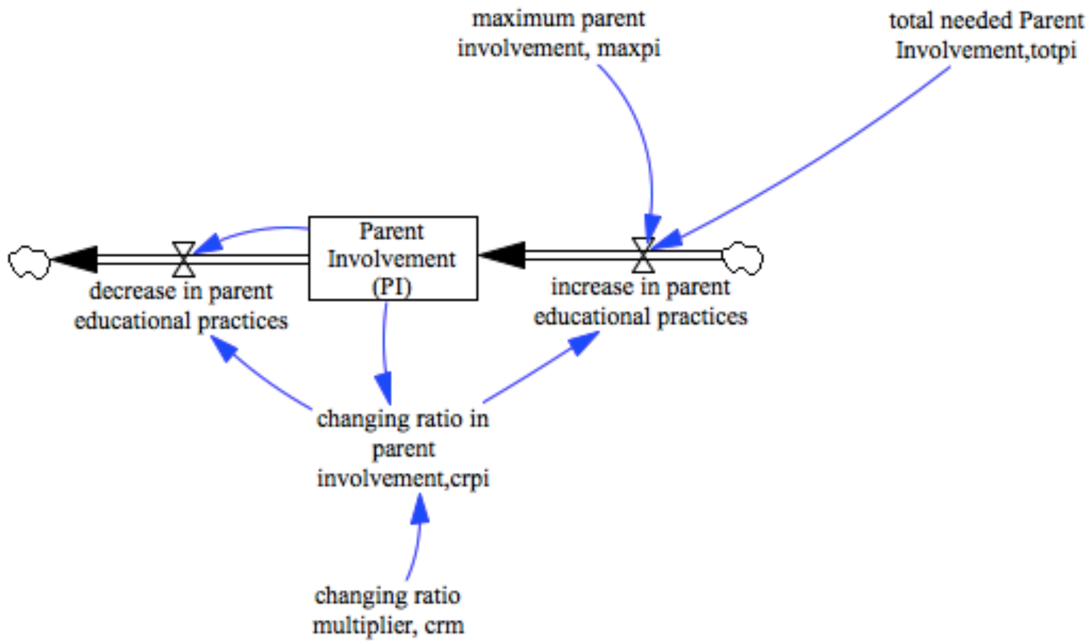


Figure 141 – Elementary relationship between Parent Involvement (PI) and rate variables / the effect of total needed parent involvement (totpi) and maximum parent involvement (maxpi) on increase in parent educational practices.

Parent's desire to engage in educational process and school activities that support parent involvement contribute significantly to the number of parent educational activities that increase parent involvement. School characteristics, attitudes and policies directly affect the level of parent involvement and shape it.

In the model, the effect of school on parent involvement is called as 'school parent involvement support effectiveness' that is categorized between 0.000 and 0.100 (0.000=not at all supported, 0.025=not supported, 0.050=partially supported, 0.075=supported and 0.100=highly supported).

Typically, parents are highly engaged and tend to be involved in their children's education. The level of parent engagement also directly affects the level of parent involvement. In the model, parent engagement is categorized between 0.000 and 0.100 (0.000=not at all engaged, 0.025=not engaged, 0.050=partially engaged, 0.075=engaged and 0.100=highly engaged). The initial value is taken as partially engaged (0.050). The effect of school support and parent engagement is added to the model and shown in figure-142.

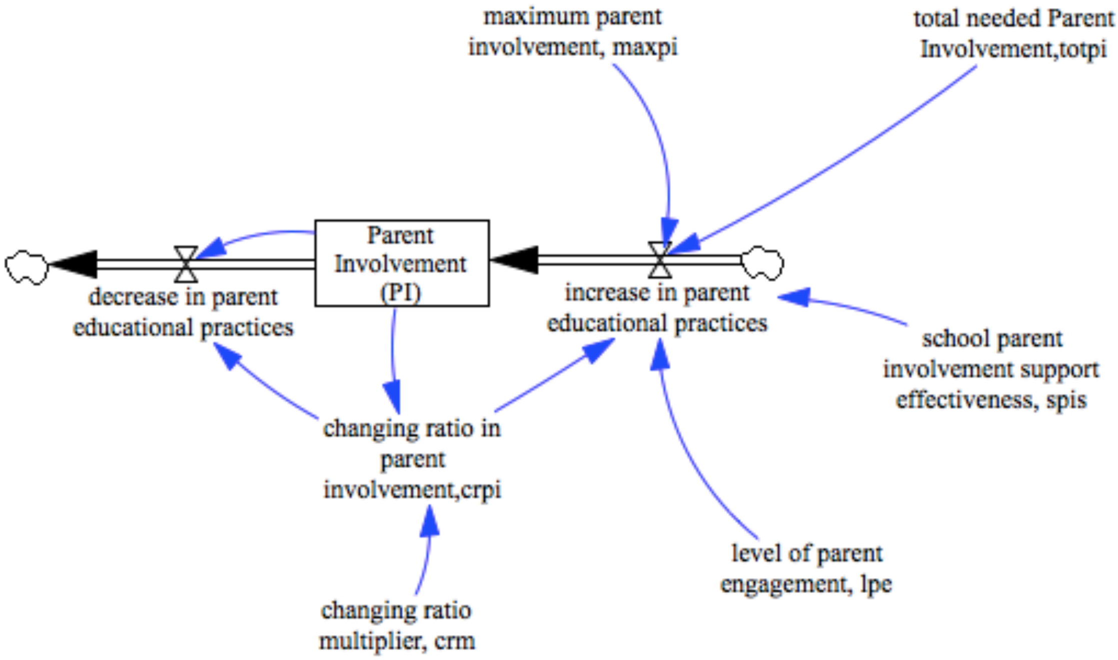


Figure 142 – Elementary relationship between Parent Involvement (PI) and rate variables / the effect of total needed parent involvement (totpi), maximum parent involvement (maxpi), school parent involvement support effectiveness (spis) and level of parent engagement (lpe) on increase in parent educational practices.

Parent Involvement is directly related with Parent Expectation. When parents have a high level of expectation at the end of a certain educational process, they will have a tendency to involve more in educational process. To show such a relation between them, Parent Expectation Stock is connected to increase rate for Parent Involvement Stock using an axuliary variable called effect of PE on PI. This is added to the model and shown in figure-143.

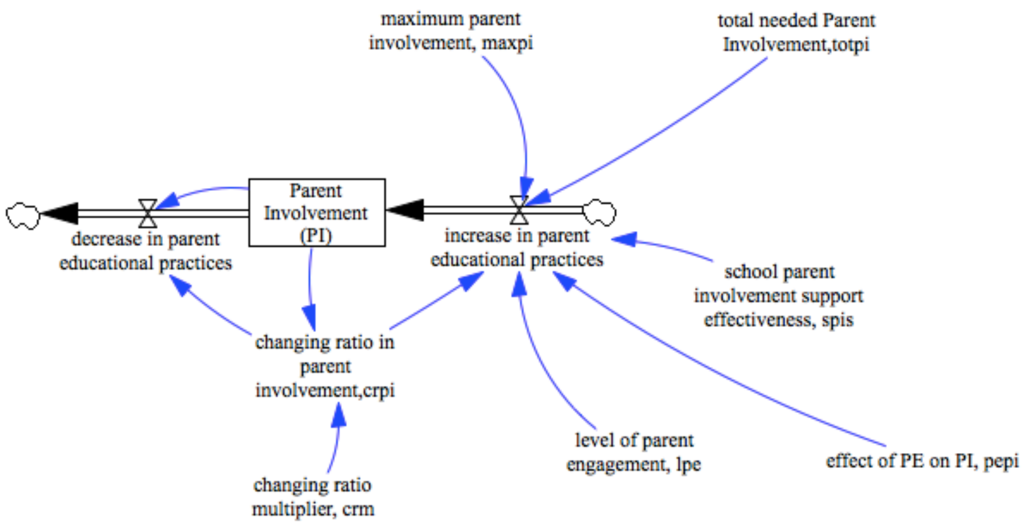


Figure 143 – Elementary relationship between Parent Involvement (PI) and rate variables / the effect of total needed parent involvement (totpi), maximum parent involvement (maxpi), school parent involvement support effectiveness (spis), level of parent engagement (lpe) and effect of parent expectation on parent involvement (pepi) on increase in parent educational practices.

Parent involvement is also affected by working hours, sleeping time and non-educational activities of parents. If parents become overload, they will have decreasing tendency to involve in educational process. The effect of parent workload time is considered as fraction of parent workload time to total time. It is added to the model and shown in figure-144.

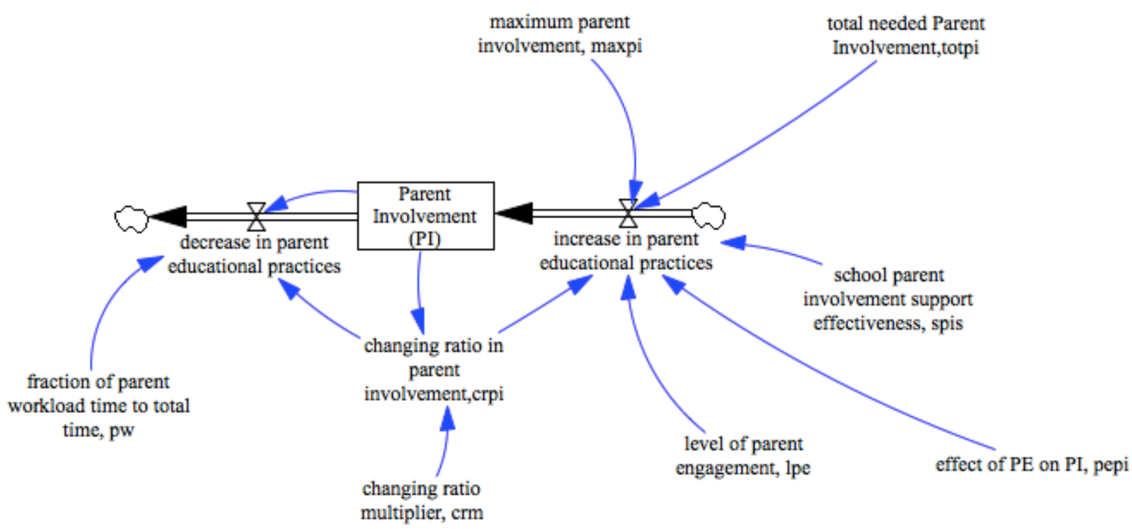


Figure 144 – Elementary relationship between Parent Involvement (PI) and rate variables / the effect of total needed parent involvement (totpi), maximum parent involvement (maxpi), school parent involvement support effectiveness (spis), level of parent engagement (lpe) and effect of parent expectation on parent involvement (pepi) on increase in parent educational practices / the effect of parent workload (pw) on decrease in parent educational practices

Time Step for parent involvement stock is in months. Hence the unit time for parent involvement is taken as one month. The final model together with its formulations for Parent Involvement (PI) is shown in figure 145.

- *Parent Involvement = INTEG (increase in parent educational practices – decrease in parent educational activities)* *(5)*
- *Increase in parent expectation = DELAY FIXED (IF THEN ELSE (totpi > maxpi,* $\frac{totpi}{utpi}$ ** (1-crpi) * lpe * spis,* pepi,* $\frac{maxpi}{utpi}$ ** (1-crpi)* lpe * spis * pepi), 2, 0)* *(6)*
- *Decrease in parent expectation =* $\frac{PI * crpi * pw}{utpi}$ *(7)*
- *changing ratio in parent involvement =* $PI * crm$ *(8)*

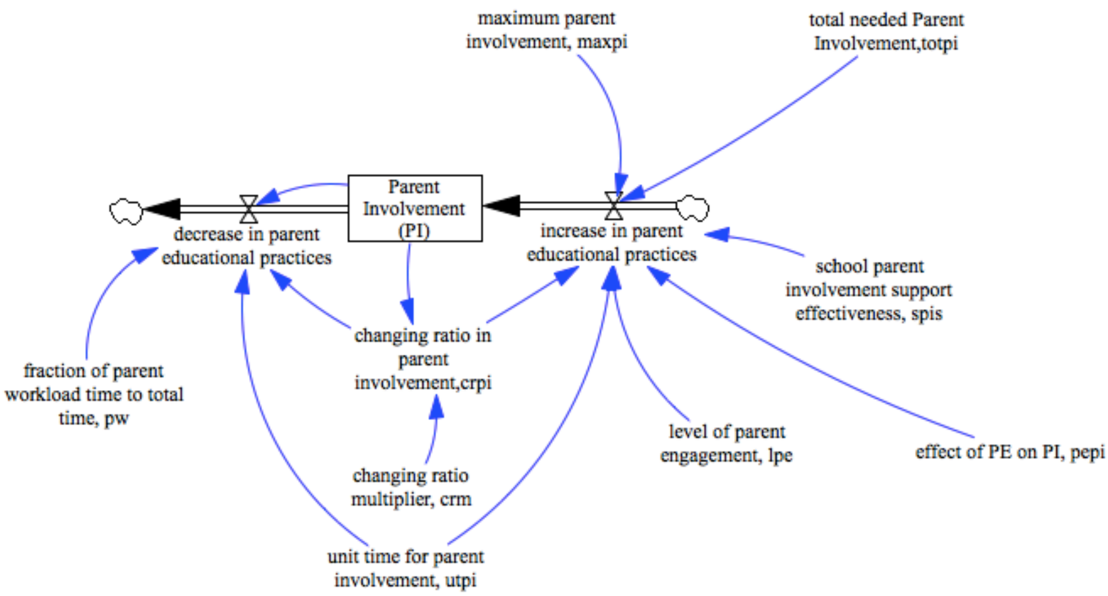


Figure 145 – Parent Involvement (PI) stock, rate variables, all the variables and the necessary formulations between them.

7.1.3. Student academic achievement (SAA) stock-flow

"To increase the incidence and quality of model assessment and reproduction studies", following information regarding with Student Academic Achievement Stock is provided in the model as it is mentioned by Barlas (2000).

- "Units of measurement for all variables and parameters."
- "Sources of data (qualitative and quantitative) for different equations and algorithmic rules."
- "Definition of all the variables used in the model and the logic behind their formulation."

The preferred model reporting requirements for Student Academic Achievement stock flow is shown in the table-3.

Table 3: Student Academic Achievement (SAA) model documentation reporting definition of all the variables, units of measurement and their formulation.

Caus. Loop	No	Variable	Formulations and Comments	Units
3	3.1	Student Academic Achievement (SAA)	$SAA(t) = SAA(0) + \int_0^t (\mathrm{ISAA(t)} - \mathrm{DSAA(t)}) * \mathrm{dt};$ $SAA(0) = 50$	grade
Student Academic Achievement (SAA), is the outcome of education as grade. It accumulates the increase in student academic achievement (ISAA) and declines as the decrease in student academic achievement (DSAA). It is the grade taken by student out of 100.				
3	3.2	increase in student academic achievement (ISAA)	$\mathrm{ISAA} = \frac{(100 - \mathrm{SAA})}{\mathrm{adjsaa}} * (sel + ser) * eftpc$	grade/ month
The increase in student academic achievement rate (ISAA), is the rate at which student academic achievement increases. The increase in student academic achievement rate is measured in how much a student can increase his academic achievement in grade (out of 100) per month. The increase in student academic achievement rate is affected by student academic achievement (SAA), adjustment time for student academic achievement (adjsaa), student energy level (sel), student effort rate (ser) and effectiveness of teaacher-parent contact on achievement (eftpc).				
3	3.3	decrease in student academic achievement (DSAA)	$\mathrm{DSAA} = \frac{\mathrm{SAA}}{\mathrm{lifsa}} * sasaa$	grade/ month
The decrease in student academic achievement rate (DSAA) is the rate at which student academic achievement decreases. The decrease in student academic achievement rate is measured in how much a student can decrease his academic achievement in grade (out of 100) per month. The decrease in student academic achievement rate is affected by Student Academic Achievement (SAA), satisfaction with student academic achievement (sasaa) and lifetime for satisfaction with student academic achievement (lifsa).				
3	3.4	student self-efficacy (sse)	$\mathrm{sse} = \mathrm{SAA} * \mathrm{sem}$	dimensi onless
Student self-efficacy is defined as student's beliefs about their capabilities to produce a certain level of performance. It is the multiplication of student academic achievement and self-efficacy multiplier. When student academic achievement is 100, student self-efficacy is assumed to be 1. Student self-efficacy is between 0 and 1.				
3	3.5	self-efficacy multiplier (sem)	$\mathrm{sem} = 0.01$	1/grade
Self-efficacy multiplier is the conversion of student academic achievement to the range of 0 and 1 for self-efficacy scale. Maximum achievement is considered as maximum student self-efficacy and hence it is assumed to be 0.01. The effect of one grade on student self-efficacy is 0.01.				
3	3.6	parent involvement pressure (pip)	$\mathrm{pip} = \frac{\mathrm{PI}}{\mathrm{maxpi}}$	dimensi onless
Parent involvement pressure (pip) on student is caused by parent involvement. It is the conversion of Parent Involvement (PI) between 0 and 1. When the parent involvement reaches at its maximum level, the pressure becomes also maximum. This maximum pressure is considered as '1'. Parent Involvement pressure on student is affected by parent involvement (PI) and maximum parent involvement (maxpi)				

Table 3: Student Academic Achievement (SAA) model documentation reporting definition of all the variables, units of measurement and their formulation.

Caus. Loop	No	Variable	Formulations and Comments	Units
3	3.7	teacher expectation rate (ter)	ter = 0.50	dimensionless
Teacher expectation rate (ter) is the level of teacher academic expectation from students. It is categorized between 0.00 and 1.00 (0.00=no expectation, 0.25=low expectation, 0.50=partial expectation, 0.75=moderate expectation and 1.00=high expectation). The initial value is taken as partiall expectation (0.50).				
3	3.8	teacher subject knowledge (tsk)	tsk = 0.50	dimensionless
Teacher subject knowledge (tsk) is the level of content and curricular knowledge for a specific field that a teacher has experience on it. It affects teacher quality. It is categorized between 0.00 and 1.00 (0.00=no subject knowledge, 0.25=little subject knowledge, 0.50=moderate subject knowledge, 0.75=more subject knowledge and 1.00=superior subject knowledge). The initial value is taken as moderate subject knowledge (0.50).				
3	3.9	teacher classroom effectiveness (tce)	tce = 0.50	dimensionless
Teacher classroom effectiveness is the level of how teacher cultivates thinking skills, stimulates interest in the subject and motivates students to learn. It is categorized between 0.00 and 1.00 (0.00=not at all effective, 0.25=slightly effective, 0.50=somewhat effective, 0.75=moderately effective and 1.00=extremely effective). The initial value is taken as somewhat effective (0.50).				
3	3.10	usage of various activities and methods (uoam)	uoam = 0.50	dimensionless
Usage of various activities and methods (uoam) is the level of usage that shows how often a teacher uses different activities and methods to attract students attention and to make them better learned. It is categorized between 0.00 and 1.00 (0.00=never, 0.25=almost never, 0.50=sometimes, 0.75=almost every time and 1.00=every time). The initial value is taken as sometimes (0.50).				
3	3.11	teacher quality (tq)	$tq = tsk * tce * uoam$	dimensionless
Teacher quality is the level of quality that shows how a teacher makes his job well in the learning environment. Teacher quality is determined by teacher subject area knowledge, teacher effectiveness in classroom and usage of various activities and methods in classroom. Since all the variables directly affect teacher quality, the multiplication of all variables gives teacher quality.				
3	3.12	student effort rate (ser)	$ser = pip * ter * tq$	dimensionless
Student effort rate (ser) is the serious attempts of students towards learning. It is directly affected by parent involvement pressure (pip), teacher expectation rate (ter) and teacher quality (tq)				

Table 3: Student Academic Achievement (SAA) model documentation reporting definition of all the variables, units of measurement and their formulation.

<table>
<tr><th>Caus. Loop</th><th>No</th><th>Variable</th><th>Formulations and Comments</th><th>Units</th></tr>
<tr><td>3</td><td>3.13</td><td>student energy level (sel)</td><td>$\mathrm{sel} = \mathrm{sse} * (1 - \mathrm{ser})$</td><td>dimensionless</td></tr>
<tr><td colspan="5">Student energy level is the level of energy to make student focused on studying. Student energy level is affected by student self-efficacy and student effort rate. Student energy level is directly proportional to his self-efficacy and indirectly proportional to his effort rate. As student effort rate increases, the student energy level falls.</td></tr>
<tr><td>3</td><td>3.14</td><td>adjustment time for student academic achievement (adjsaa)</td><td>$\mathrm{adjsaa} = 0.125$</td><td>month</td></tr>
<tr><td colspan="5">Adjustment time for student academic achievement (adjsaa) is the time duration of adaptation to the current academic achievement situation. It is initially taken as 0.125 months.</td></tr>
<tr><td>3</td><td>3.15</td><td>satisfaction with student academic achivement (sasaa)</td><td>$\mathrm{sasaa} = 1 - \frac{\mathrm{ag}}{\mathrm{maxsaa}}$</td><td>dimensionless</td></tr>
<tr><td colspan="5">Satisfaction with student academic achievement is the level of parent satisfaction depending on the difference between the parent expectation (PE) and student academic achievement (SAA). If the academic gap (ag) between parent expectation (PE) and student academic achivement (SAA) increases the satisfaction with student academic achievement decreases. Satisfaction is inversely proportional to academic gap.</td></tr>
<tr><td>3</td><td>3.16</td><td>desired student academic achievement (dsaa)</td><td>$\mathrm{dsaa} = \mathrm{PE}$</td><td>grade</td></tr>
<tr><td colspan="5">Desired student academic achievement is the parent's expected grade from his child.</td></tr>
<tr><td>3</td><td>3.17</td><td>maximum student academic achievement (maxsaa)</td><td>$\mathrm{maxsaa} = 100$</td><td>grade</td></tr>
<tr><td colspan="5">Maximum student academic achievement (maxsaa) is the highest available grade that a student will be able to gain from a written exam.</td></tr>
<tr><td>3</td><td>3.18</td><td>lifetime for satisfaction (lifsa)</td><td>$\mathrm{lifsa} = 2$</td><td>month</td></tr>
<tr><td colspan="5">Lifetime for satisfaction is how much a parent can continue with the same level of satisfaction depending on student academic achievement. Student academic achievement is shown on report cards formally. Parent can be aware of general academic achievement of his child when he has a report card sent by the school. Report cards and interim reports are issued bimonthly. That's why, parents keep their level of satisfaction until the next report card will be issued.</td></tr>
</table>

Student Academic Achievement is the heart of the model since that is one of the outputs at the end of an educational process. Even though so many interrelated variables affect student academic achievement, only variables in parent and teacher dimensions are taken into consideration in order to make the model simplified and explainable.

To analyze all the variables at the same time especially for a social research is very difficult. But using system dynamics modeling is the beauty of the study to analyze a complicated process. Student Academic Achievement is taken as a stock and its rates are defined as increase in student academic achievement and decrease in student academic achievement as shown in figure-146. The unit of student academic achievement is grade between 0 and 100.

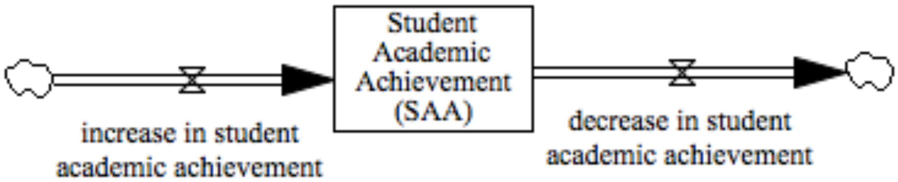


Figure 146 – The stock flow diagram of Student Academic Achievement.

In figure 147, student academic achievement affects its own increasing rate and decreasing rate both directly and indirectly.

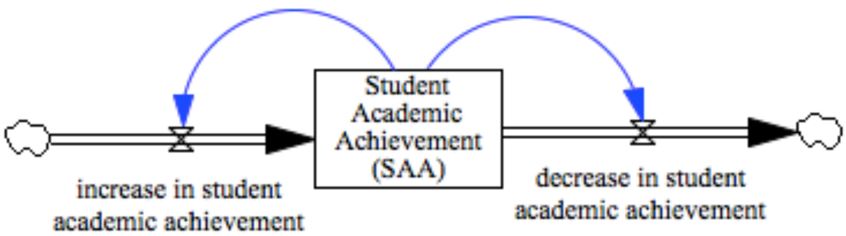


Figure 147 – Elementary relationship between Student Academic Achievement (SAA) and rate variables.

The important contributor to student academic achievement is to emerge self-efficacy beliefs. Self-efficacy is gained if students feel a sense of achievement. Self-efficacy is motivation related factor and it motivates the students to work hard. When students are unmotivated and lack of a necessary level of self-efficacy, they feel like an overloaded person and no desire to do something.

Self-efficacy beliefs increase the level of student effort to complete his work and become successful. Students who have a high level of self-efficacy increase the number of hours spent on studies per week. To study more is an important predictor of academic achievement. The interrelation between self-efficacy and student academic achievement is an important cycle and affects both directions.

High self-efficacy beliefs prevents an emotion of anxiety and generates positive emotions that help students to succeed academically and student academic achievement increases the level of student self-efficacy. This relation is added to the model and shown in figure-148.

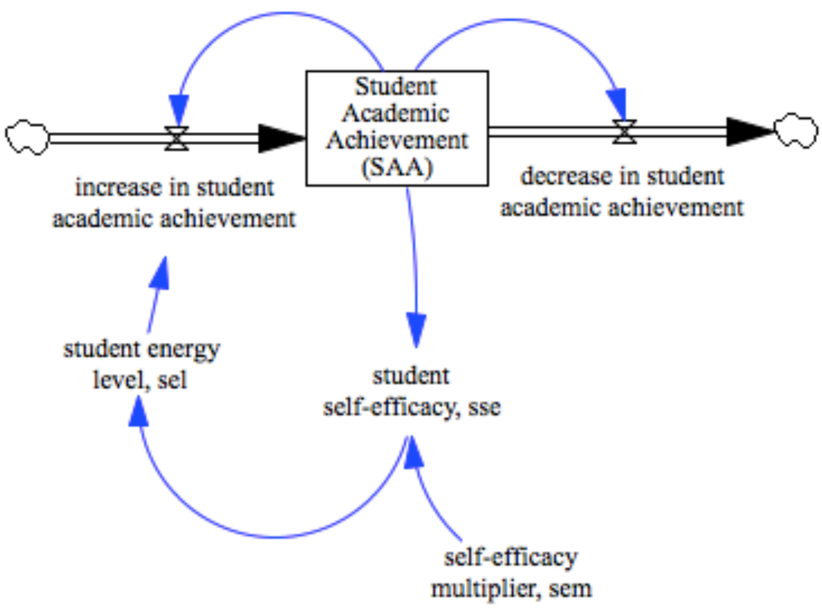


Figure 148 – Elementary relationship between Student Academic Achievement (SAA) and rate variables / the effect of student self-efficacy (sse) on student academic achievement.

There is a first-order linear negative feedback system between student academic achievement (State of the system) and parent expectation (Desired State of the System). If student academic achievement increases, the academic gap decreases. However, if parent expectation increases, academic gap increases as well. Both student academic achievement and parent expectation stock are controlled by academic gap. Academic gap is the subtraction of student academic achievement from Parent's expected academic grade. Additionally, academic gap is inversely proportional to satisfaction with student academic achievement. Academic gap inversely affects satisfaction and rate of decrease in student academic achievement. When student academic achievement approaches to its maximum value, satisfaction with student academic achievement converges to 1. More satisfaction may decrease the rate of student academic achievement. The relation between student academic achievement, academic gap and parent expectation is added to the model and shown in figure-149.

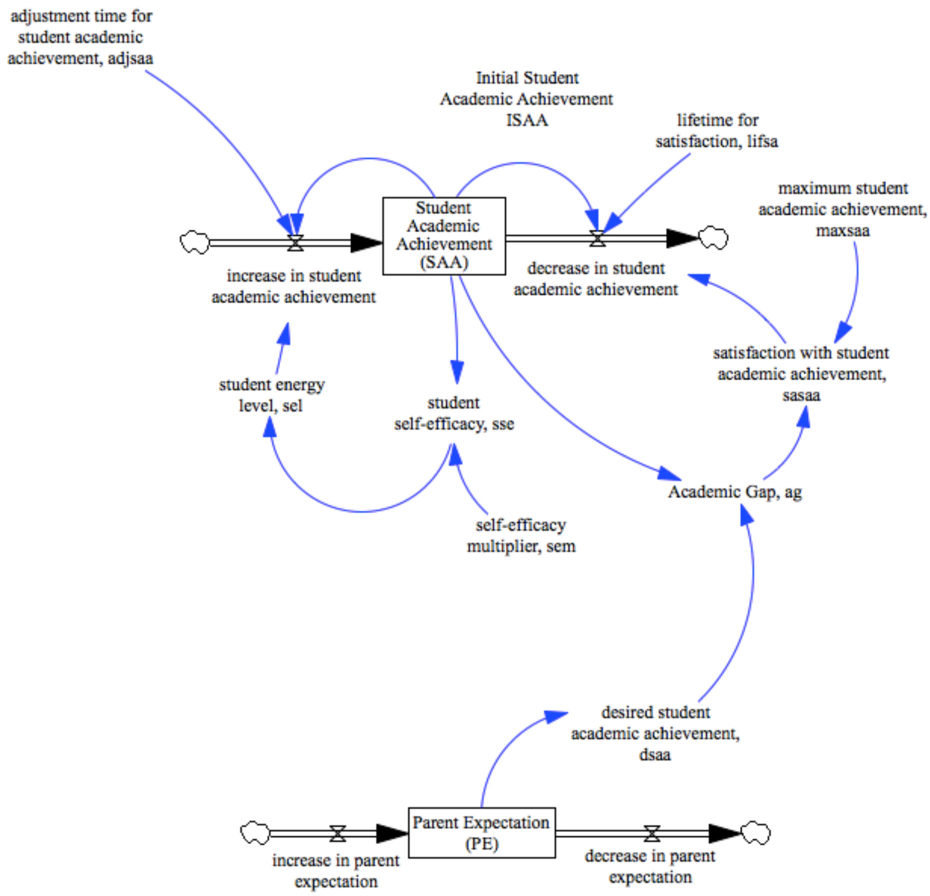


Figure 149 – Elementary relationship between Student Academic Achievement (SAA) and rate variables / the effect of student self-efficacy (sse), academic gap (ag) and Parent Expectation (PE) on the rates of student academic achievement.

Academic gap also affects the level of parent involvement. In order to gain on academic gap, more parent involvement is required. Hence, total needed parent involvement increases as academic gap increases. Total needed parent involvement will increase the parent involvement. The relation between academic gap and Parent Involvement stock is added to the model and shown in figure-150.

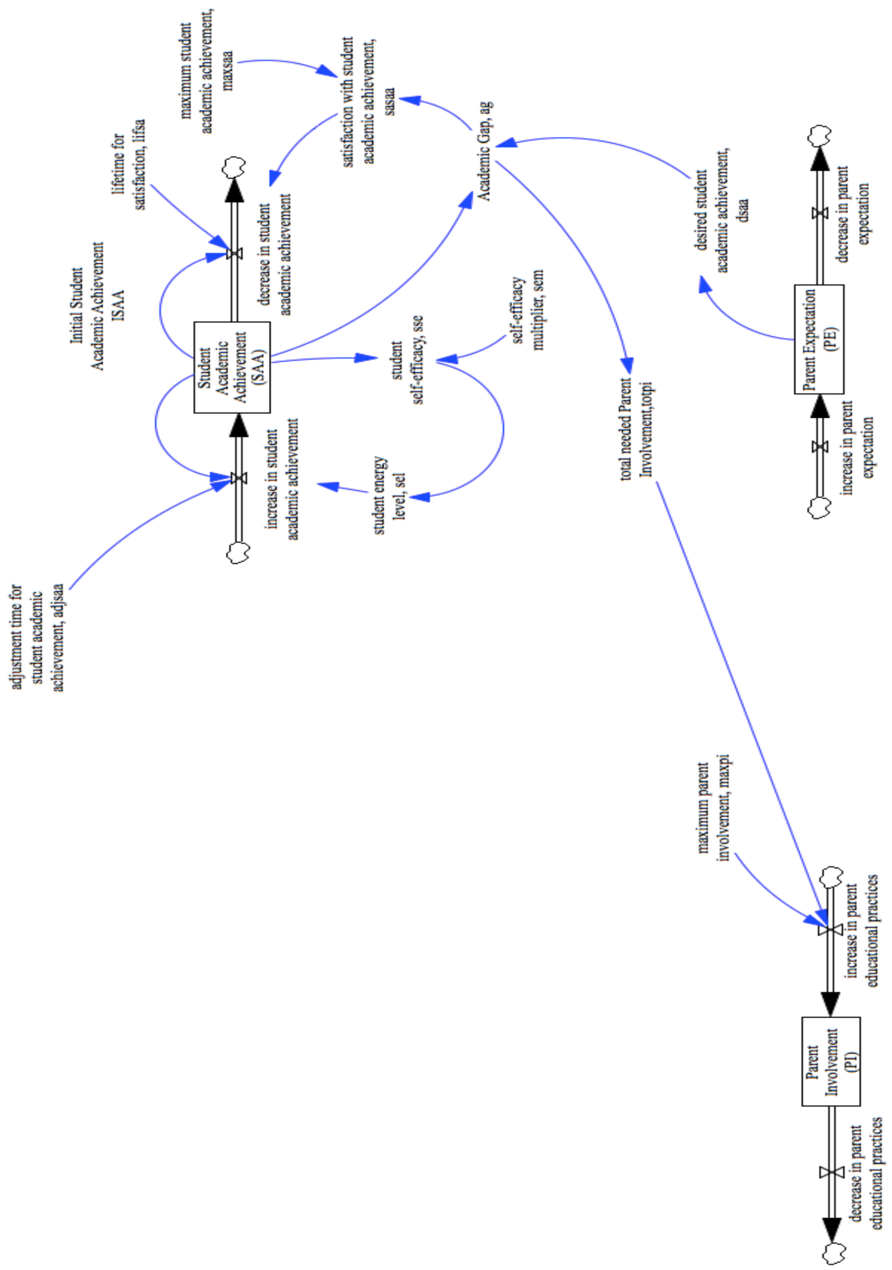


Figure 150 – Elementary relationship between Student Academic Achievement (SAA) and rate variables / the effect of student self-efficacy (sse), academic gap (ag) and Parent Expectation (PE) on the rates of student academic achievement / the effect of academic gap on Parent Involvement Stock.

Parent Involvement also affects student academic achievement. When parents spend more time for educational activities and involve in educational process whether at home or at school, this puts a certain level of pressure on student to work hard and increase academic achievement.

Parents encourage students to study hard at home by giving advice, monitoring their behavior, creating discipline atmosphere at home and helping directly to their studies. Parental support increases student effort and hence student academic achievement.

However, effort rate of students decrease the energy level of student within the time. The relation between how Parent Involvement stock affects Student Academic Achievement stock is added to the model and shown in figure-151.

Student effort rate is an important contributor for academic success. In addition to parent dimension, teacher dimension also affects the level of student effort to complete homework or work harder. Teachers make a significant difference in student academic achievement. Teachers influence educational outcomes and directly affect student academic achievement. Teachers beliefs and academic expectations play a important role to create a quality of class instruction and hence increases student effort towards achieving high grades. Teachers design the learning environment effectively in order to help students for attaining higher achievement goals. Teachers who have higher expectations from students at the end of an educational process encourage them study hard and increase their effort rate.

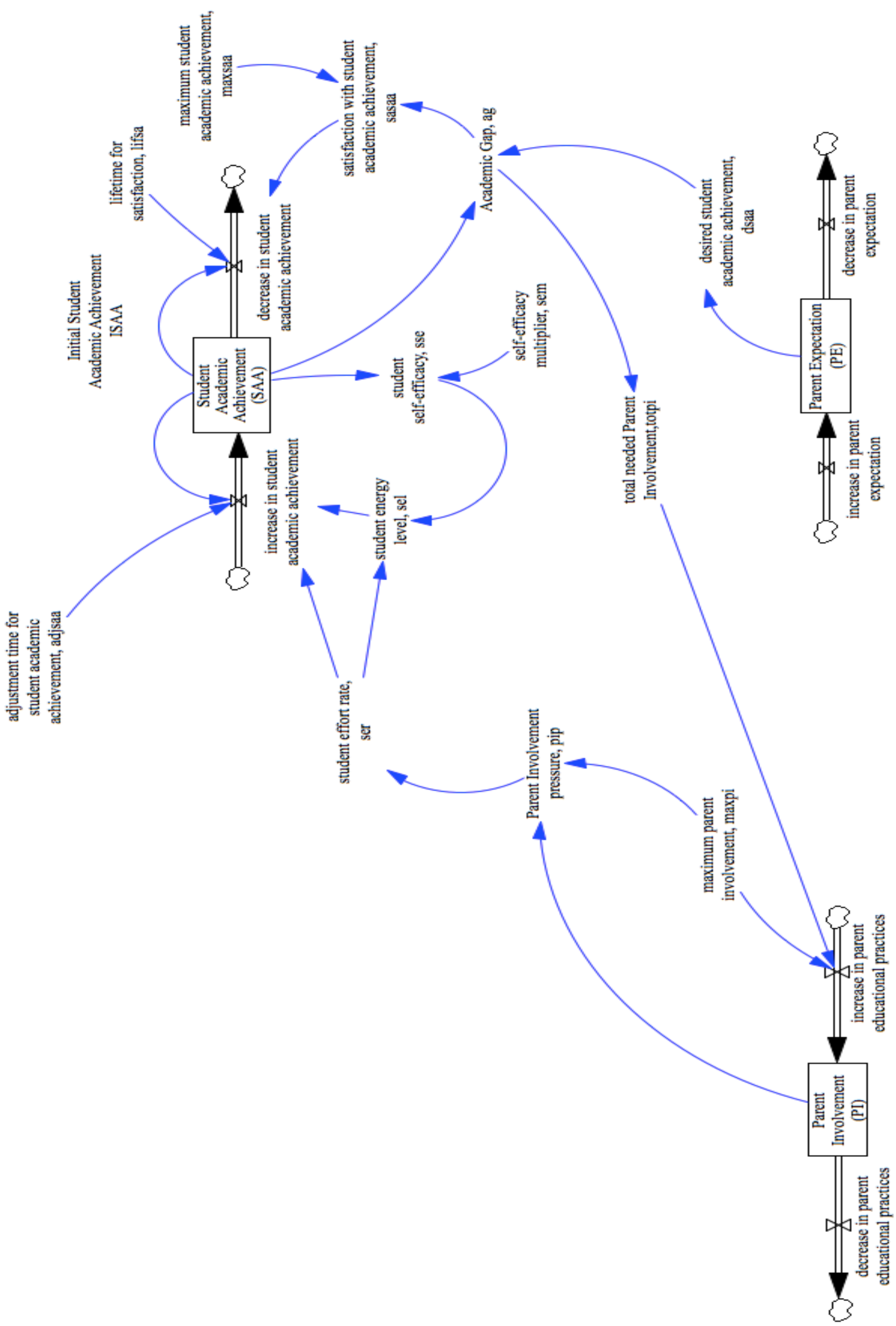


Figure 151 –Elementary relationship between Student Academic Achievement (SAA) and rate variables / the effect of student self-efficacy (sse), academic gap (ag) and Parent Expectation (PE) on the rates of student academic achievement / the effect of academic gap on Parent Involvement Stock and the effect of Parent Involvement Stock on Student Academic Achievement Stock.

In addition to teacher expectation, teacher quality is also important contributor for students to be motivated. Teachers design the learning environment and they are only facilitator to arouse student's curiosity and engage them in the process. Teacher classroom effectiveness, teacher subject knowledge and usage of various activities and methods in learning environment shows quality of a teacher. The use of variety of teaching activities and methods creates a positive and supportive learning environment for students. Qualified teachers create a supportive learning environment. Qualified teachers listen to students, understand their abilities, skills and knowledge and teach them accordingly. This helps students be motivated and put more effort towards working hard. The effect of teacher expectation and teacher quality on student effort is added to the model and shown in figure-152.

Another variable from teacher dimension that affects student academic achievement is the teacher-parent contact. If the quality and rate of teacher-parent contact increases, the rate of increase in student academic achievement also increases. Teachers can make their parent meeting effectively and deliver meaningful information to parents. The valuable information linkage between teachers and parents increases the quality of teacher-parent communication and gives feedback to parents how to start a course of action to increase academic achievement. And then parents can realize the pathway about how to help their children at home to encourage them study hard. Hence, teacher-parent contact affects student academic achievement. It is added to the model and final form of Student Academic Achievement Stock is shown in figure-153.

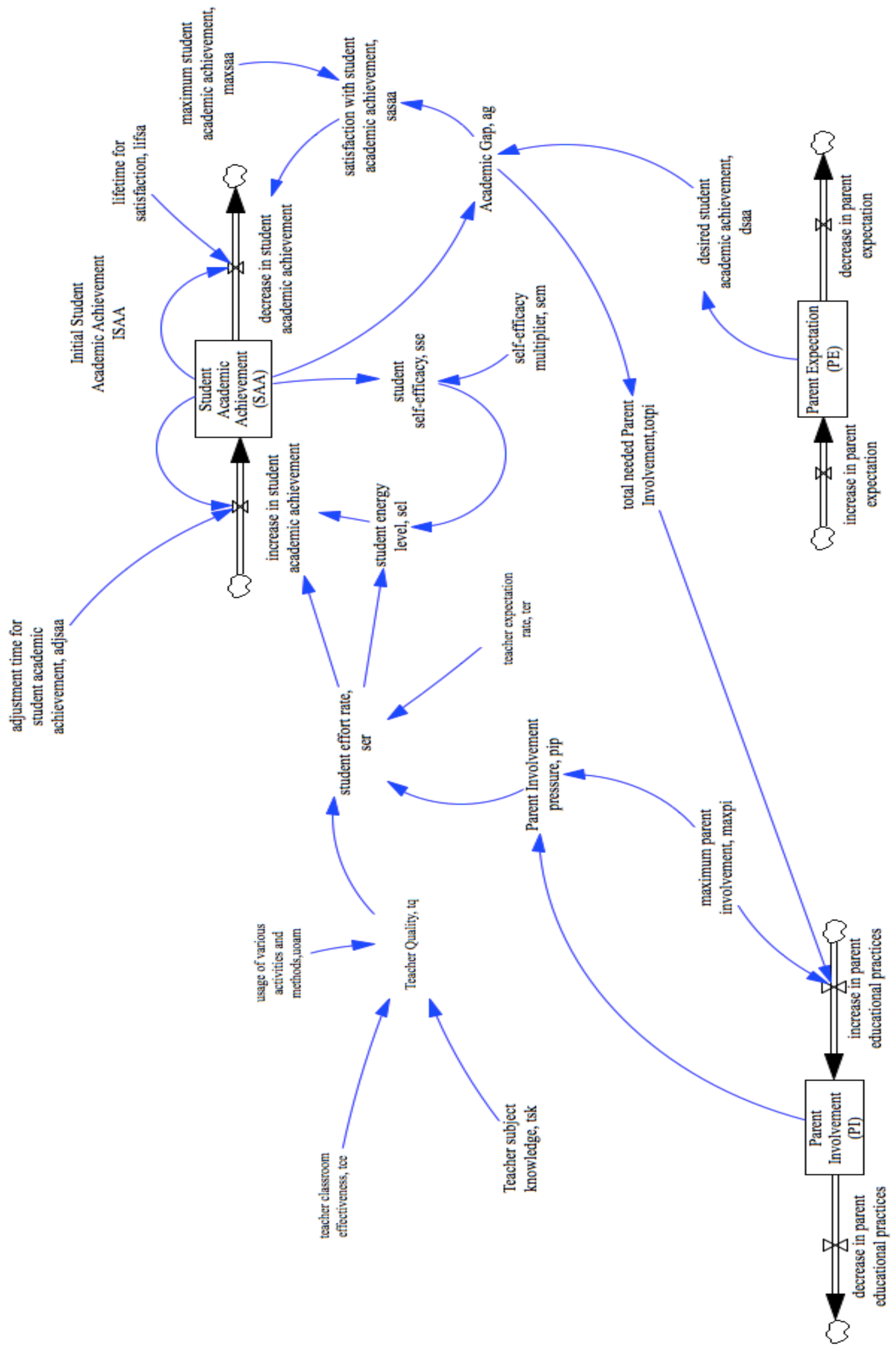


Figure 152 –Elementary relationship between Student Academic Achievement (SAA) and rate variables / the effect of student self-efficacy (sse), academic gap (ag), Parent Expectation (PE), teacher quality (tq) and teacher expectation (te) on the rates of student academic achievement / the effect of academic gap on Parent Involvement Stock and the effect of Parent Involvement Stock on Student Academic Achievement Stock.

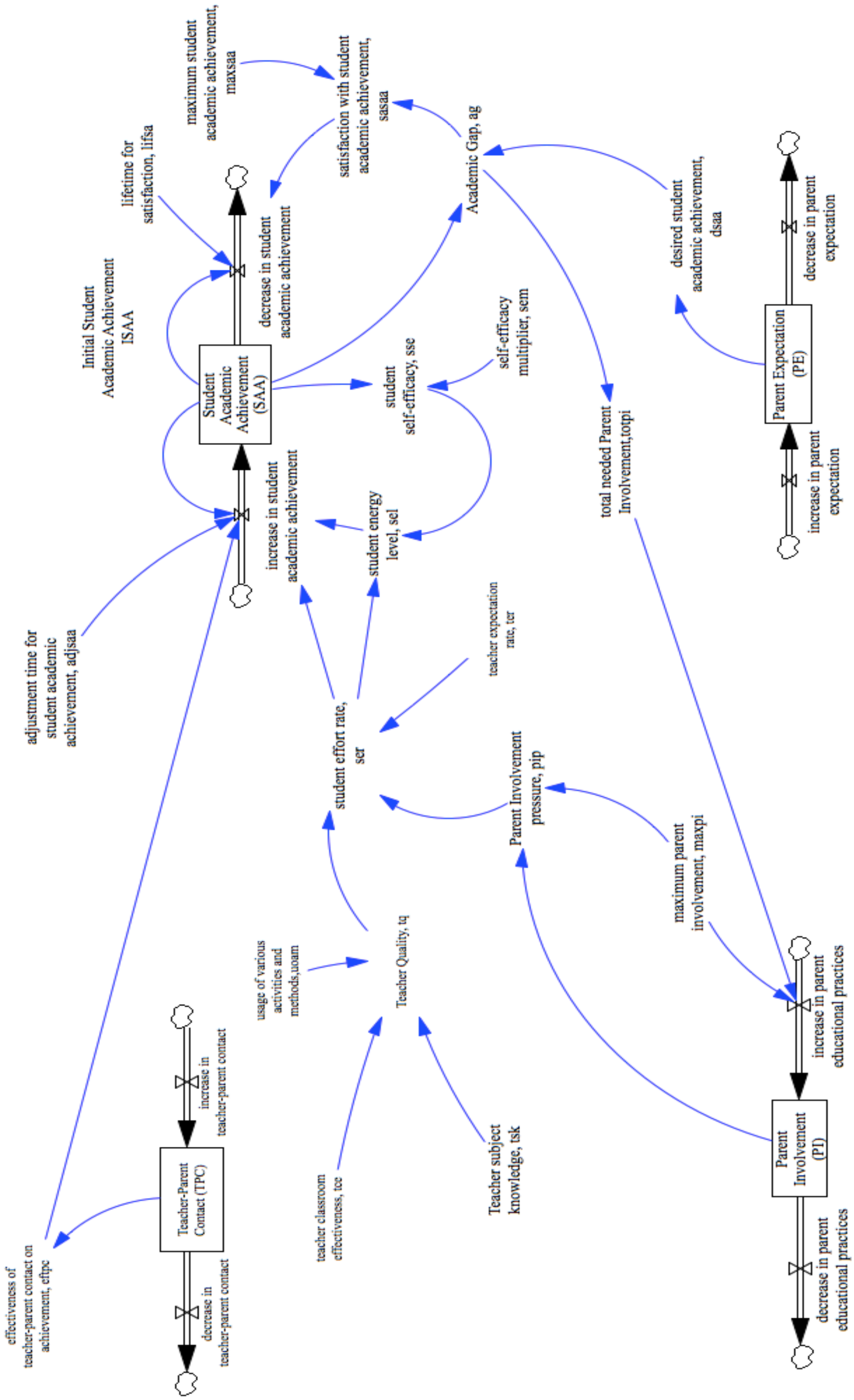


Figure 153 –Student Academic Achievement (SAA) stock, rate variables and all the variables related to the stock.

7.1.4. Teacher-parent contact (TPC) stock-flow

“To increase the incidence and quality of model assessment and reproduction studies”, following information regarding with Teacher-parent Contact Stock is provided in the model as it is mentioned by Barlas (2000).

- “Units of measurement for all variables and parameters.”
- “Sources of data (qualitative and quantitative) for different equations and algorithmic rules.”
- “Definition of all the variables used in the model and the logic behind their formulation.”

The preferred model reporting requirements for Teacher-parent contact stock flow is shown in the table-4.

Table 4: Teacher-parent contact (TPC) model documentation reporting definition of all the variables, units of measurement and their formulation.

<table>
<tr><th>Caus. Loop</th><th>No</th><th>Variable</th><th>Formulations and Comments</th><th>Units</th></tr>
<tr><td>4</td><td>4.1</td><td>Teacher-parent contact (TPC)</td><td>$TPC(t) = TPC(0) + \int_0^t (\mathrm{ITPC(t)} - \mathrm{DTPC(t)}) * \mathrm{dt}; TPC(0) = 0$</td><td>hour</td></tr>
<tr><td colspan="5">Teacher-parent contact (TPC), is the total meeting time of teacher and parents. It accumulates the increase in teacher-parent contact (ITPC) and declines as the decrease in teacher-parent contact (DTPC). It is the grade taken by student out of 100.</td></tr>
<tr><td>4</td><td>4.2</td><td>increase in teacher-parent contact (ITPC)</td><td>$\mathrm{ITPC} = \frac{(1 - \mathrm{crtpc}) * \mathrm{PI} * \mathrm{sca} * \mathrm{tc} * \mathrm{tcq}}{\mathrm{uttpc}}$</td><td>hour/ month</td></tr>
<tr><td colspan="5">The increase in teacher-parent contact rate (ITPC), is the rate at which teacher-parent contact time increases. The increase in teacher-parent contact rate is measured in how many hours per month a parent can talk with teachers or school administration about his child's educational progress. The increase in teacher-parent contact rate is affected by changing ratio in teacher-parent contact (crtpc), parent involvement (PI), teacher caring (tc), teacher communication quality (tcq), school communication awareness (sca) and unit time for teacher-parent contact (uttpc).</td></tr>
<tr><td>4</td><td>4.3</td><td>decrease in teacher-parent contact (DTPC)</td><td>$\mathrm{DTPC} = \frac{\mathrm{crtpc} * \mathrm{TPC} * \mathrm{acoac}}{\mathrm{uttpc}}$</td><td>hour/ month</td></tr>
<tr><td colspan="5">The decrease in teacher-parent contact rate (DTPC) is the rate at which teacher-parent contact time decreases. The decrease in teacher-parent contact rate is affected by changing ratio in teacher-parent contact (crtpc), teacher-parent contact (TPC), acceptability of achievement by teacher (acoac) and unit time for teacher-parent contact (uttpc).</td></tr>
<tr><td>4</td><td>4.4</td><td>school community awareness constant (sca)</td><td>$\mathrm{sca} = 0.50$</td><td>dimensi onless</td></tr>
<tr><td colspan="5">School community awareness constant (sca), is the level of school community awareness about the importance of getting contact with parents in order to increase student academic achievement. It is categorized between 0.00 and 1.00 (0.00=not at all aware, 0.25=slightly aware, 0.50=somewhat aware, 0.75=moderately aware and 1.00=extremely aware). The initial value is taken as somewhat aware (0.50).</td></tr>
<tr><td>4</td><td>4.5</td><td>teacher caring constant (tc)</td><td>$\mathrm{tc} = 0.50$</td><td>dimensi onless</td></tr>
<tr><td colspan="5">Teacher caring constant (tc) is the level of how teachers support students in order to make them succeed more. It is categorized between 0.00 and 1.00 (0.00=not at all cared, 0.25=slightly cared, 0.50=somewhat cared, 0.75=moderately cared and 1.00=extremely cared). The initial value is taken as somewhat cared (0.50).</td></tr>
<tr><td>4</td><td>4.6</td><td>teacher verbal ability (tv)</td><td>$\mathrm{tv} = 0.50$</td><td>dimensi onless</td></tr>
<tr><td colspan="5">Teacher verbal ability is the level of how teachers use effective language during parent and student meetings. It contributes to teacher communication quality. It is categorized between 0.00 and 1.00 (0.00=poor, 0.25=fair, 0.50=good, 0.75=very good and 1.00=excellent). The initial value is taken as good (0.50).</td></tr>
<tr><td>4</td><td>4.7</td><td>teacher pedagogical knowledge (tp)</td><td>$\mathrm{tp} = 0.50$</td><td>dimensi onless</td></tr>
<tr><td colspan="5">Teacher pedagogical knowledge is the level of teacher knowledge about his job. It contributes to teacher communication quality. It is categorized between 0.00 and 1.00 (0.00=poor, 0.25=fair, 0.50=good, 0.75=very good and 1.00=excellent). The initial value is taken as good (0.50).</td></tr>
</table>

Table 4: Teacher-parent contact (TPC) model documentation reporting definition of all the variables, units of measurement and their formulation.

Caus. Loop	No	Variable	Formulations and Comments	Units
4	4.8	teacher communication quality (tcq)	$\mathrm{tcq} = \mathrm{tv} * \mathrm{tp}$	dimensionless
Teacher Communication Quality (tcq) is the level of teacher effectiveness during parent meeting to increase teacher parent contact time and hence student academic achievement. Teacher communication quality depends on teacher verbal ability and teacher pedagogical knowledge.				
4	4.9	changing ratio in teacher-parent contact (crtpc)	$\mathrm{crtpc} = \dfrac{\mathrm{TPC}}{\mathrm{maxtpc}}$	dimensionless
Changing ratio in teacher-parent contact describes the effect of teacher-parent contact on rates when teacher-parent contact increases more or less. The changing ratio is the conversion of teacher-parent contact between 0 and 1 by the division of real teacher-parent contact time (TPC) to maximum teacher parent contact time (maxtpc).				
4	4.10	maximum teacher-parent contact (maxtpc)	$\mathrm{maxtpc} = 22$	hour
Maximum teacher-parent contact is the maximum plausible time in a month that a teacher can communicate with a parent. It is assumed that a teacher can communicate with the same parent for one hour per day. Since the working days are 22 in a month, maximum teacher-parent contact time is considered as 22 hours.				
4	4.11	unit time for teacher-parent contact (uttpc)	$\mathrm{uttpc} = 1$	month
Unit time for teacher-parent contact (uttpc) is taken as one month since the time step is in months.				
4	4.12	acceptability of achievement by teacher (acoac)	$\mathrm{acoac} = 0.50$	dimensionless
Acceptability of achievement by teacher (acoac) is the level of acceptability of teachers about their student's current academic achievement. If they accept the current success of students and don't believe extra effort to increase student academic achievement, it will decrease the level of teacher-parent contact rate. It is categorized between 0.00 and 1.00 (0.00=totally unacceptable, 0.25=unacceptable, 0.50=neutral, 0.75=acceptable and 1.00=perfectly acceptable). The initial value is taken as neutral (0.50).				
4	4.13	effectiveness of teacher-parent contact on achievement (eftpc)	$\mathrm{eftpc} = \dfrac{\mathrm{TPC}}{\mathrm{maxtpc}}$	dimensionless
The effectiveness of teacher-parent contact is the level of how teacher-parent contact affect student academic achievement between o and 1. It is measured by the division of real teacher-parent contact time (TPC) to maximum teacher parent contact time (maxtpc).				

Teacher and parent are two important variables that affect deeply student academic achievement. They both encourage students to increase their effort level for success. That's why the contact between them gains so much importance for two ways information transfer. The teacher-parent contact increases the parental support since it increases parent awareness about children's academic results and situations in school. Parents encourage the students to study hard at home by giving advice, monitoring their behavior, creating discipline atmosphere at home and helping directly to their studies.

This support increases student motivation and effort level towards studying hard. Moreover, a teacher can also learn how to motivate each student in learning environment. This contact gives feedback to parents and teachers how to start a course of action to increase academic achievement. This is the important stock that combines two important dimensions.

Teacher-parent contact is taken as a stock and its rates are defined as increase in teacher-parent contact and decrease in teacher-parent contact as shown in figure-154. The unit of teacher-parent contact is considered as hours.

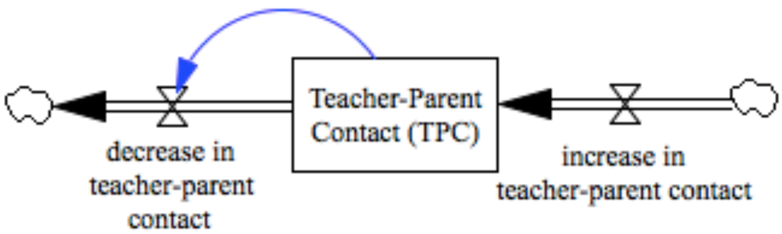


Figure 154 –The stock flow diagram of Teacher-parent contact.

In figure 155, teacher-parent contact affects its own increasing rate and decreasing rate both directly and indirectly. Indirect feedback loop of Teacher-parent contact is linked by the variable of changing ratio in teacher-parent contact that represents intervening variables in feedback loops.

The changing ratio in teacher-parent contact is actually the conversion of Teacher-parent contact between 0 and 1. When teacher-parent contact converges towards its maximum value, the changing ratio in teacher-parent contact converges towards 1 directly. Depending on the changing ratio, rates are also subject to change accordingly. In order to ensure this, the increase in teacher-parent contact is defined to converge towards zero as the value of teacher-parent contact passess mid-value between its minimum and maximum values and approaches to its maximum value. On the other hand, the decrease in teacher-parent contact is defined to converge towards zero as the value of teacher-parent contact goes to zero. To control this change in the model, the changing ratio in teacher-parent contact is added to the model and shown in figure-155.

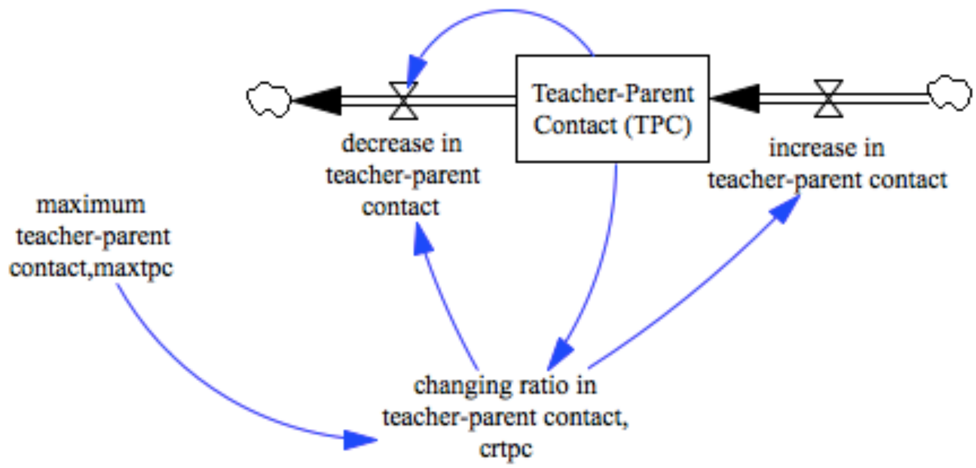


Figure 155 –Elementary relationship between Teacher-parent contact (TPC) and rate variables.

There must be a motivational factor for teachers to get contact with parents. This can be due to both school policy about parent involvement and teacher's desire to do that. If teachers and school administration give more importance to school community, they will be in favor of getting contact with them frequently.

Therefore, school community awareness is an important contributor for teacher-parent contact rate. When school community awareness constant in the model increases, that means sharing information within school community is considered as an important educational activity for student academic achievement and progress. To control this effect, school community awareness constant is added to the model and shown in figure-156.

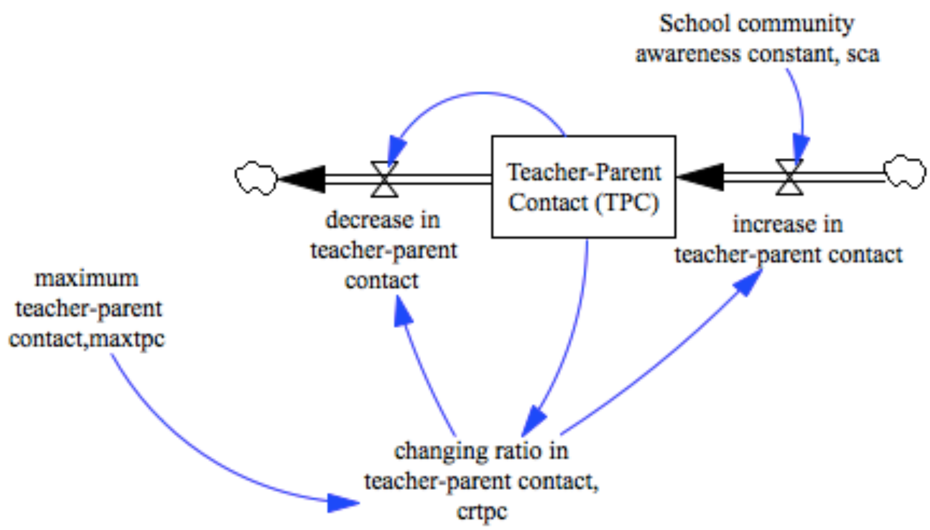


Figure 156 –Elementary relationship between Teacher-parent contact (TPC) and rate variables / the effect of school community awareness constant (sca) on increase in teacher-parent contact.

Teacher characteristics also affect the rate of teacher-parent contact. Teachers play a crucial and active role in facilitating teacher-parent contact. If teacher cares about student academic achievement, they will try to find a solution to encourage them. Teacher-parent contact is the most efficient way to do that. Teacher caring directly affects the teacher-parent contact rate. Another important teacher variable that affects teacher-parent communication is the teacher communication quality. Teacher verbal ability and teacher pedagogical knowledge makes communication qualified. Pedagogical knowledge of teachers makes them comfortable during communication with school community and makes them active in learning environment. However, teacher verbal ability is the actually transfer of knowledge from teachers to parents in an effective way.

Although, the school is responsible for the academic and social growth of students, yet parents at home play enormous roles in building the personality of the child and making the child what he is. Families can also set up a learning environment at home. The acquisitions from this learning environment affect student academic achievement. Therefore, establishing quality relatinships with parents always contributes to the success of students. When teachers lack of verbal abilities and necessary pedagogical knowledge, they will probably get contact with parents less. The variables of teacher caring and teacher communication quality are added to the model and shown in figure-157.

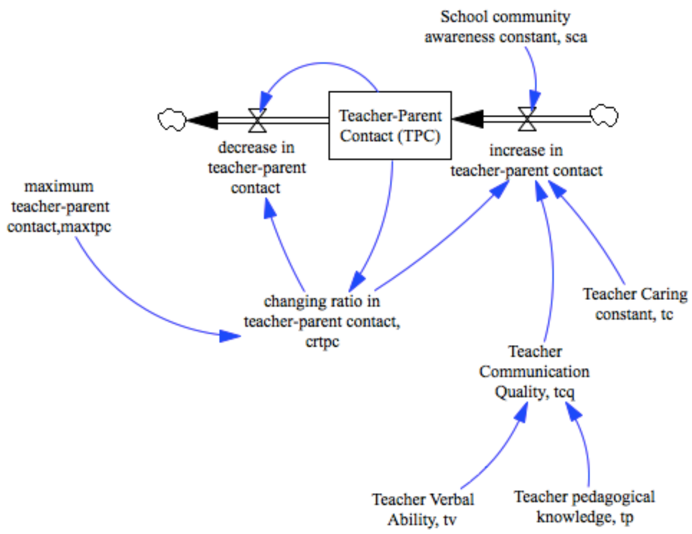


Figure 157 –Elementary relationship between Teacher-parent contact (TPC) and rate variables / the effect of school community awareness constant (sca), teacher caring (tc) and teacher communication quality (tcq) on increase in teacher-parent contact.

Moreover, parents also affect teacher-parent contact rate as well as teachers. When the hours of parent involvement increases, the teacher-parent contact time directly increases. Parent involvement has two dimensions whether it is at home or at school. The majority of school contacts for parents are to get contact with teachers. Therefore, there is a direct relationship between these two stocks, parent involvement and teacher-parent contact. This relation is added to the model and shown in figure-158.

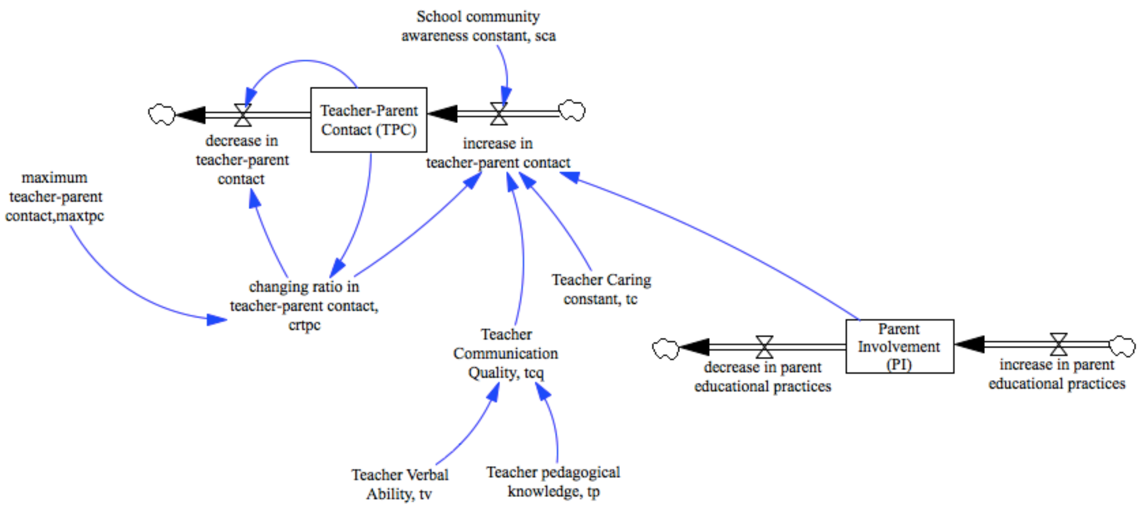


Figure 158 –Elementary relationship between Teacher-parent contact (TPC) and rate variables / the effect of school community awareness constant (sca), teacher caring (tc), teacher communication quality (tcq) and Parent Involvement (PI) on increase in teacher-parent contact.

However, teacher's belief about student academic achievement is important to facilitate teacher-parent contact rate. If teachers believe he or she has the capacity to make better, they probably engage more actively in getting contact with parents. Getting contact with parents is the most commonly used and the best way to keep students on working hard even at home. If teachers accept the current academic achievement, they will be unmotivated to get contact with parents. This deeply affects the frequency of teacher-parent contact. This event is described by the variable called acceptability of achievement by teacher that is added to the model and shown in figure-159.

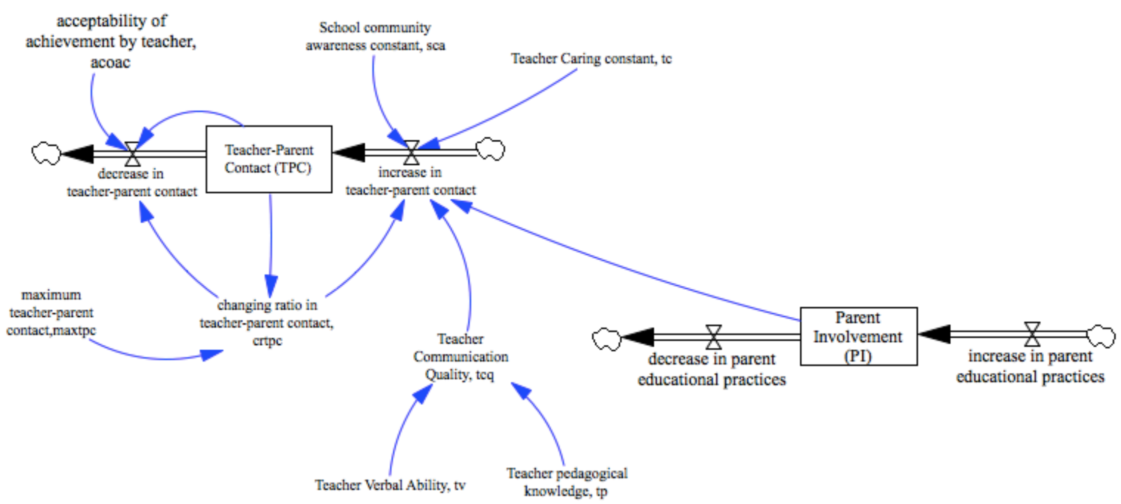


Figure 159 –Elementary relationship between Teacher-parent contact (TPC) and rate variables / the effect of school community awareness constant (sca), teacher caring (tc), teacher communication quality (tcq) and Parent Involvement (PI) on increase in teacher-parent contact / the effect of acceptability of achievement by teacher (acoac) on decrease in teacher-parent contact.

Time Step for teacher-parent contact stock is in months. Hence the unit time for teacher-parent contact is taken as one month. The final model together with its formulations for Teacher-parent contact (TPC) is shown in figure 160.

- *Teacher-parent Contact = INTEG (increase in teacher-parent contact - decrease in teacher-parent contact)* *(9)*

- *Increase in parent expectation* $= \frac{(1-crtpc)*sca*tc*tcq*PI}{uttpc}$ *(10)*

- *Decrease in parent expectation* $= \frac{TPC*crpi*acoac}{uttpc}$ *(11)*

- *changing ratio in parent involvement* $= \frac{TPC}{maxtpc}$ *(12)*

- *teacher communication quality* $= tv * tp$ *(13)*

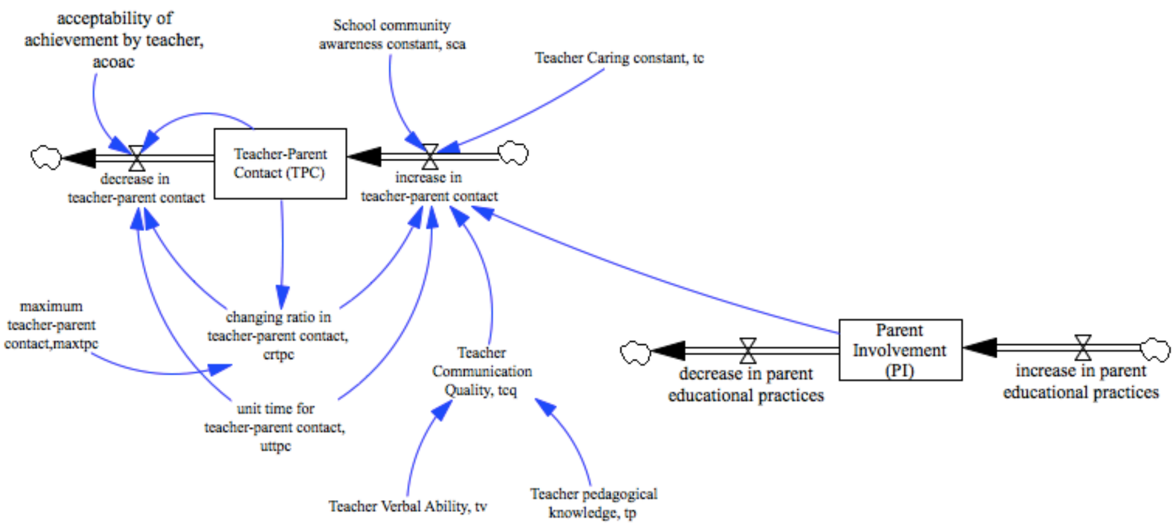


Figure 160 –Teacher-parent contact (TPC) stock, rate variables, all the variables and the necessary formulations between them.

7.2. Simulation Model

When all the stocks are combined, the final simulation model is taken as in figure-161. Its A3 form is also shown in the Appendix K. This model shows the interrelations between all the stocks and their variables.

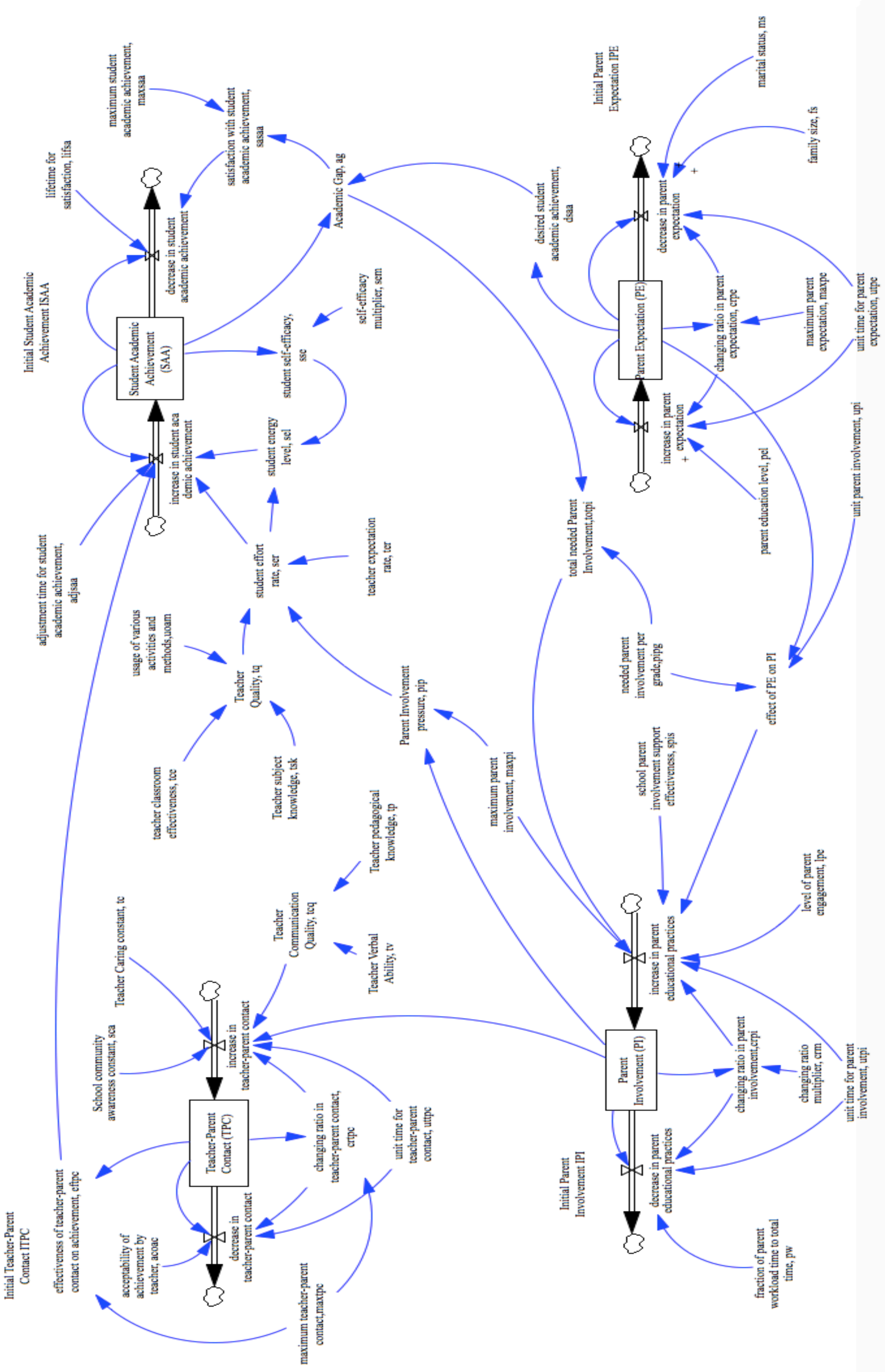


Figure 161 –Simulation model

8. RESULTS AND DISCUSSION

8.1. Model Test Results

To test the model, Barlas (2000) has proposed “a sequence of validation tests for validation”. In this section, how the model is tested and validated will be explained. The model has internal consistency and the simulation model is more accurate representation of real-life situations. The model does what the modeler intends to do. The model is verified that there are no inconsistencies between the model and the dynamics hypothesis.

After verification, model validity test has been carried out. Depending on Barlas (2000) ideas, model validity test has been by two types of tests. These are direct structure test and structure oriented behavior test.

8.1.1. Direct structure test

The model makes direct comparison with the real life situations. Each variable is taken alone and evaluated with the current knowledge in literature with dimensional consistency. To do that, stock and flow models were built at the same time. Each equation was checked and evaluated if it reflects real life situation. Zero fudge-factoring is aimed at and the units of item, a ‘rate’ has the unit of item/time since they reflect flows in the model. Overall, the structure of the model is a meaningful description of the real relations between the stakeholders in education.

8.1.2. General principles of formulation – structure-oriented behavior tests

System Dynamics model includes causal loop diagrams and cause-effect formulation to describe the relation between the variables. As such, these formulations must obey some fundamental principles mentioned by Barlas (2000). These fundamental principles carry out structure-oriented behavior test of the model. This test is essential to build a robust model and validate it. These fundamental principles are;

a) ***“Equations must have real-life meaning.”***

   All the equations, variables and parameters must correspond to real-life concepts and they must be understandable and explainable by the specialists in that corresponding area. All the variables and relations between the parameters are taken from the literature and they are discussed by a couple of teachers, school managers and educational experts through implementing group model building activities. Behaviour tests were designed to compare the major pattern components in the model behavior with the pattern components in the real life behaviour.

b) ***"Equations must be dimensionally consistent."***
The dimensional consistency of each equation was verified without including any "dummy" coefficients in order to make the units consistent. The real-life units of each coefficient were used and they are meaningful.

c) ***"Equations must yield valid results even in extreme conditions."*** The stocks have logical and realistic maximum and minimum values. In the model, the parameters are taking their realistic values. The extreme conditions for the variables, parameters and stocks are in realistic domain. When academic gap between the desired student academic achievement and current student academic achievement converges to zero, the satisfaction with grade converges also to maximum value.

d) ***"Realism should not be sacrificed for mathematical simplicity."*** The model provides a realistic description of real educational process with respect to the dynamic problem. Real processes obviously involve non-linear relations, interacting so many multiple feedback loops and time delays. Normally, each of these factors makes mathematical analysis of the model complex. In the model, this complexity was taken into consideration in order not to sacrifice the realism. The relations are taken directly from the literature and they are discussed with a couple of teachers and school managers. Mathematical exactness was not considered as a primary concern to build the model. The real life situations in learning environment were analyzed to make the model effective. It is believed that the model reflects the real-life educational process with the meaningful formulation behind it.

e) ***"Equations must not unrealistically assume optimality or equilibrium."*** Equations in the model describe the real world situations rather than assuming that all actors behave optimally. Equations derived from equilibrium assumptions were not applied to the model.

8.1.3. Linear formulation

“A linear equation assumes that the output is proportional to the input” (Barlas, 2000). “The general form is $Y = a + bX$, where the intercept a and slope b are both constant”. Here is the some examples used in the model to show linear relationship between the parameters.

- $Total\ needed\ PI = academic\ gap * needed\ PI\ per\ grade$ *(14)*

- $PI\ pressure = \frac{PI}{maximum\ PI}$ *(15)*

- $satisfaction\ with\ grade = 1 - \frac{academic\ gap}{maximum\ SAA}$ *(16)*

The above formulations are all linear, because needed PI per grade, maximum PI and maximum SAA are all assumed to be constant. But some of the parameters such as total needed PI, PI pressure, satisfaction with grade and academic gap are direct or indirect functions of some stock variables. Therefore, formulation becomes non-linear as proportionality (in other words, constant slope) assumption between input and output is not hold.

8.1.4. Non-linear equation formulation

“The simple definition of a non-linear formulation is “a formulation that is not linear.” This means any mathematical expression other than $a + bX$ including any x^a, $In(x)$, e^x any other combination of such functions” (Barlas, 2000).

a) “Prevalence of non-linearity”

In a dynamics model, non-linearity is natural. Consider the following equations used in the model;

- $energy\ level = selfefficacy * (1 - effort\ rate)$ (17)

- $Academic\ gap = desired\ SAA - SAA$ *(18)*

They are linear equations if desired SAA and self-efficacy are constant. But in the model self-efficacy is determined as a result of student academic achievement stock and desired SAA is determined as a result of parent expectation stock. Their value depends on how much the stocks change. Hence, they become non-linear equations.

b) *"Non-linear formulation examples and multiplicative "effect" formulations"*

A basic and standard non-linear formulation is used in the model. The general tendency is to use 'product' formulation in the models. Most of the equations are expressed in terms of production of variables or parameters. A generalization of product formulation becomes "multiplicative effect" formulation. It can be given as an example that teacher quality is mostly considered a teacher subject knowledge, teacher classroom effectiveness, usage of activities and methods in the learning environment. Therefore teacher quality is considered as;

$$tq = (effect\ of\ tsk\ on\ tq) * (effect\ of\ tce\ on\ tq) * (effect\ of\ uoam\ on\ tq) \qquad (19)$$

where tq (teacher quality), tsk (teacher subject knowledge), tce (teacher classroom effectiveness) and uoam (usage of various activities and methods)

However, some input values are normalized to measure its effect on an output. "The meaning of "normal" values is that when all input variables are at their normal values, we expect the output value Y to be at its normal value. In an multiplicative effect formulation this requires that all functions must yield 1 when the input variable has its normal value" (Barlas 2000). Here is the example to show how it works;

$$PI\ pressure = \frac{PI}{maximum\ PI} \qquad \text{where maximum PI = 46 hours} \qquad (20)$$

The above equation says that when the input variable Parent Involvement is at its normal value of 45, the Parent Involvement pressure takes its normal value of 1.

Such a normalization is important in building robust models, because if absolute values are used as inputs to these functions, then it would be almost impossible to experiment with different model parameters, as the input values would quickly go outside the ranges of function (Barlas, 2000).

Multiplicative effect formulations have two important properties. First, in a multiplicative formulation, extreme values of any of the inputs will completely dominate the outcome. If a variable is dominant, it can underestimate the effects of other inputs on the output. A second important characteristic is that the combined effect will increase or decrease geometrically. It means that it prevents the existence of huge numbers as an outcome.

8.1.5. Time delay formulations

"Time delays often play an important role in the dynamics of systems. Significant time lags may intervene between causes and their effects. Two general categories (material delays and information delays)" were used in the model (Barlas, 2000).

a) "Simple material delay"

"Such delays exist on conserved stock-flow chains. Since delays involve stock-flow structures, they introduce phase lags between the inputs and outputs" (Barlas, 2000). There are different methods to formulate delays in dynamics models. Here is the example to show such a delay;

$$Increase\ rate\ in\ SAA\ = \frac{(100-SAA)}{adjsaa} \tag{21}$$

Student academic achievement (SAA) affects its increasing rate. But it happens after a certain delay. When a certain academic achievement is done, there is a waiting period before it shows it effect on the increasing rate. This is expressed by using 'adjustment time for student academic achievement (adjsaa)".

b) Simple information delay

Due to the gradual learning of a changing situation and human awareness, there is also a type of delay called information delay. Here is the example used in the model to represent an information delay in the model;

$$Academic\ gap = desired\ SAA - SAA \tag{22}$$

$$satisfaction = 1 - \frac{Academic\ gap}{\max SAA} \tag{23}$$

$$decrease\ in\ SAA = SAA * \frac{satisfaction}{lifsa} \tag{24}$$

Desired Student Academic Achievement (desired SAA) is the parent expectation from students. When there is a gap between the expected and real values, this gap affects the level of satisfaction and then this satisfaction affects the decrease rate in student academic achievement. But this process takes a certain time and there is a simple information time delay as parents are aware of the current student academic achievement. This delay is expressed as “lifetime for satisfaction (lifsa)” in the model.

If lifetime for satisfaction is taken for 2 months, it means that parents will react the current academic achievement situation after 2 months. This delay is related with the issue date of report cards. Since the families are aware of the student academic achievement after getting the report cards, they will show a certain reaction to that academic achievement after a certain delay.

8.2. Simulation Results

Simulations are made using Vensim PLE 6.3 software. Simulation analysis is implemented for each stock and its appropriate variables. The values for variables are taken differently and some suitable combinations of them are made. Each test result is compared with a current result. All initial values in the model are assumed to be current values and changes on variables are mentioned as test results. Variable values, graphs and their explanations are given in a table for each stock.

8.2.1. Parent expectation (PE) simulation results

Parent Expectation stock flow simulation is shown in the figure 139. The variables that affect parent expectation are taken at different values and at different combinations among them. There are 9 test results when the initial value for the parent expectation stock is taken as 50 grades and 9 more test results when its initial value is taken as 25 grades. For these test results, parent education level (pel), family size (fs) and marital status (ms) have been changed with different ratios. Parent education level is taken as 0.2, 0.3, 0.4, 0.5, 0.6 and 0.7 while family size is taken as 0.2, 0.3 and 0.4. Marital status is taken as 0.0 and 0.2. These different values are taken to make different combinations of them. The appropriate combination of these variables is made and test results are mentioned in Table-5.

Table 5: Simulation Results of Parent Expectation Stock

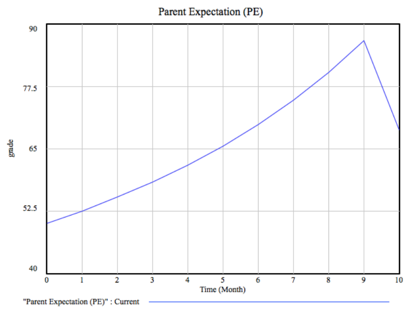
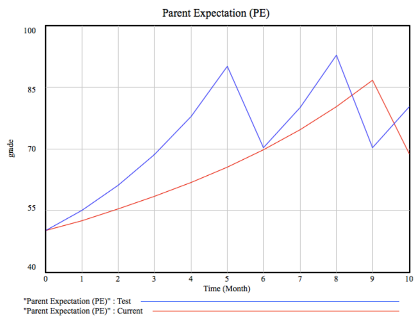
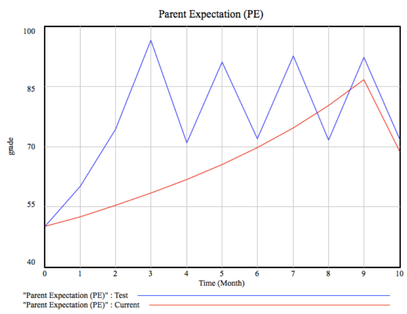
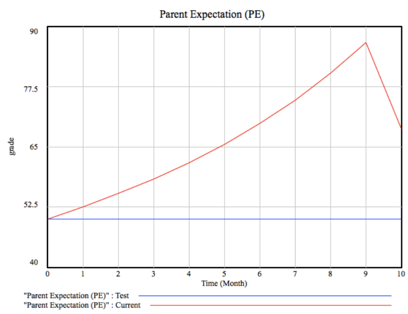
PARA METERS	**GRAPH**	**EXPLANATION**
PE = 50 pel = 0.4 fs = 0.3 ms = 0.0		The initial values for the stock and rate variables are taken as current baseline values. Initial parent expectation is assumed to be 50 out of 100, parent education level (pel) is 0.4 (high school), family size (fs) is 0.3 (father, mother and one child) and marital status (ms) is 0.0 (parents are not divorced). Parent expectation initially increases and after taking 85 it starts to decrease to a level of 70 and increases again. 85 means 5 out of 5 and 70 means 4 out of 4. When a student gets a grade of 5, parent expectation is at the top and no need to increase more. Hence, it starts to decline. But parents never let children go down from 70 (It means going down to 3 and less). The range for parent expectation changes between 70 and 85 or higher.
PE = 50 pel = 0.5 fs = 0.3 ms = 0.0		The parent education level is increased to 0.5 (two year degree), parent expectation range changes between 70 and 92. The maximum parent expectation increases and becomes around 90. This also creates some fluctuations on student academic achievement at higher grades. Moreover, parent expectation reaches its maximum value in a short time period than initial value for parent education level did.
PE = 50 pel = 0.7 fs = 0.3 ms = 0.0		The parent education level is increased to 0.7 (master), parent expectation range changes between 72 and 97 with showing so much up and down behaviour. The maximum parent expectation increases and becomes around 97. Moreover, parent expectation reaches its maximum value in a short time period than initial value for parent education level did. During the test period, the frequency of parent expectation change between the range 72 and 90 is more than the frequency in the current model. It changes quickly. It shows more oscillations when the parent education level is increased more.
PE = 50 pel = 0.3 fs = 0.3 ms = 0.0		When the parent education level is considered as 0.3 (middle school), parent expectation continues with its initial value. Nothing is increased or decreased. When family size is 3 and level of paren education is middle school, family keeps expectation same as initially they did.

Table 5: Simulation Results of Parent Expectation Stock

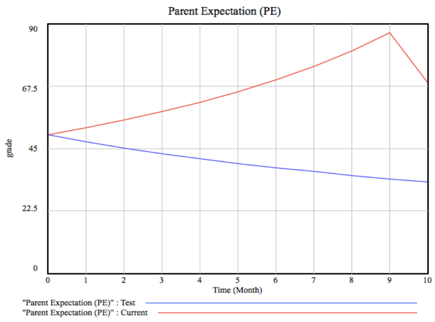
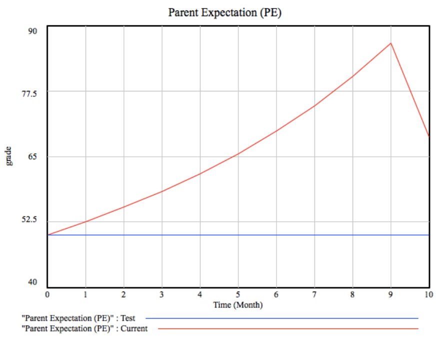
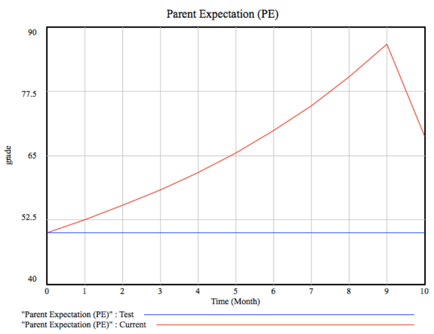
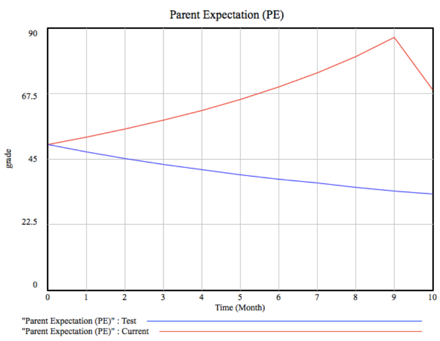
PARA METERS	**GRAPH**	**EXPLANATION**
PE = 50 pel = 0.2 fs = 0.3 ms = 0.0		When the parent education level is considered as 0.2 (primary school), parent expectation declines from its initial value. Parents with low education background have a tendency to decrease its level of expectation through the year.
PE = 50 pel = 0.4 fs = 0.4 ms = 0.0		All the values are kept same as their initial values except for family size. When the family size is increased to 0.4 (father, mother and two children), parent expectation continues with its initial value. Nothing is increased or decreased. Having more children affects the level of expectation.
PE = 50 pel = 0.4 fs = 0.2 ms = 0.2		One child family is divorced. Family size becomes 0.2 (single parent and one child) and marital status is therefore taken as 0.2 (single parent status), parent expectation continues with its initial value. Nothing is increased or decreased. Parent education level is kept as its initial value. Even though family size is smaller, single parents seem to have same expectation as they initially had.
PE = 50 pel = 0.4 fs = 0.3 ms = 0.2		Two-children family is divorced. Family size becomes 0.3 (single parent and two children) and marital status is therefore taken as 0.2 (single parent status), parent expectation starts to decline from its initial value for this case.

Table 5: Simulation Results of Parent Expectation Stock

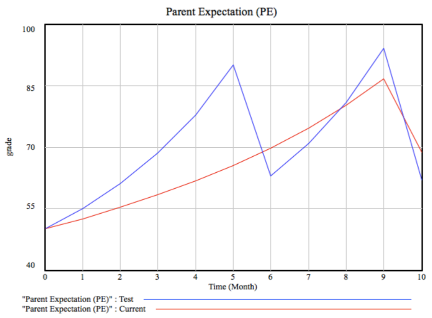
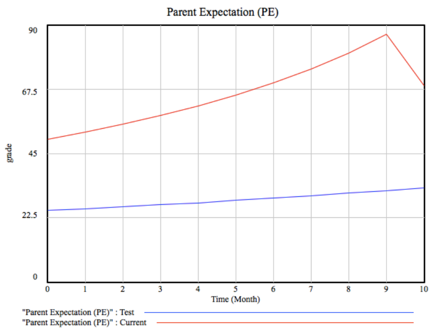
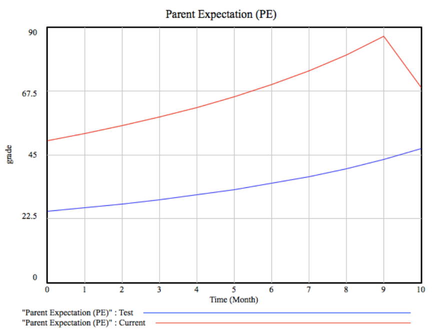
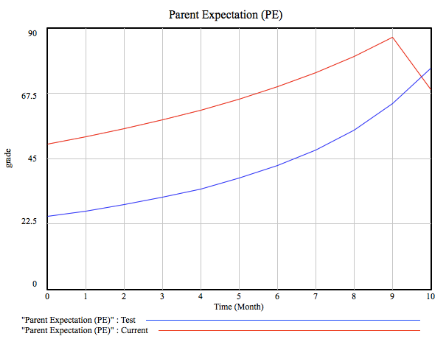
PARA METERS	GRAPH	EXPLANATION
PE = 50 pel = 0.6 fs = 0.6 ms = 0.2		One child family is divorced when parent education level is increased. Parent education level is now 0.6 (undergraduate). Family size becomes 0.2 (single parent and one child) and marital status is therefore taken as 0.2 (single parent status), parent expectation changes between 65 and 95 with low frequency. The range seems to be going down under 70. The level of parent education becomes dominant over the disadvantages of marital status.
PE = 25 pel = 0.4 fs = 0.3 ms = 0.0		All the variables are kept constant except for the initial value for parent expectation. If parent expectation starts from the lowest value like 25 (it means 0 out of 5), it takes more time to reach at the maximum parent expectation value. Initial value of parent expectation affects the amount of increase per time for parent expectation. However, it incrementally increases. If initial value for parent expectation is decided according to previous student academic achievement, that means that previous school achievement affects parent expectation for the next coming year.
PE = 25 pel = 0.5 fs = 0.3 ms = 0.0		Initial value for parent expectation and parent education level has been changed. When parent education level increased to 0.5 (two year degree), parent expectation increases as parallel to the current situation without taking highest values. At the end of 10 months, it reaches to a grade of 50.
PE = 25 pel = 0.6 fs = 0.3 ms = 0.0		Initial value for parent expectation and parent education level has been changed. When the parent education level increased to 0.6 (undergraduate), parent expectation increases. The time for reaching at highest available grade is quicker than the test results when parent education level is taken as 0.5. At the end of 10 months, the highest expectation is observed as 70. The level of parent education still have an affect on parent expectation with regardless of its initial value.

Table 5: Simulation Results of Parent Expectation Stock

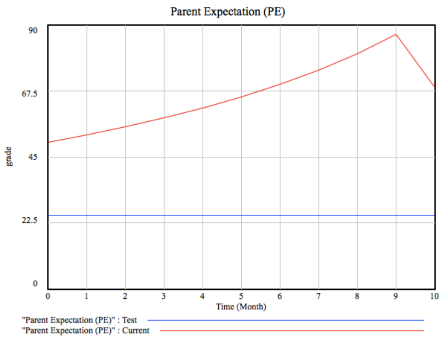
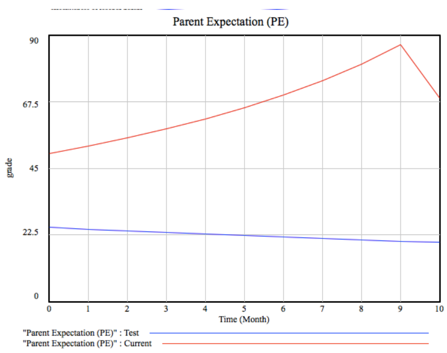
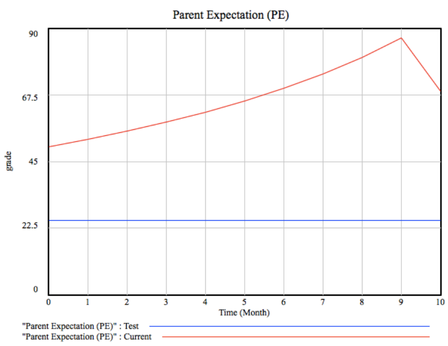
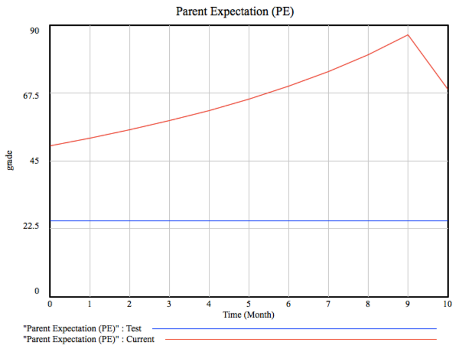
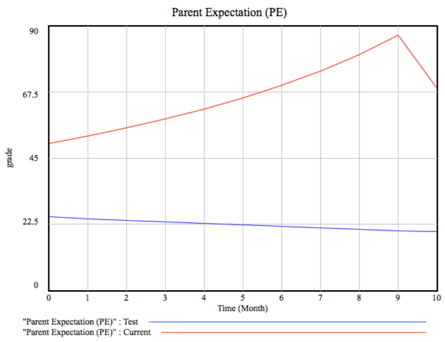
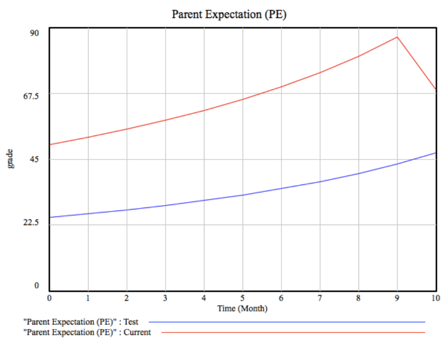
<table>
<tr><th>PARA METERS</th><th>GRAPH</th><th>EXPLANATION</th></tr>
<tr><td>PE = 25
pel = 0.3
fs = 0.3
ms = 0.0</td><td>
</td><td>When the parent education level is considered as 0.3 (middle school), parent expectation continues with its initial value. Nothing is increased or decreased. When level of parent education becomes middle school, they keep the same level of expectation throughout the year.</td></tr>
<tr><td>PE = 25
pel = 0.2
fs = 0.3
ms = 0.0</td><td>
</td><td>When the parent education level is considered as 0.2 (primary school), parent expectation declines from its initial value. But it changes within a narrow range when initial parent expectation is taken as 25. It changes between 25 and 20. However, when initial value for parent expectation is taken as 50, this range changes between 50 and 32. The rate of change is less when initial value for parent expectation is low.</td></tr>
<tr><td>PE = 25
pel = 0.4
fs = 0.4
ms = 0.0</td><td>
</td><td>All the values are kept same as their initial values except for family size and initial value for parent expectation. When the family size is increased to 0.4 (father, mother and two children) and initial value for parent expectation is taken as 25, parent expectation continues with its initial value. Nothing is increased or decreased. The number of family members also affect the parent expectation for each one.</td></tr>
</table>

Table 5: Simulation Results of Parent Expectation Stock

PARA METERS	GRAPH	EXPLANATION
PE = 25 pel = 0.4 fs = 0.2 ms = 0.2		One child family is divorced. When family size becomes 0.2 (single parent and one child) and marital status is therefore taken as 0.2 (single parent status), parent expectation continues with its initial value. Nothing is increased or decreased. Parent education level is kept as its initial value.
PE = 25 pel = 0.4 fs = 0.3 ms = 0.2		Two-children family is divorced. Family size becomes 0.3 (single parent and two children) and marital status is therefore taken as 0.2 (single parent status), parent expectation starts to decline from its initial value.
PE = 25 pel = 0.6 fs = 0.2 ms = 0.2		One child family is divorced when parent education level is increased. Parent education level is now 0.6 (undergraduate). Family size becomes 0.2 (single parent and one child) and marital status is taken as 0.2 (single parent status), parent expectation increases from 25 to 50 at the end of 10 months.

8.2.2. Parent involvement (PI) simulation results

Parent Expectation stock flow simulation is shown in the figure 144. The variables that affect parent involvement are taken at different values and at different combinations among them. There are 8 test results when the initial value for the parent involvement stock is taken as 1 hour and 8 more test results when its initial value is taken as 10 hours. For these test results, level of parent engagement (lpe), school parent involvement support effectiveness (spis) and fraction of parent workload time to total time (pw) have been changed with different ratios. Level of parent engagement and school parent involvement support are taken as 0.05 and 0.08 and parent workload is taken as 0.5 and 0.8 to make different combinations of them. The appropriate combination of these variables is made and test results are mentioned in Table-6.

Table 6: Simulation Results of Parent Involvement Stock

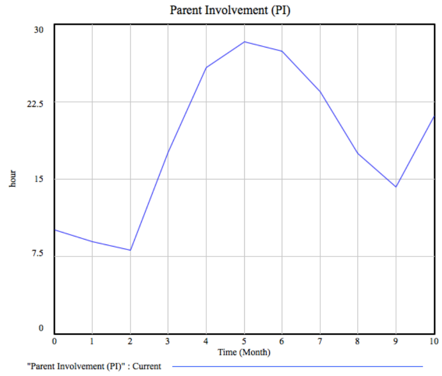
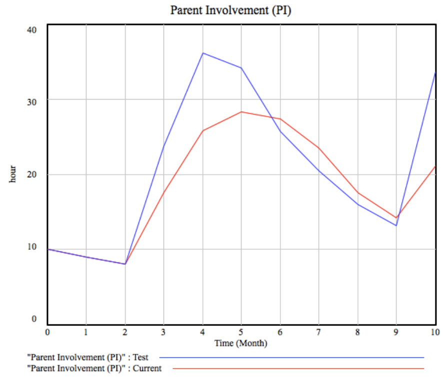
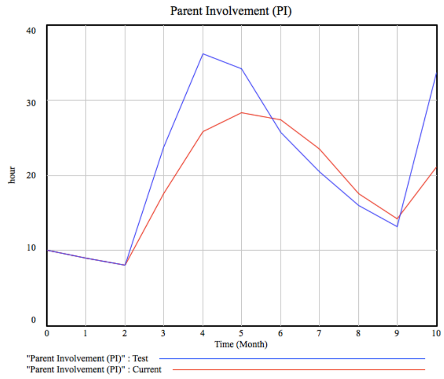
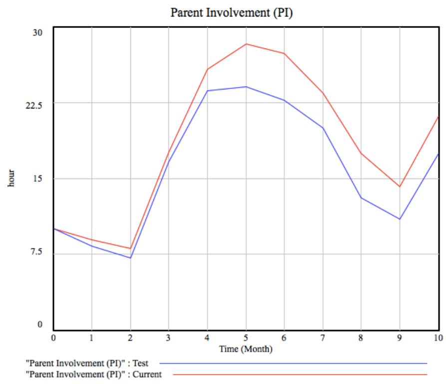
PARA METERS	GRAPH	EXPLANATION
PI = 10 lpe = 0.05 spis = 0.05 pw = 0.5		Initially, parent involvement has a tendency to decline in two months. After taking first report card in two months, parent involvement starts to increase depending on the academic gap between student academic achievement and parent expectation. In the graph, Parent Involvement can't take a value gretaer than 28. In the model, maximum value for parent involvement is considered as 46. After taking its maximum value it decreases up to a point of 15 and increases again. The range for parent involvement becomes between 15 and 28 hours depending on academic gap.
PI = 10 lpe = 0.08 spis = 0.05 pw = 0.5		The level of parent engagement affects parent involvement. If parents are more prone to engage in educational activities whether at home or at school, they will show a higher level of involvement. When level of parent engagement is increased, parent involvement increases more sharply and increases its maximum point in the current case. But the lowest involvement will be the same again as in the current case.
PI = 10 lpe = 0.05 spis = 0.08 pw = 0.5		Instead of level of parent engagement, if school parent involvemenet support increases, parent involvement shows the same increase pattern in the graph. The effect of parent engagement and school behaviour have the same effect on parent involvement.
PI = 10 lpe = 0.05 spis = 0.05 pw = 0.8		When parent workload increases, this affects parent involvement negatively. It starts to increase with the same rate after two months. Maximum parent involvement becomes around 23 hours instead of 28 hours and lowest parent involvement becomes around 10 hours instead of 15 hours. But behaviour pattern of graph is the same as with the current graph.

Table 6: Simulation Results of Parent Involvement Stock

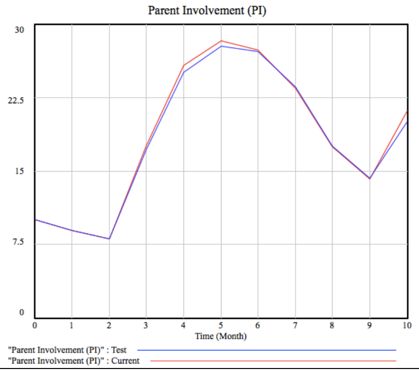
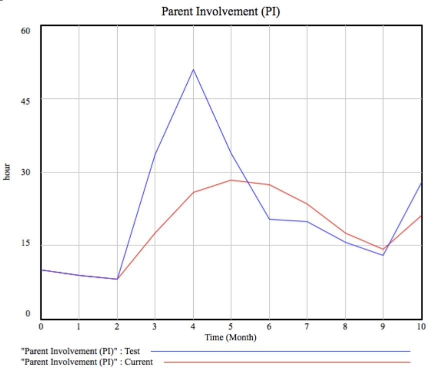
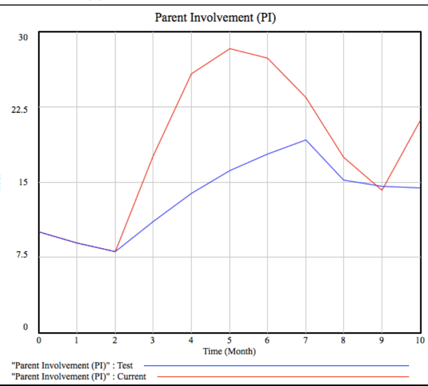
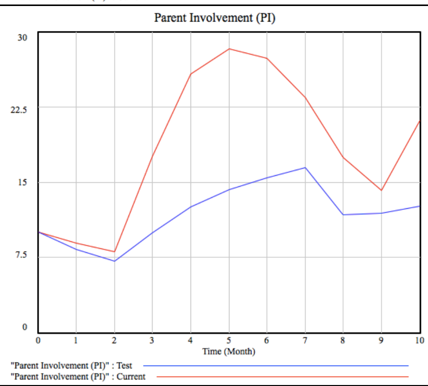
PARA METERS	GRAPH	EXPLANATION
PI = 10 lpe = 0.08 spis = 0.03 pw = 0.5		When level of parent engagement is increased and school parent involvement support is decreased, nothing changes on the current graph. Parent and school becomes two complementary parts to encourage parent involvement.
PI = 10 lpe = 0.08 spis = 0.08 pw = 0.5		Both level of parent engagement and school parent involvement support are increased, parent involvement increases sharply and takes its maximum value around 50. This value also exceeds the maximum parent involvement value defined in the model (It was 46). From taking its maximum value, it starts to decline up to a point of 15. It changes sharply. In all tests done so far, lowest value is taken as 15 regardless of variable values.
PI = 10 lpe = 0.03 spis = 0.03 pw = 0.5		Both level of parent engagement and school parent involvement support are decreased, parent involvement increases gradually and takes its maximum value around 19. From taking its maximum value, it starts to decline up to a point of 15. It takes the same lowest value as in all tests done so far. Exceptionally, it seems to be steady at that value.
PI = 10 lpe = 0.03 spis = 0.03 pw = 0.8		Both level of parent engagement and school parent involvement support are decreased and parent workload is increased, parent involvement increases less gradually and takes its maximum value around 16. From taking its maximum value, it starts to decline up to a point of 10. It seems to be steady at that value. When parent workload increases, parent involvement becomes stable around 10 hours. Parent working time deeply affects the range of parent involvement.

Table 6: Simulation Results of Parent Involvement Stock

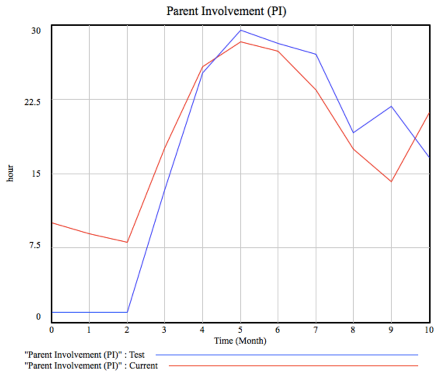
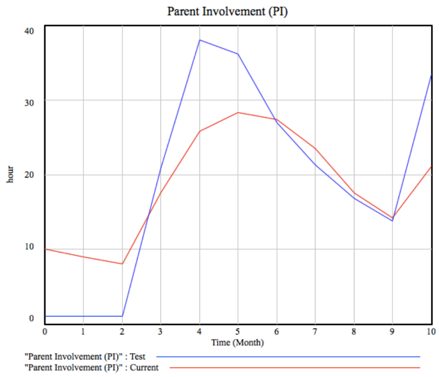
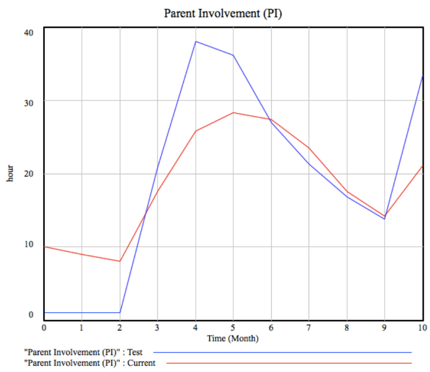
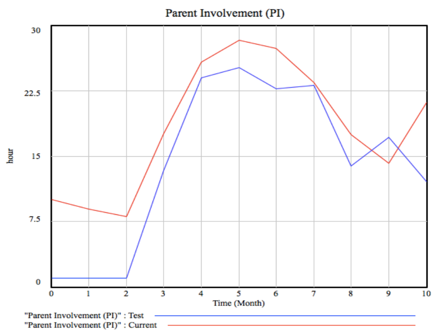
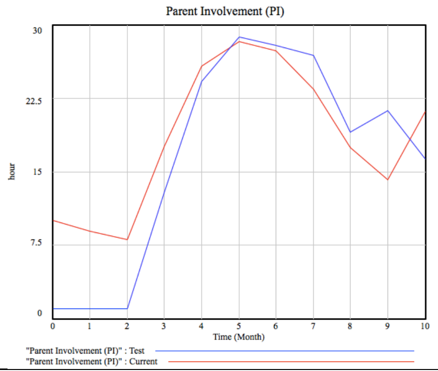
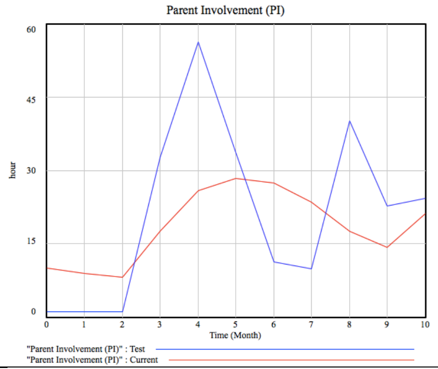
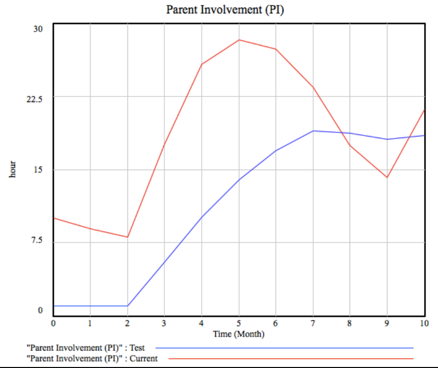
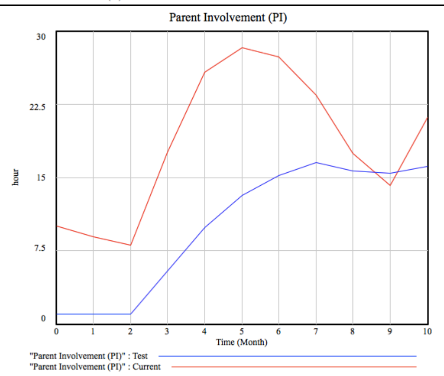
PARA METERS	GRAPH	EXPLANATION
PI = 1 lpe = 0.05 spis = 0.05 pw = 0.5		Only initial value for parent involvement has been changed from 10 hours to 1 hour. The graph again reaches to the same maximum points and returns back. Maximum value is quite similar to 30. Within time the graph seems to be steady at the same parent involvement value as in the current graph. Average parent involvement changes around 15 hours even though there is no control for 15 hours in the model.
PI = 1 lpe = 0.08 spis = 0.05 pw = 0.5		Using the same initial value if level of parent engagement is increased, it makes peak values quite similar to 40 hours. Maximum value increases too but it returns back again to the same level of parent involvement (15 hours).
PI = 1 lpe = 0.05 spis = 0.08 pw = 0.5		Instead of level of parent engagement, if school parent involvement support increases, parent involvement shows the same increase pattern in the graph. The effect of parent engagement and school behaviour have the same effect on parent involvement. Lowest initial value for parent involvement only makes it reach higher maximum value.
PI = 1 lpe = 0.05 spis = 0.05 pw = 0.8		When we only increase parent workload in the model, test graph again increases with a quite similar rate to the current graph. But maximum value on the graph decreases. Parent workload affects the maximum value that it can take. Its average value seems to be around 15 hours. No variables do not have a strong affect on average value of parent involvement. All test graphs seem to be around 15 hours at the end.

Table 6: Simulation Results of Parent Involvement Stock

<table>
<tr><th>PARA METERS</th><th>GRAPH</th><th>EXPLANATION</th></tr>
<tr><td>PI = 1
lpe = 0.08
spis = 0.03
pw = 0.5</td><td>
</td><td>When level of parent engagement is increased and school parent involvement support is decreased, no more differences between current and test graphs. Parent involvement stays between 15 and 30 hours.</td></tr>
<tr><td>PI = 1
lpe = 0.08
spis = 0.08
pw = 0.5</td><td>
</td><td>Both level of parent engagement and school parent involvement support are increased, parent involvement increases sharply and takes its maximum value around 55. This value also exceeds the maximum parent involvement value defined in the model (It was 46). From taking its maximum value, it starts to decline up to a point of 10. It changes sharply. But the second peak is less than the previous peak. The general behaviour of the graph has a tendency of being around 15.</td></tr>
<tr><td>PI = 1
lpe = 0.03
spis = 0.03
pw = 0.5</td><td>
</td><td>Both level of parent engagement and school parent involvement support are decreased, parent involvement increases gradually and takes its maximum value around 18. From taking its maximum value, it starts to be steady at that value.</td></tr>
<tr><td>PI = 1
lpe = 0.03
spis = 0.03
pw = 0.8</td><td>
</td><td>Both level of parent engagement and school parent involvement support are decreased and parent workload is increased, parent involvement increases less gradually and takes its maximum value around 16. From taking its maximum value, it starts to be steady at that value. Parent workload does not affect the general behaviour so much when it is at lower values. Under different combinations of variables, parent involvement shows steady behaviour around 15 hours.</td></tr>
</table>

8.2.3. Student academic achievement (SAA) simulation results

Student Academic Achievement stock flow simulation is shown in the figure 153. The variables that affect student academic achievement are taken at different values and at different combinations among them. There are 10 test results when the initial value for the student academic achievement stock is taken as 50 grades and 10 more test results when its initial value is taken as 25 grades. For these test results, teacher expectation rate (ter), teacher subject knowledge (tsk), teacher classroom effectiveness (tce), usage of various activities and methods (uoam), adjustment time for student academic achievement (adjsaa) and lifetime for satisfaction (lifsa) have been changed with different ratios.

Teacher expectation rate, teacher subject knowledge, teacher classroom effectiveness and usage of various activities and methods are taken as 0.3, 0.5 and 0.8, adjustment time for student academic achievement is taken as 0.125 and 0.25 months and finally lifetime for satisfaction is taken 2 and 4 months in the simulation to make different combinations of them. The appropriate combination of these variables is made and test results are mentioned in Table-7.

Table 7: Simulation Results of Student Academic Achievement Stock

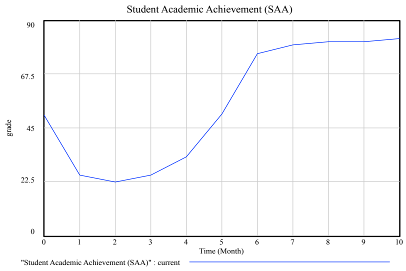
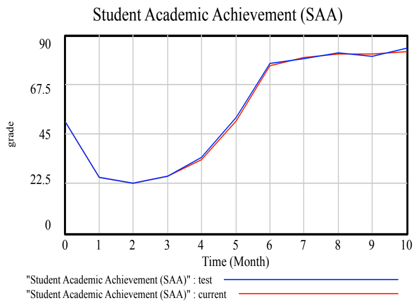
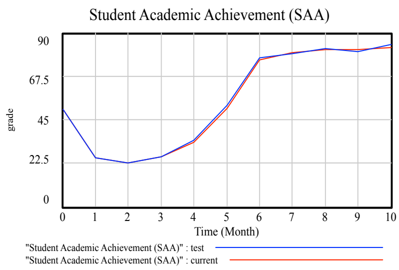
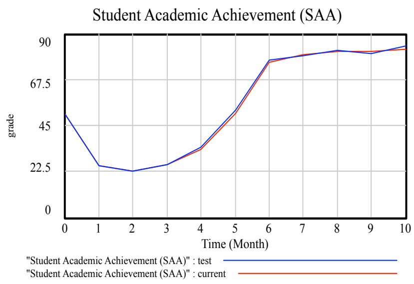
<table>
<tr><th>PARA METERS</th><th>GRAPH</th><th>EXPLANATION</th></tr>
<tr><td>SAA = 50
ter = 0.5
tsk = 0.5
tce = 0.5
uoam = 0.5
lifsa = 2
adjsaa = 0.125</td><td>
</td><td>Student Academic Achievement decreases up to a level of 22 and then increases. The delay for realizing academic achievement by parents is taken for 2 months. Low academic achievement encourages parents to involve in educational process and then it academic achievement starts to increase. Maximum academic achievement seem to oscillate around 90's. Sharp increase in the graph is observed when parent involvement is at the maximum rates. Even though parent involvement starts to decline after 6 months, academic achievement continues to increase gradually.</td></tr>
<tr><td>SAA = 50
ter = 0.8
tsk = 0.5
tce = 0.5
uoam = 0.5
lifsa = 2
adjsaa = 0.125</td><td>
</td><td>Teacher expectation rate does not change so much the general behaviour of graph pattern. It makes a little bit higher effect on academic achievement after 6 months when parent involvement starts to decline. Teacher and Parent becomes two complementary parts to encourage academic achievement.</td></tr>
<tr><td>SAA = 50
ter = 0.5
tsk = 0.8
tce = 0.5
uoam = 0.5
lifsa = 2
adjsaa = 0.125</td><td>
</td><td>Like teacher expectation rate, teacher subject knowledge does not change so much the general behaviour of graph pattern. It makes a little bit higher effect on academic achievement after 6 months when parent involvement starts to decline. Teacher and Parent becomes two complementary parts to encourage academic achievement.</td></tr>
<tr><td>SAA = 50
ter = 0.5
tsk = 0.5
tce = 0.8
uoam = 0.5
lifsa = 2
adjsaa = 0.125</td><td>
</td><td>Like teacher expectation rate and teacher subject knowledge, teacher classroom effectiveness does not change so much the general behaviour of graph pattern. It makes a little bit higher effect on academic achievement after 6 months when parent involvement starts to decline. Teacher and Parent becomes two complementary parts to encourage academic achievement.</td></tr>
</table>

Table 7: Simulation Results of Student Academic Achievement Stock

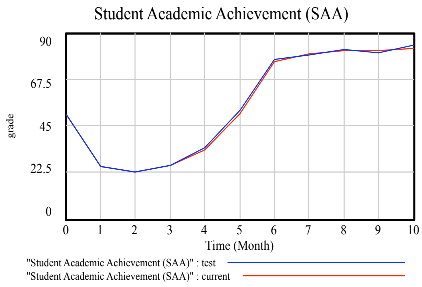
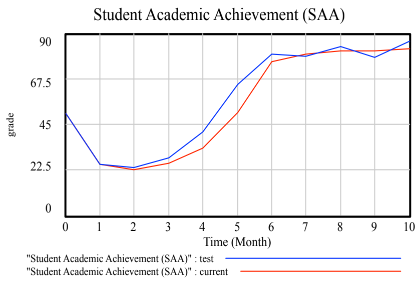
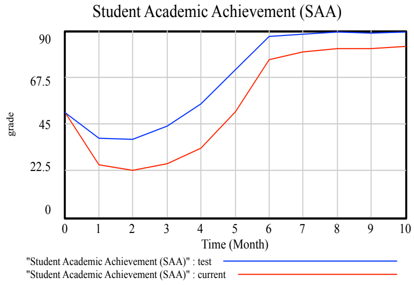
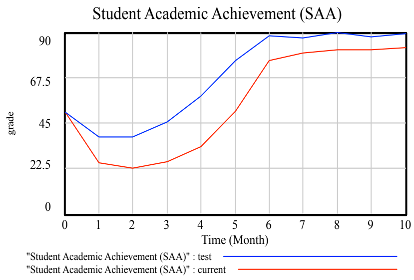
PARA METERS	GRAPH	EXPLANATION
SAA = 50 ter = 0.5 tsk = 0.5 tce = 0.5 uoam = 0.8 lifsa = 2 adjsaa = 0.125		Like teacher expectation rate, teacher subject knowledge and teacher classroom effectiveness, usage of various activities and methods does not change so much the general behaviour of graph pattern. It makes a little bit higher effect on academic achievement after 6 months when parent involvement starts to decline. Teacher and Parent becomes two complementary parts to encourage academic achievement.
SAA = 50 ter = 0.8 tsk = 0.8 tce = 0.8 uoam = 0.8 lifsa = 2 adjsaa = 0.125		When all teacher quality variables are increased, it makes a sharp increase in the graph. But, it keeps the maximum academic achievement at the same level and fluctations at maximum grades are more.
SAA = 50 ter = 0.5 tsk = 0.5 tce = 0.5 uoam = 0.5 lifsa = 4 adjsaa = 0.125		When lifetime for satisfaction is changed to 4 months, test results take higher grades than the current graph. Graph pattern remains the same. If parents continue with the same satisfaction level for 4 months instead of 2 months, academic achievement becomes just above the current graph. Parent satisfaction affects student academic achievement and makes a meaningful increase in student academic achievement.
SAA = 50 ter = 0.8 tsk = 0.8 tce = 0.8 uoam = 0.8 lifsa = 4 adjsaa = 0.125		When lifetime for satisfaction is kept at 4 months and all teacher quality variables are increased, student academic achievement increase more then the current graph. But, this test graph is quite similar to the previous graph. When parent satisfaction lasts more, teacher quality variables have less effect on academic achievement. Parent satisfaction affects student academic achievement and makes a meaningful increase in student academic achievement as teacher quality variables did.

Table 7: Simulation Results of Student Academic Achievement Stock

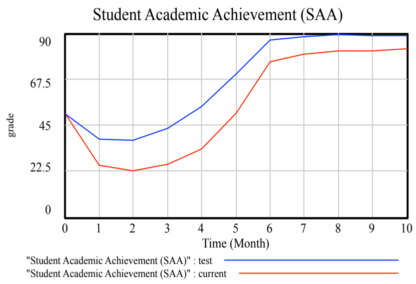
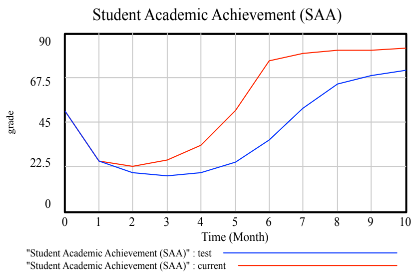
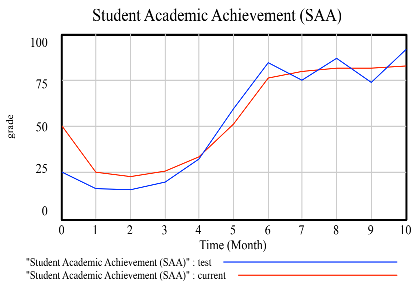
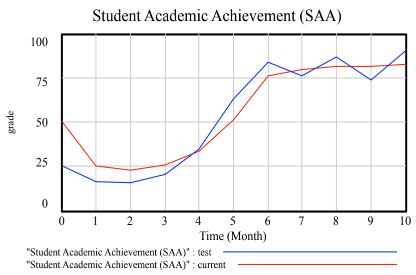
PARA METERS	GRAPH	EXPLANATION
SAA(0) = 50 ter = 0.3 tsk = 0.3 tce = 0.3 uoam = 0.3 lifsa = 4 adjsaa = 0.125		This graph also shows the low effect of teacher quality variables on academic achievement when parent satisfaction lasts for 4 months instead of 2 months. The change of teacher quality variables does not make so much influence on the graph pattern if parents are satisfied with the current student academic achievement.
SAA(0) = 50 ter = 0.5 tsk = 0.5 tce = 0.5 uoam = 0.5 lifsa = 2 adjsaa = 0.25		Adjustment time for student academic achievement affects academic achievement. When adjustment time is doubled, student academic achievement decreases. Students who react slowly to the current academic achievement situation will not probably affected by other variables in a short time.
SAA(0) = 25 ter = 0.5 tsk = 0.5 tce = 0.5 uoam = 0.5 lifsa = 2 adjsaa = 0.125		When initial value for Student Academic Achievement is taken as 25, the graph shows the same pattern. It decreases up to a level of 15 and then starts to increase. Lowest initial value for Student Academic Achievement makes fluctuations at the maximum grades. Initial academic achievement is effective especially for taking highest grades.
SAA(0) = 25 ter = 0.8 tsk = 0.5 tce = 0.5 uoam = 0.5 lifsa = 2 adjsaa = 0.125		Teacher expectation rate does not change so much the general behaviour of graph pattern. It makes a little bit higher effect on academic achievement after 4 months. The increase rate is higher during those months and student academic achievement reaches the same academic achievement indcated by previous graphs. Initial value does not affect general behaviour of the graph but makes fluctuations at highest grades.

Table 7: Simulation Results of Student Academic Achievement Stock

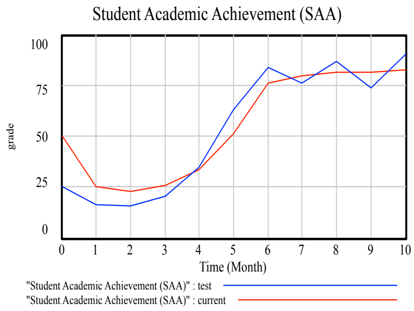
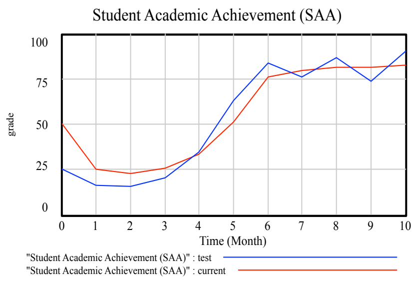
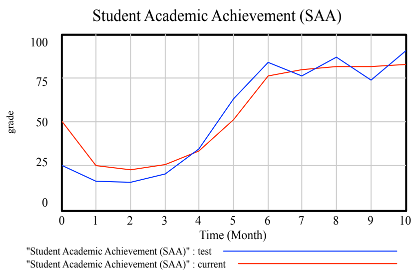
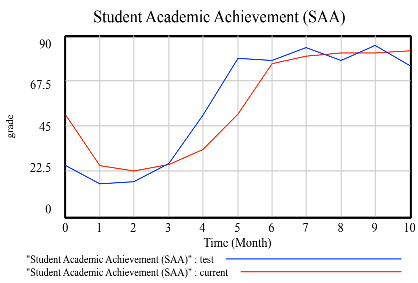
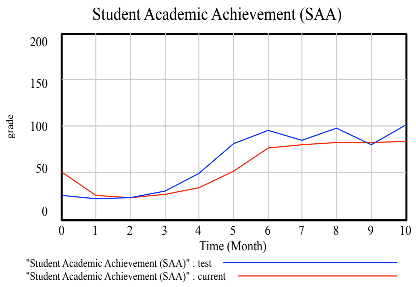
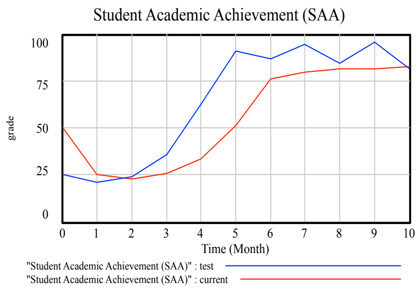
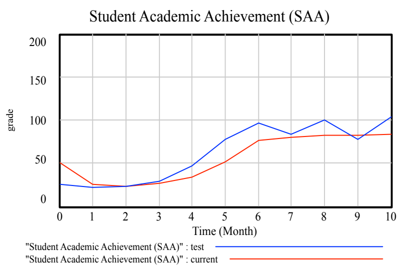
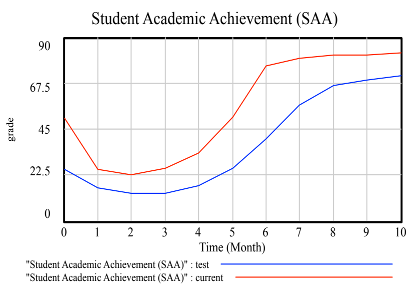
PARA METERS	**GRAPH**	**EXPLANATION**
SAA = 25 ter = 0.5 tsk = 0.8 tce = 0.5 uoam = 0.5 lifsa = 2 adjsaa = 0.125		Like teacher expectation rate, teacher subject knowledge does not change so much the general behaviour of graph pattern. It makes a little bit higher effect on academic achievement after 4 months. The increase rate is higher during those months and student academic achievement reaches the same academic achievement indcated by previous graphs. Initial value does not affect general behaviour of the graph but makes fluctuations at highest grades.
SAA = 25 ter = 0.5 tsk = 0.5 tce = 0.8 uoam = 0.5 lifsa = 2 adjsaa = 0.125		Like teacher expectation rate and teacher subject knowledge, teacher classroom effectiveness does not change so much the general behaviour of graph pattern. It makes a little bit higher effect on academic achievement after 4 months. The increase rate is higher during those months and student academic achievement reaches the same academic achievement indcated by previous graphs. Initial value does not affect general behaviour of the graph but makes fluctuations at highest grades.
SAA = 25 ter = 0.5 tsk = 0.5 tce = 0.5 uoam = 0.8 lifsa = 2 adjsaa = 0.125		Like teacher expectation rate, teacher subject knowledge and teacher classroom effectiveness, usage of various activities and methods does not change so much the general behaviour of graph pattern. It makes a little bit higher effect on academic achievement after 4 months. The increase rate is higher during those months and student academic achievement reaches the same academic achievement indcated by previous graphs. Initial value does not affect general behaviour of the graph but makes fluctuations at highest grades.
SAA = 25 ter = 0.8 tsk = 0.8 tce = 0.8 uoam = 0.8 lifsa = 2 adjsaa = 0.125		When all teacher quality variables are increased, it makes a sharp increase in the graph. But, it keeps the maximum academic achievement at the same level and fluctations at maximum grades are more. Moreover, teacher variables also decrease the level of fluctuations at the maximum grades and it tends to be more stable graphic line. Initial value does not affect general behaviour of the graph but makes fluctuations at highest grades.

Table 7: Simulation Results of Student Academic Achievement Stock

PARA METERS	**GRAPH**	**EXPLANATION**
SAA = 25 ter = 0.5 tsk = 0.5 tce = 0.5 uoam = 0.5 lifsa = 4 adjsaa = 0.125		When lifetime for satisfaction is changed to 4 months, test results take higher grades than the current graph. Graph pattern remains the same. If parents continue with the same satisfaction level for 4 months instead of 2 months, academic achievement becomes just above the current graph. Parent satisfaction affects student academic achievement and makes a meaningful increase in student academic achievement regardless of its initial value. Initial value does not affect general behaviour of the graph but makes fluctuations at highest grades.
SAA = 25 ter = 0.8 tsk = 0.8 tce = 0.8 uoam = 0.8 lifsa = 4 adjsaa = 0.125		When lifetime for satisfaction is kept at 4 months and all teacher quality variables are increased, student academic achievement increase more then the current graph. But, this test graph is quite similar to the graph in which only lifetime for satisfaction was changed to 4 months. When parent satisfaction lasts more, teacher quality variables have less effect on academic achievement. Parent satisfaction affects student academic achievement and makes a meaningful increase in student academic achievement as teacher quality variables did. Initial value does not affect general behaviour of the graph but makes fluctuations at highest grades.
SAA = 25 ter = 0.3 tsk = 0.3 tce = 0.3 uoam = 0.3 lifsa = 4 adjsaa = 0.125		This graph also shows the low effect of teacher quality variables on academic achievement when parent satisfaction lasts for 4 months instead of 2 months. The change of teacher quality variables does not make so much influence on the graph pattern. Initial value does not affect general behaviour of the graph but makes fluctuations at highest grades.
SAA = 25 ter = 0.5 tsk = 0.5 tce = 0.5 uoam = 0.5 lifsa = 2 adjsaa = 0.25		Adjustment time for Student Academic Achievement affects academic achievement. When adjustment time is doubled, student academic achievement decreases. Students who react slowly to the current academic achievement situation will not probably affected by other variables in a short time. Initial value does not affect general behaviour of the graph but it affects the level of maximum achievement. Students who have low initial academic achievement will probably achieve less than those who have higher initial academic achievement.

8.2.4. Teacher-parent contact (TPC) simulation results

Teacher-parent Contact stock flow simulation is shown in the figure 160. The variables that affect teacher-parent contact are taken at different values and at different combinations among them. There are 10 test results when the initial value for the teacher-parent contact is taken as 0 hour and 10 more test results when its initial value is taken as 5 hours. For these test results, teacher verbal ability (tv), teacher pedagogical knowledge (tp), teacher caring constant (tc), school community awareness constant (sca) and acceptability of achievement by teachers (acoac) have been changed with different ratios. All the variables are taken as 0.3, 0.5 and 0.8 to make different combinations of them. The appropriate combination of these variables is made and test results are mentioned in Table-8.

Table 8: Simulation Results of Teacher-parent Contact Stock

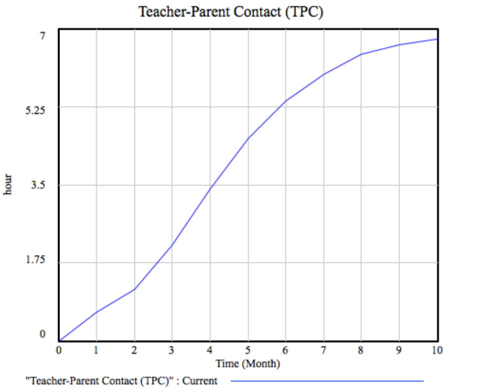
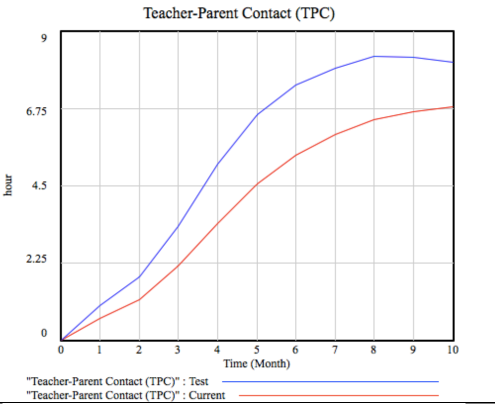
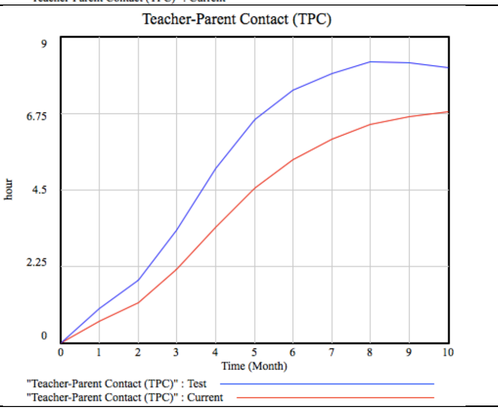
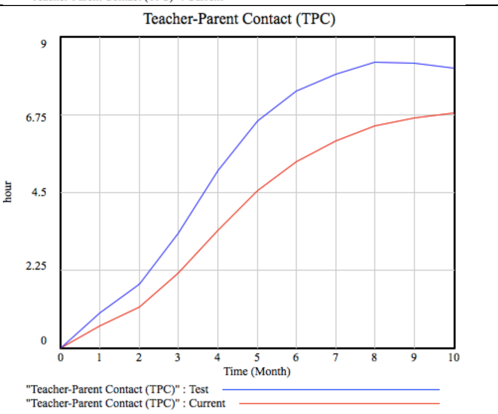
PARAMETERS	GRAPH	EXPLANATION
TPC = 0 tv = 0.5 tp = 0.5 tc = 0.5 sca = 0.5 acoac = 0.5		All the variables are taken as mid values for their own range. So, teacher-parent contact increases and remains on the straight line around 7 hours. In the model, when simulation is made for 10 months, teacher-parent contact time never exceeds 7 hours.
TPC = 0 tv = 0.8 tp = 0.5 tc = 0.5 sca = 0.5 acoac = 0.5		When teacher verbal ability increases, teacher-parent contact time increases sharply and exceeds 7 hours. Maximum teacher-parent contact time becomes around 8. Teacher verbal ability has effect on teacher-parent contact.
TPC = 0 tv = 0.8 tp = 0.8 tc = 0.5 sca = 0.5 acoac = 0.5		Like teacher verbal ability, when teacher pedagogical knowledge increases, teacher-parent contact time increases sharply and exceeds 7 hours again. Maximum teacher-parent contact time becomes around 8. Teacher pedagogical knowledge has effect on teacher-parent contact.
TPC = 0 tv = 0.8 tp = 0.5 tc = 0.8 sca = 0.5 acoac = 0.5		Like teacher verbal ability and teacher pedagogical knowledge, when teacher caring constant increases, teacher-parent contact time increases sharply and exceeds 7 hours again. Maximum teacher-parent contact time becomes around 8. Teacher caring has effect on teacher-parent contact.

Table 8: Simulation Results of Teacher-parent Contact Stock

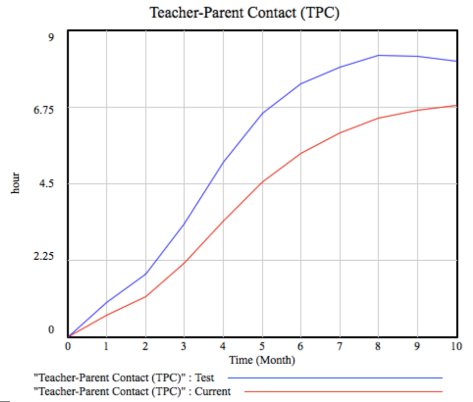
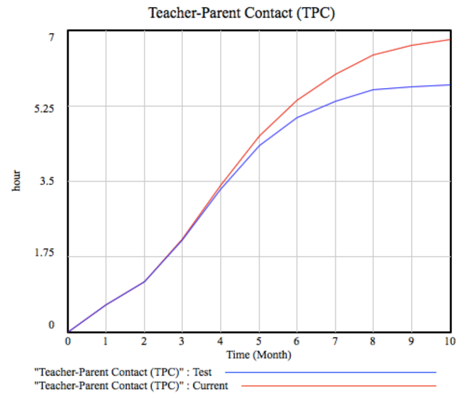
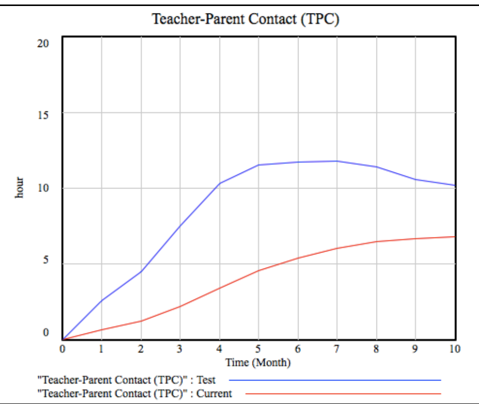
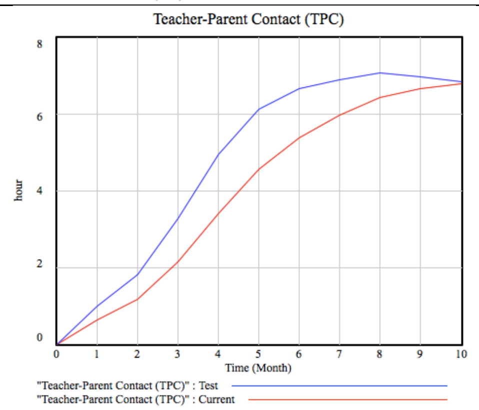
PARA METERS	**GRAPH**	**EXPLANATION**
TPC = 0 tv = 0.5 tp = 0.5 tc = 0.5 sca = 0.8 acoac = 0.5		Like teacher verbal ability, teacher pedagogical knowledge and teacher caring, when school community awareness constant increases, teacher-parent contact time increases sharply and exceeds 7 hours again. Maximum teacher-parent contact time becomes around 8. School community awareness has effect on teacher-parent contact.
TPC = 0 tv = 0.5 tp = 0.5 tc = 0.5 sca = 0.5 acoac = 0.8		Initially, acceptability of academic achievement by teachers has the same effect in first 6 months. During those months, parent involvement increases. When parent involvement starts to decline, higher acceptability of academic achievement by teacher makes more meaningful decrease in teacher-parent contact.
TPC = 0 tv = 0.8 tp = 0.8 tc = 0.8 sca = 0.5 acoac = 0.5		When teacher quality related variables are increased, there is sharp increase in teacher-parent contact time. Maximum values are around 12 hours. After reaching its maximum value, graph has a tendency to remain straight on 10 hours. It was 7 hours when variables are taken as their mid values as shown in the current graph.
TPC = 0 tv = 0.5 tp = 0.5 tc = 0.5 sca = 0.8 acoac = 0.8		School community awareness is directly proportional to teacher-parent contact and acceptability of student achievement by teachers are inversely proportional to it. When both are increased, the effect of school community awareness becomes superior to the effect of acceptability of academic achievement by teachers. Overall has a meaningful effect on teacher-parent contact.

Table 8: Simulation Results of Teacher-parent Contact Stock

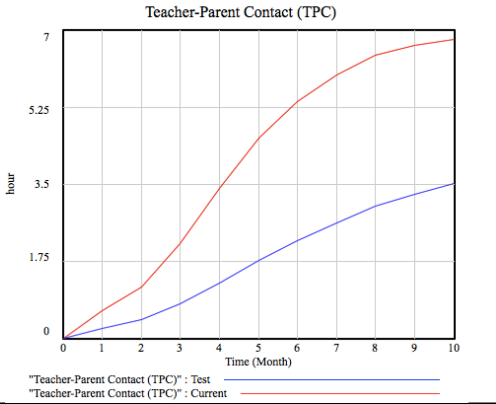
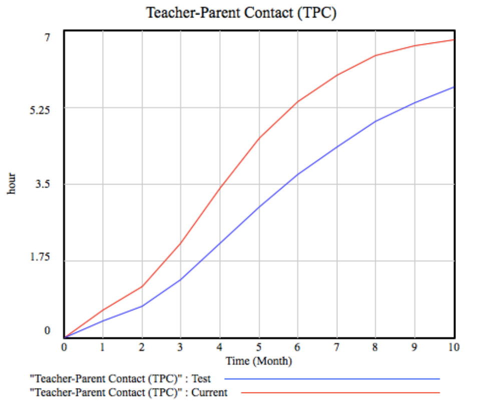
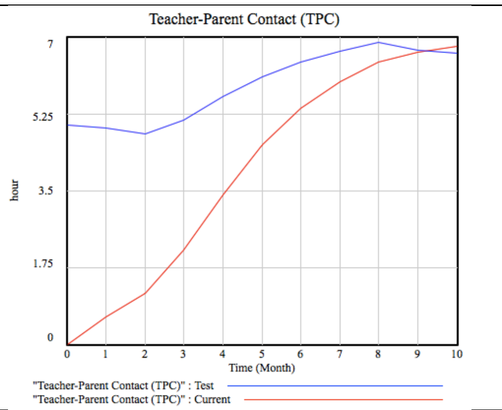
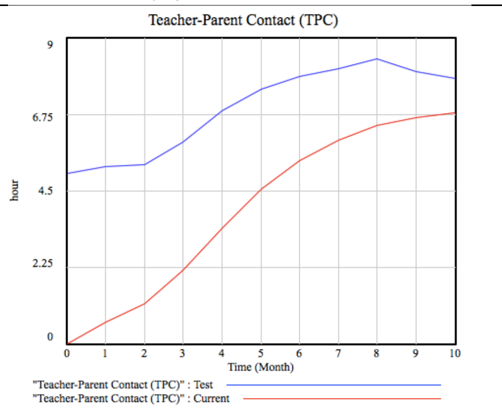
PARA METERS	GRAPH	EXPLANATION
TPC = 0 tv = 0.3 tp = 0.3 tc = 0.3 sca = 0.8 acoac = 0.5		When teacher quality related variables is decreased, school community awareness variables can not increase teacher-parent contact. Even though every teacher is aware of the importance of getting contact with parents, teacher variables will affect deeply it. Maximum teacher-contact time reaches at 3.5 hours and has a tendency to remain on that value.
TPC = 0 tv = 0.5 tp = 0.5 tc = 0.5 sca = 0.3 acoac = 0.3		School community awareness is directly proportional to teacher-parent contact and acceptability of student achievement by teachers are inversely proportional to it. When both are decreased, the effect of accetability of academic achievement by teachers becomes superior to the effect of school community awareness. When school gives less importance to get contact with parents, teacher's acceptability of current academic achievement makes a sharp decrease in teacher-parent contact time. Overall has a meaningful effect on teacher-parent contact.
TPC = 5 tv = 0.5 tp = 0.5 tc = 0.5 sca = 0.5 acoac = 0.5		All the variables are taken as mid values for their own range. So, teacher-parent contact increases and remains on the straight line around 7 hours. In the model, when simulation is made for 10 months, teacher-parent contact time never exceeds 7 hours. Initial value for teacher-parent contact does not affect that maximum value.
TPC = 5 tv = 0.8 tp = 0.5 tc = 0.5 sca = 0.5 acoac = 0.5		When teacher verbal ability increases, teacher-parent contact time increases sharply and exceeds 7 hours. Maximum teacher-parent contact time becomes around 8. Teacher verbal ability has effect on teacher-parent contact. That maximum value is the same as the maximum value when initial value is zero.

Table 8: Simulation Results of Teacher-parent Contact Stock

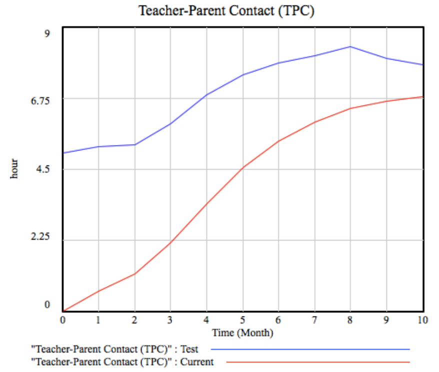
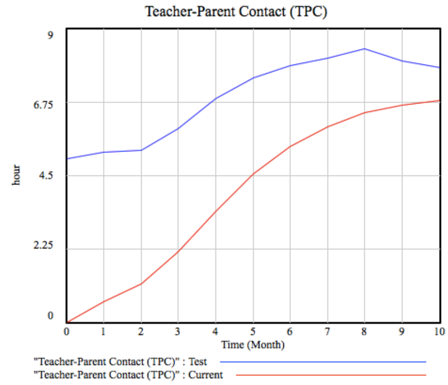
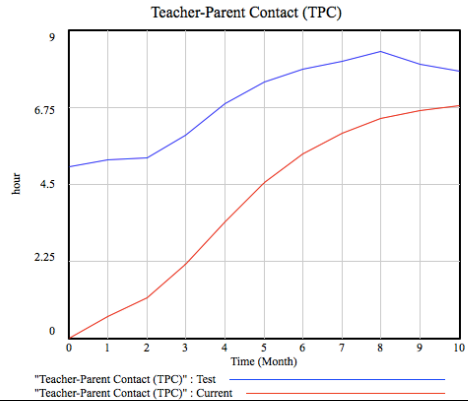
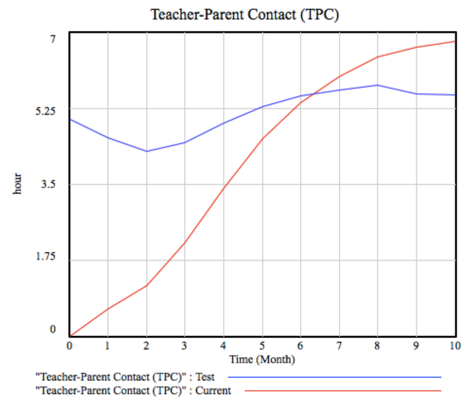
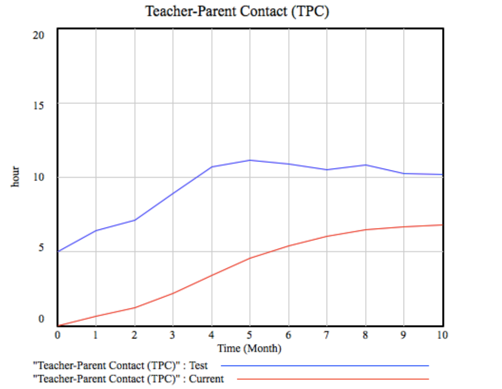
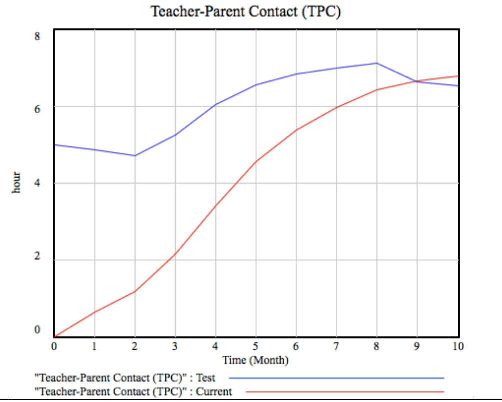
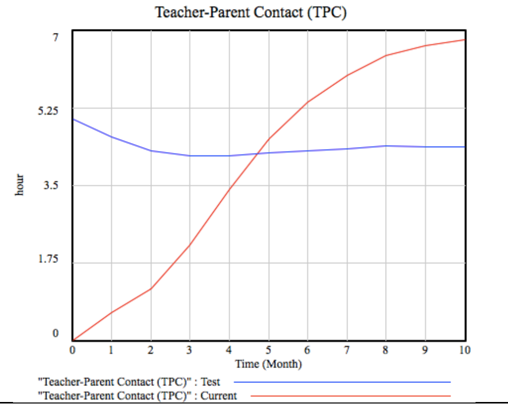
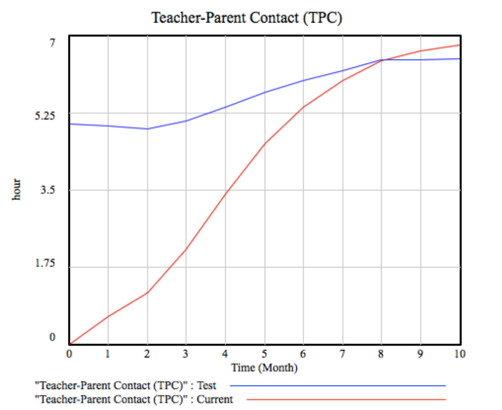
PARA METERS	GRAPH	EXPLANATION
TPC = 5 tv = 0.5 tp = 0.8 tc = 0.5 sca = 0.5 acoac = 0.5		Like teacher verbal ability, when teacher pedagogical knowledge increases, teacher-parent contact time increases sharply and exceeds 7 hours again. Maximum teacher-parent contact time becomes around 8. Teacher pedagogical knowledge has effect on teacher-parent contact. That maximum value is the same as the maximum value when initial value is zero.
TPC = 5 tv = 0.5 tp = 0.5 tc = 0.8 sca = 0.5 acoac = 0.5		Like teacher verbal ability and teacher pedagogical knowledge, when teacher caring constant increases, teacher-parent contact time increases sharply and exceeds 7 hours again. Maximum teacher-parent contact time becomes around 8. Teacher caring has effect on teacher-parent contact. That maximum value is the same as the maximum value when initial value is zero.
TPC = 5 tv = 0.5 tp = 0.5 tc = 0.5 sca = 0.8 acoac = 0.5		Like teacher verbal ability, teacher pedagogical knowledge and teacher caring, when school community awareness constant increases, teacher-parent contact time increases sharply and exceeds 7 hours again. Maximum teacher-parent contact time becomes around 8. School community awareness has effect on teacher-parent contact. That maximum value is the same as the maximum value when initial value is zero.
TPC = 5 tv = 0.5 tp = 0.5 tc = 0.5 sca = 0.5 acoac = 0.8		When acceptability of academic achievement by teachers is decreased, teacher-parent contact increases with less rate. Teacher-parent contact wants to remain the same on 6 hours which is below the current graph. Initial value does not affect the maximum value that a graph can take under the same variable values.

Table 8: Simulation Results of Teacher-parent Contact Stock

<table>
<tr><th>PARA METERS</th><th>GRAPH</th><th>EXPLANATION</th></tr>
<tr><td>TPC = 5
tv = 0.8
tp = 0.8
tc = 0.8
sca = 0.5
acoac = 0.5</td><td>
</td><td>When teacher quality related variables are increased, there is sharp increase in teacher-parent contact time. Maximum values are around 12 hours. After reaching its maximum value, graph has a tendency to remain straight on 10 hours. It was 7 hours when variables are taken as their mid values as shown in the current graph. Initial value has no effect on the graph pattern and the maximum value.</td></tr>
<tr><td>TPC = 5
tv = 0.5
tp = 0.5
tc = 0.5
sca = 0.8
acoac = 0.8</td><td>
</td><td>School community awareness is directly proportional to teacher-parent contact and acceptability of student achievement by teachers are inversely proportional to it. When both are increased, the effect of school community awareness becomes superior to the effect of acceptability of academic achievement by teachers. Overall has a meaningful effect on teacher-parent contact. Initial value has no effect on the graph pattern and the maximum value.</td></tr>
<tr><td>TPC = 5
tv = 0.3
tp = 0.3
tc = 0.3
sca = 0.8
acoac = 0.5</td><td>
</td><td>When teacher quality related variables is decreased, school community awareness variables can not increase teacher-parent contact. Even though every teacher is aware of the importance of getting contact with parents, teacher variables will affect deeply it and makes the graph decline. Maximum teacher-contact time reaches at 3.5 hours and has a tendency to remain on that value. Initial value has no effect on the graph pattern.</td></tr>
<tr><td>TPC = 5
tv = 0.5
tp = 0.5
tc = 0.5
sca = 0.3
acoac = 0.3</td><td>
</td><td>School community awareness is directly proportional to teacher-parent contact and acceptability of student achievement by teachers are inversely proportional to it. When both are decreased, the effect of accetability of academic achievement by teachers becomes superior to the effect of school community awareness. When school gives less importance to get contact with parents, teacher's acceptability of current academic achievement makes a sharp decrease in teacher-parent contact time. At the end, the graph takes lower value than the current graph's. Initial value has no effect on the graph pattern.</td></tr>
</table>

8.3. Sensitivity Analysis

Sensitivity analysis shows how “sensitive” a model is by changing the value of the parameters of the model. In this part, we focus on parameter sensitivity simulations (Monte Carlo) using Vensim PLE 6.3 software. Vensim PLE can carry out multiple simulations by changing the value of parameters. We can also measure the boundaries of the model by taking different range values for each parameter.

Parameter sensitivity analysis helps us to see the effect of a single or multiple parameters on overall system. Sensitvity Analysis measures how the system reacts against those changes on the paramters. That’s why it is useful tool to measure the reliability of the model.

“Sensitivity analysis also helps to have a confidence range in the model by studying the uncertainties. Many parameters in system dynamics models represent quantities that are very difficult, or even impossible to measure to a great deal of accuracy in the real world. Also, some parameter values change in the real world. Therefore, when building a system dynamics model, the modeler is usually at least somewhat uncertain about the parameter values he chooses and must use estimates. Sensitivity analysis allows him to determine what level of accuracy is necessary for a parameter to make the model sufficiently useful and valid. If the tests reveal that the model is insensitive, then it may be possible to use an estimate rather than a value with greater precision. Sensitivity analysis can also indicate which parameter values are reasonable to use in the model. If the model behaves as expected from real world observations, it gives some indication that the parameter values reflect, at least in part, the real world” (Barlas, 2000). Sensitivity tests help the modeler to understand how dynamics of a system function.

In assessing sensitivity to parametric assumptions, first of all a reasonable range of uncertainty for each parameter is identified. A test for sensitivity to those parameters over a much wider range is implemented. Vensim PLE has stimulated the model multiple times randomly selecting values for the uncertain assumptions. At the end of the analysis, a probability distribution that characterizes the likely values of each variable is specified as shown in figure 162. This simulation called Monte Carlo Sensitivity Simulation allows us to generate dynamic confidence intervals for the trajectories of the variables in the model. In figure 162, the probability distribution for the effect of parent educational level on parent expectation from a sample of 1200 simulations is given as an example to explain how sensitivity analysis is implemented in this part.

Yellow, green, blue and grap areas show the 50%, 75%, 95% and 100% confidence bounds accordingly for parent involvement in a sample of 1200 simulations when only parent education level is taken into consideration. This graph shows the uncertainty in Parent Expectation as it changes over time due to parent education level parameter.

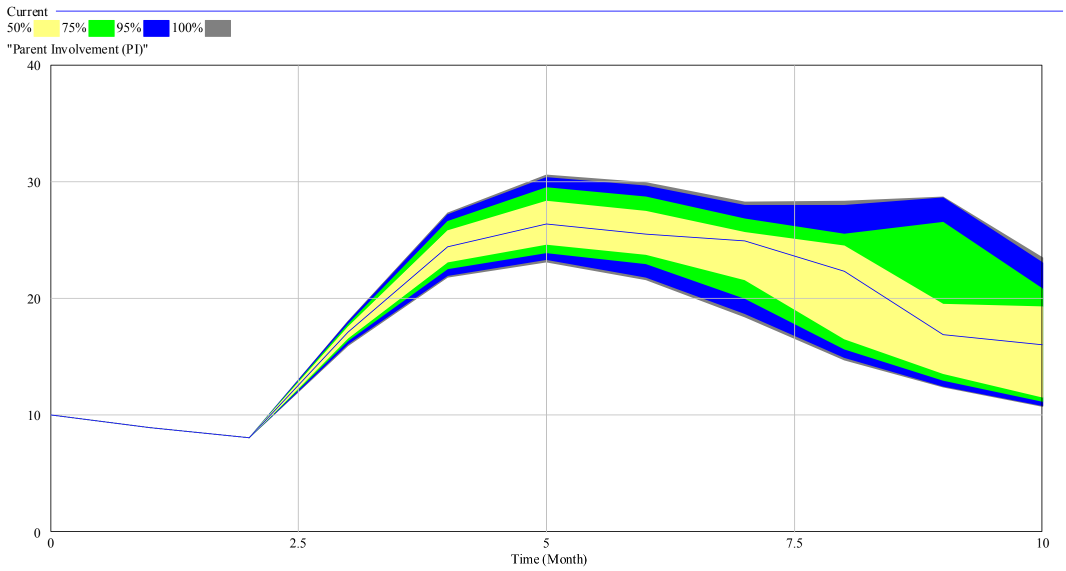


Figure 162 –Dynamic confidence bounds for Parent Involvement Stock from a sensitivity analysis using parent education level (pel) parameter.

To implement sensitivity analysis for the model, all the variables are categorized as parent, teacher, school and student in the model. The distribution of those parameters over the dimensions is given in table-9. First of all, a test for sensitivity to one parameter over a much wider range is implemented. Its effect on each stock (Parent Expectaton, Parent Involvement, Student academic Achievement and Teacher-parent Contact) is tested showing the probability distribution for each stock. Then, the parameters which belong to one of dimensions are categorized and a test for sensitivity to those parameters over a much wider range is implemented. Sensitivity simulation test results are shown in the following figures.

Table 9: Distribution of parameters using in the model over their dimensions.

Parent Dimension Parameters	**Teacher Dimension Parameters**	**School Dimension Parameters**	**Student Dimension Parameters**
parent education level (pel)	teacher verbal ability (tv)	school parent involvement support effectiveness (spis)	Adjustment time for student academic achievement (adjsaa)
family size (fs)	teacher pedagogical knowledge (tp)	school community awareness constant (sca)	
marital status (ms)	teacher caring constant (tc)		
level of parent engagement (lpe)	acceptability of academic achievement by teacher (acoac)		
fraction of parent workload time to total time (pw)	teacher classroom effectiveness (tce)		
lifetime for satisfaction (lifsa)	teacher subject knowledge (tsk)		
needed parent involvement per grade (pipg)	usage of various activities and methods (uoam)		
	teacher expectation (te)		

Table 10: Dynamic confidence bounds for all stocks from a sensitivity simulation using parent education level (pel) parameter. Sensitivity analysis is implemented between a range of 0.2 and 0.6 for the parameter whose initial value is 0.4. Its equation is shown in page 156.

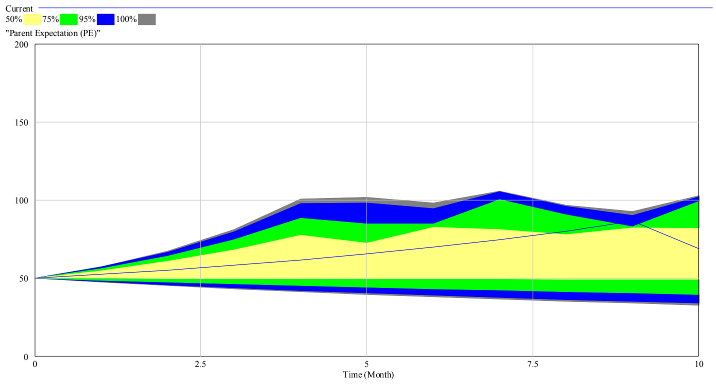
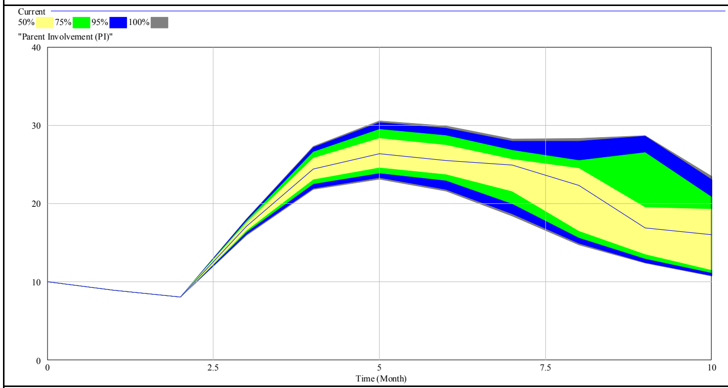
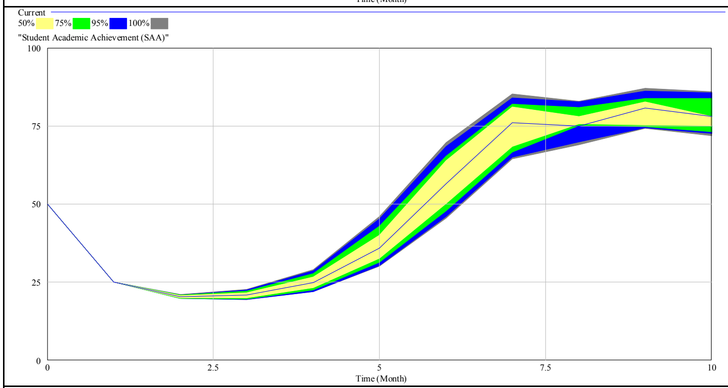
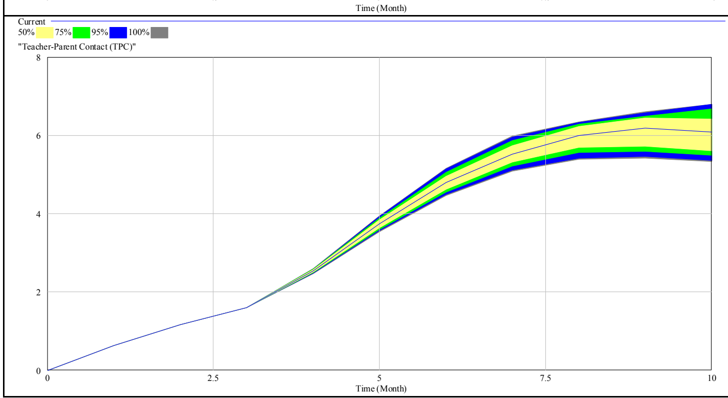
SENSITIVITY SIMULATION RESULTS	**EXPLANATIONS**
	Parent Expectation is highly sensitive towards the level of parent education parameter. When it is simulated between primary (0.2) and undergraduate (0.6) level of education, parent expectation becomes highly sensitive. It directly affects the parent expectation. This outcome is same with the findings in the research done by Gill and Reynolds in 1999.
	Level of parent education also changes sharply parent involvement. Highly educated parents have a tendency to involve in educational process whether at home or at school. Parent involvement is highly sensitive to parent education. According to Keith et al., 1998, parent involvement is highly affected by parent education and then parent involvement affects student academic achievement.
	Level of parent education affects student academic achievement. In the literature, parent education firstly affects parent expectation and parent involvement and then student academic achievement. Student academic achievement is sensitive to parent education level.
	Level of parent education affects teacher-parent contact time. According to Kohl, Lengua and McMahon (2000), teacher-parent contact is the important factor for parent involvement. The result is same as the findings in a research done by McBride, Sullian, Ho-Ho (2005). Highly educated parents try to get more contact with teachers.

Table 11: Dynamic confidence bounds for all stocks from a sensitivity simulation using family size (fs) parameter. Sensitivity analysis is implemented between a range of 0.1 and 0.5 for the parameter whose initial value is 0.3. Its equation is shown in page 156.

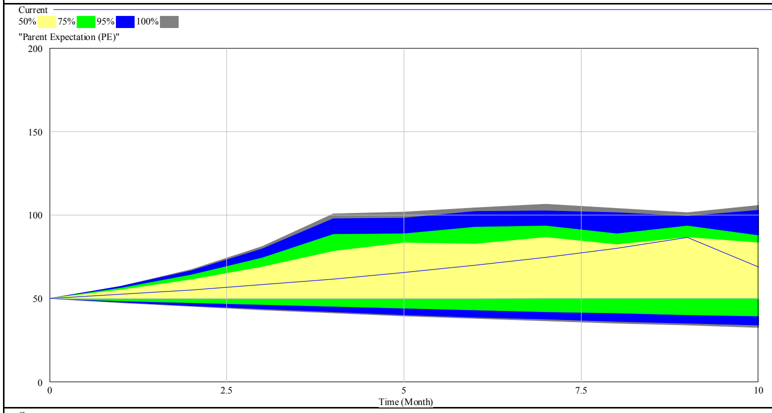
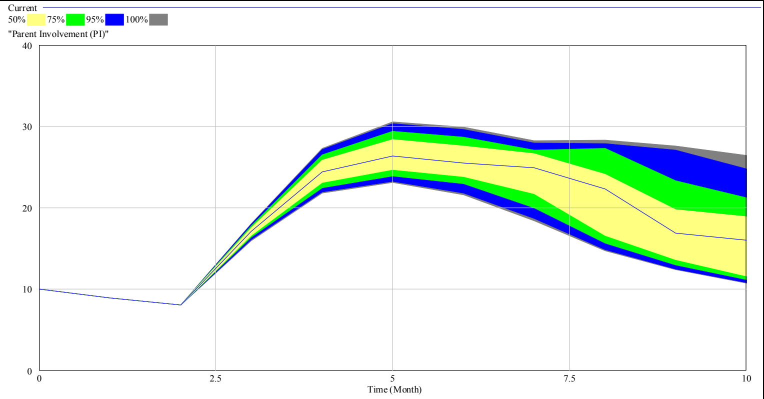
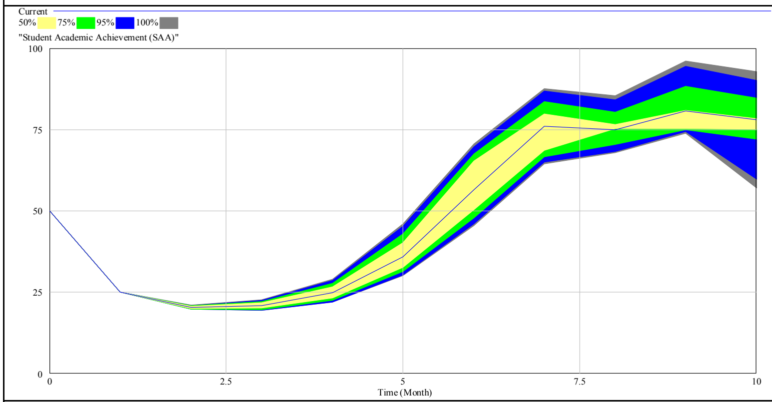
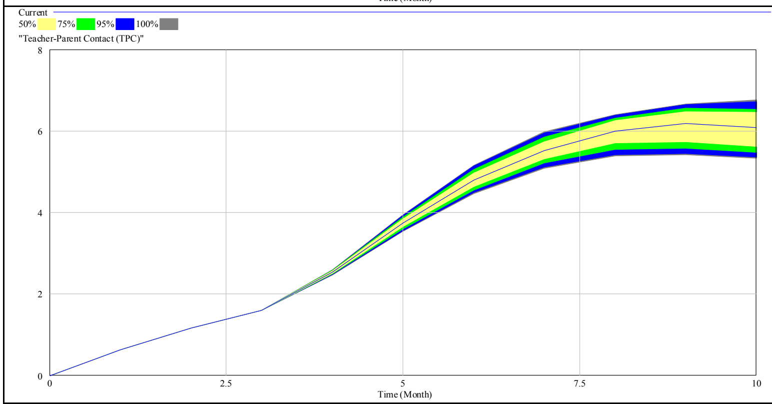
SENSITIVITY SIMULATION RESULTS	EXPLANATIONS
	Parent Expectation is highly senstitive to family size. When family size is simulated between one member and five members, parent expectation changes between 40 and 100. Parent expectation also takes lower values than initial value (50).
	Family size deeply affects parent involvement. Family size is a strong predictor of how much it will affect parent involvement. McBride, Sullian, and Ho-Ho (2005) have mentioned the same relationship between family size and parent involvement. Additionally they stated that parent involvement will also affect student academic achievement.
	Student Academic Achievement is also sensitive to family size parameter. In Keith (1998) research, family size directly affects parent involvement and then student academic achievement. In Gill and Reynolds (1999), number of children affects parent expectation and then student academic achievement. Family size directly or indirectly contributes to student academic achievement.
	When family size is simulated between one member and five members, teacher-parent contact time changes between 5 and 7 hours at the maximum range. Parent involvement is more sensitive than teacher-parent contact for family size parameter.

Table 12: Dynamic confidence bounds for all stocks from a sensitivity simulation using marital status (ms) parameter. Sensitivity analysis is implemented between a range of -0.2 and 0.2 for the parameter whose initial value is 0.0. Its equation is shown in page 156.

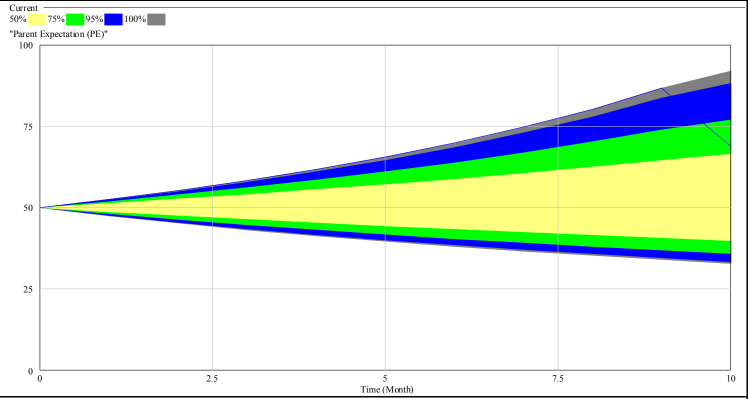
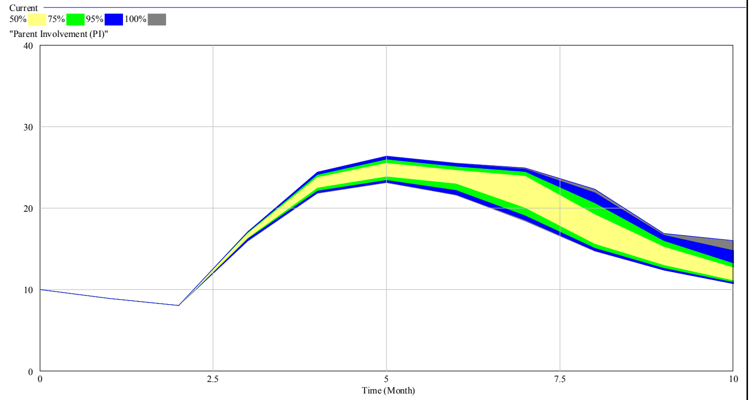
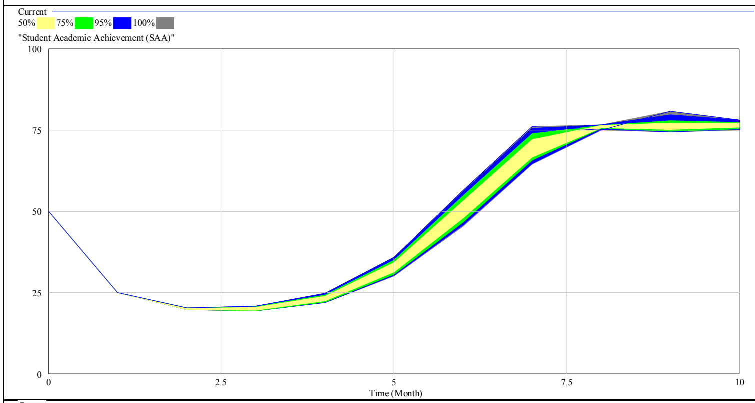
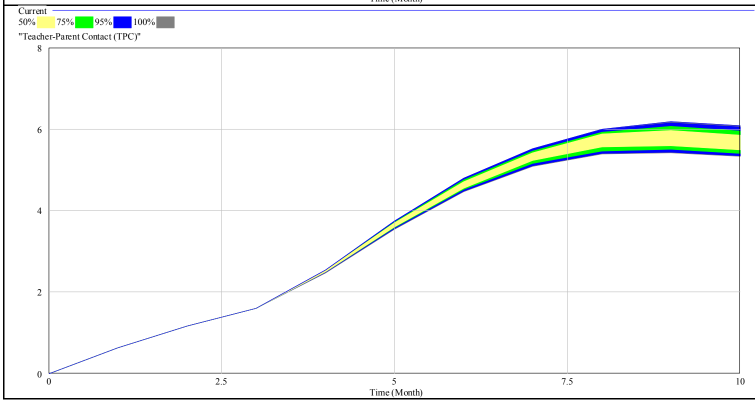
SENSITIVITY SIMULATION RESULTS	**EXPLANATIONS**
	Marital status of family is another predictor for parent expectation. Single parent families have less expectations than married parents. Parent expectation is highly sensitive to such a family demographic factor.
	Single-parent status is also important for parent involvement. Kohl et al (2000), has reported "lower levels of school involvement for single parents. Single parents naturally have fewer resources such as money, social support, and time to invest in their child's education and development. Therefore, single-parent status is a marker of multiple risks that may influence a parent's likelihood of being involved in school or with the child directly."
	Marital status of family indirectly affects student academic achievement. In sensitivity simulation, student academic achievement seems to be less sensitive towards marital status.
	Marital status of family indirectly affects teacher-parent contact. In sensitivity simulation, teacher-parent contact seems to be less sensitive towards marital status. Marital status first of all has more impact on parent involvement than teacher-parent contact even though teacher-parent contact is an important factor of parent involvement.

Table 13: Dynamic confidence bounds for all stocks from a sensitivity simulation using level of parent engagement (lpe) parameter. Sensitivity analysis is implemented between a range of 0.025 and 0.075 for the parameter whose initial value is 0.050. Its equation is shown in page 163.

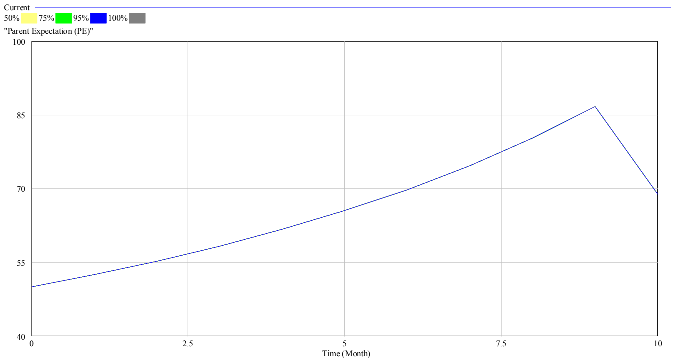
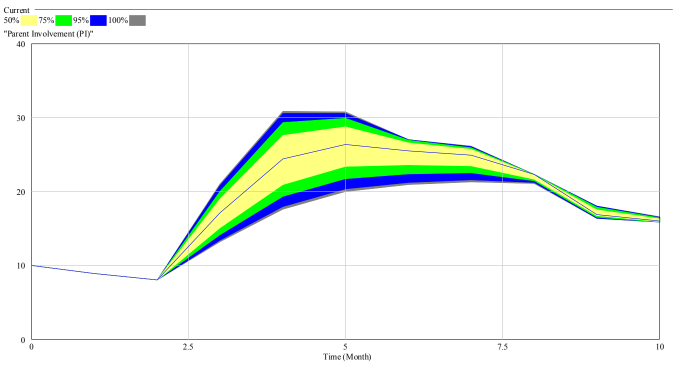
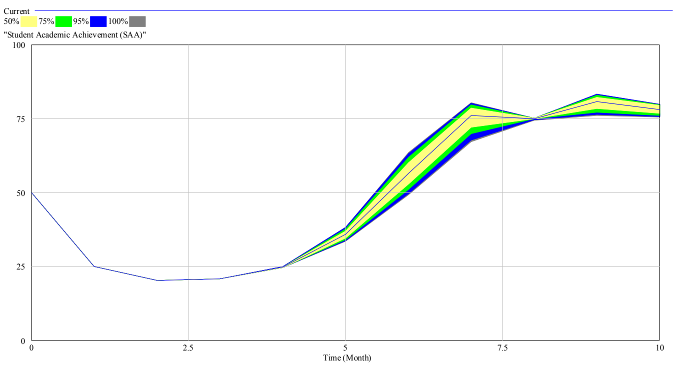
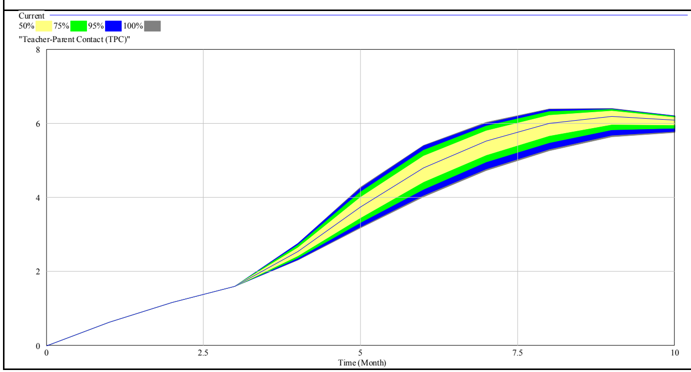
SENSITIVITY SIMULATION RESULTS	**EXPLANATIONS**
	Level of parent engagement has no direct effect on parent expectation. According to Fantuzzo, Perry and Childs (2006), "parental beliefs and expectations about their children's learning are strongly related to children's beliefs about their own competencies, as well as their academic achievement." If parents have a certain belief about their children's academic achievement, the level of engagement in educational process will not meaningfully contribute to parent expectation.
	Parent engagement is one of the parent involvement factors mentioned by Kohl, Lengua and McMahon (2000). This sensitivity simulation results are parallel to the research findings that parent involvement is sensible to parent engagement. Parent engagement makes enormous changes on parent involvement when it reaches its maximum values.
	Student Academic Achievement is less sensitive to level of parent engagement. Its effect seems to be indirect. Parent engagement affects parent involvement and then student academic achievement. When student academic achievement starts to increase, parent engagement becomes sensitive.
	Teacher-parent contact is sensitive to parent engegement. According to Kohl (2000), parent engagement increases parent involvement and parent engagement is one of the parent involvement factors. Since there is a relation between parent engagement and parent involvement, teacher-parent contact becomes sensitive to parent engagement.

Table 14: Dynamic confidence bounds for all stocks from a sensitivity simulation using fraction of parent workload to total time (pw) parameter. Sensitivity analysis is implemented between a range of 0.3 and 0.7 for the parameter whose initial value is 0.5. Its equation is shown in page 163.

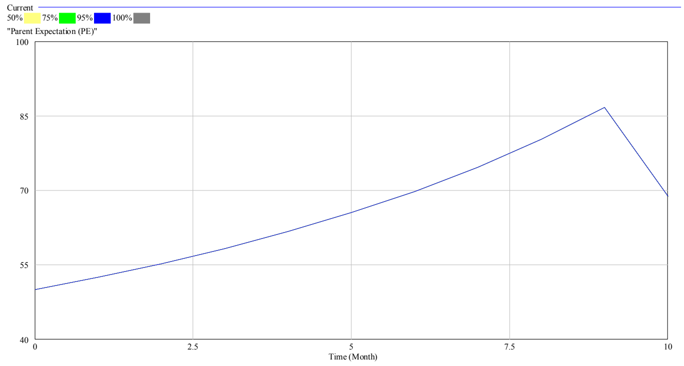
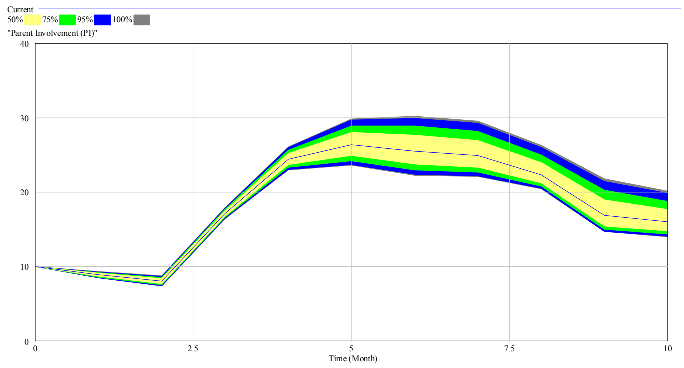
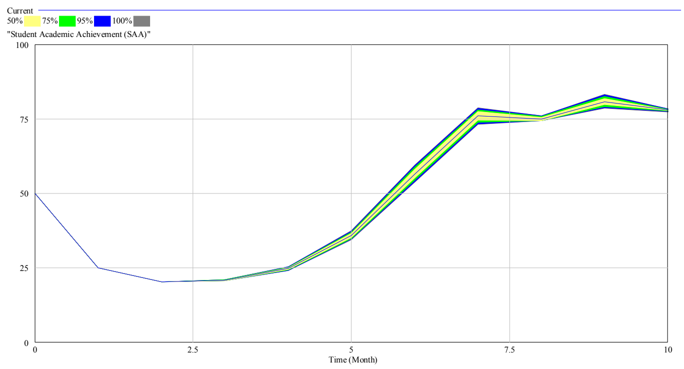
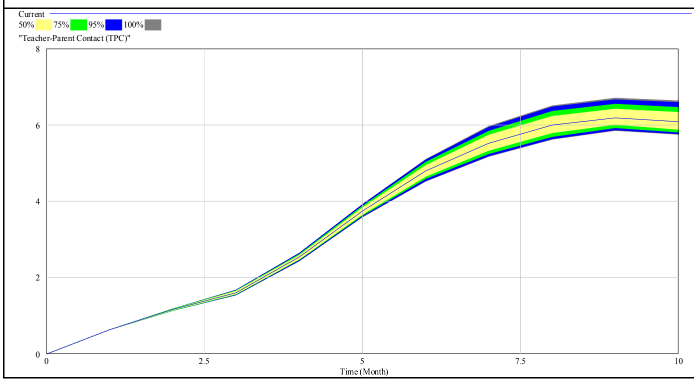
<table>
<tr><th>SENSITIVITY SIMULATION RESULTS</th><th>EXPLANATIONS</th></tr>
<tr><td>
</td><td>Parent workload has no direct effect on parent expectation. According to Fantuzzo, Perry and Childs (2006), "parental beliefs and expectations about their children's learning are strongly related to children's beliefs about their own competencies, as well as their academic achievement." If parents have a certain belief about their children's academic achievement, parent workload to total time will not meaningfully contribute to parent expectation.</td></tr>
<tr><td>
</td><td>Hours of employment are strong factor for parent involvement. Parker (2001) has found that more hours of employment usually associated with negative effects on parent involvement. The effect of parent workload on parent involvement can be observed during all the simulation. Parents need time to involve in educational process. Parent workload becomes strong factor at any time for parent involvement.</td></tr>
<tr><td>
</td><td>Even though parent workload is a strong predictor for parent involvement, it has less effect on student academic achievement. In the literature, there is no direct relationship between parent workload and student academic achievement. Most researches are about the relationship with parent involvement. In simulation results, student academic achievement seems to be less sensitive to parent workload to total time.</td></tr>
<tr><td>
</td><td>Parent workload is also effective for teacher-parent contact time. When parents spend so much time for their non-educational activities, they will have a less tendency to get contact with teachers due to the time limitation. It is sensitive to parent workload but not so much like parent involvement.</td></tr>
</table>

Table 15: Dynamic confidence bounds for all stocks from a sensitivity simulation using lifetime for satisfaction (lifsa) parameter. Sensitivity analysis is implemented between a range of 1 and 3 for the parameter whose initial value is 2. Its equation is shown in page 173.

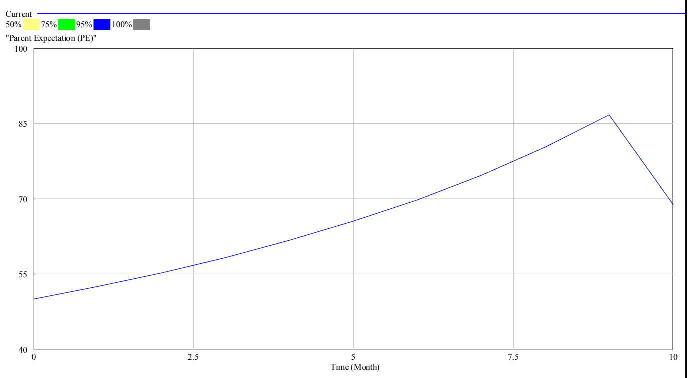
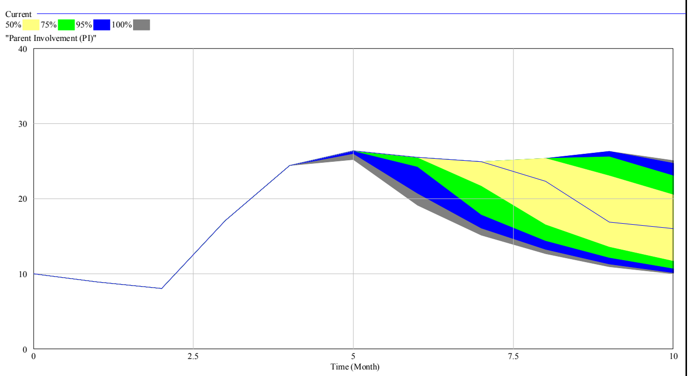
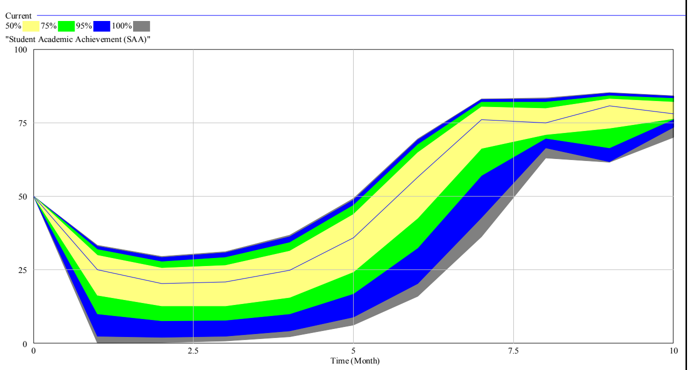
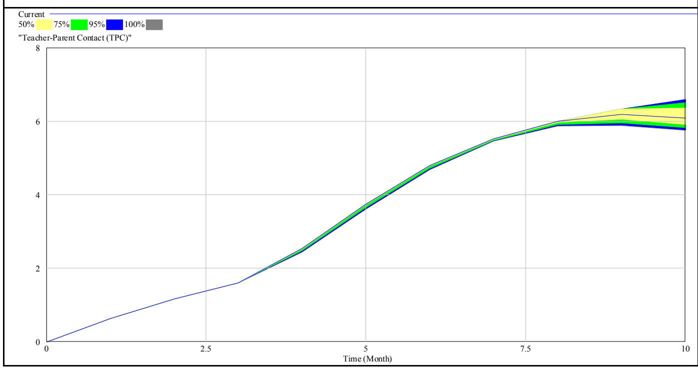
SENSITIVITY SIMULATION RESULTS	EXPLANATIONS
	Lifetime for satisfaction has no direct effect on parent expectation. According to Fantuzzo, Perry and Childs (2006), “parental beliefs and expectations about their children’s learning are strongly related to children’s beliefs about their own competencies, as well as their academic achievement.” If parents have a certain belief about their children’s academic achievement, the level of parent satisfaction will not meaningfully contribute to parent expectation.
	Lifetime for satisfaction becomes more strong factor for parent involvement especially when it takes its maximum values. This outcome is realize in the literature. Under closer home-school relationships, parents may be more committed to schools they have chosen. According to Hausman and Goldring (2000), “parents highly satisfied tend to be involved in their children’s education.”
	Student Academic Achievement and Parent Satisfaction are two important educational outcomes. Lifetime for parent satisfaction becomes effective during all the simulation periods. When parents are satisfied or dissatisfied with current student academic achievement, parents play a crucial role to contribute to student academic achievement. Satisfaction with grades makes great fluctuations on student academic achievement graph. This result is similar to those mentioned by Griffith, 1997.
	Lifetime for satisfaction is also effective on teacher-parent contact but it is less sensitive to lifetime for parent satisfaction. When parents are dissatisfied with the current situation, they look for other involvement factors in addition to teacher-parent contact. Teacher-parent contact is not only way for parents to involve in educational process. Kohl, Lengua and Mahon (2000) have mentioned six ways for parent involvement.

Table 16: Dynamic confidence bounds for all stocks from a sensitivity simulation using needed parent involvement per grade (pigg) parameter. Sensitivity analysis is implemented between a range of 1 and 3 for the parameter whose initial value is 2. Its equation is shown in page 162.

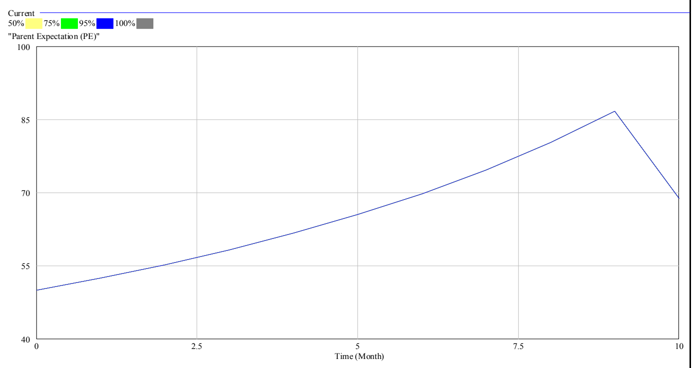
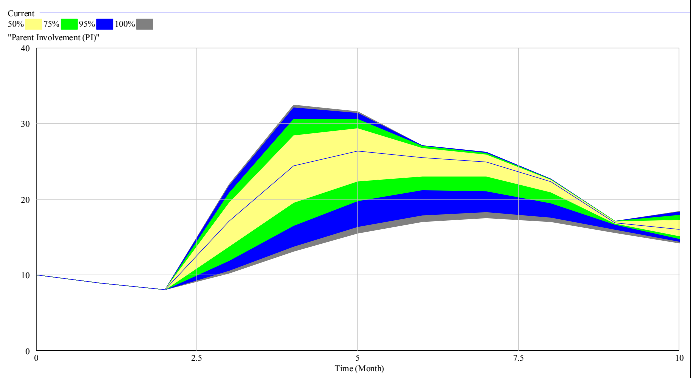
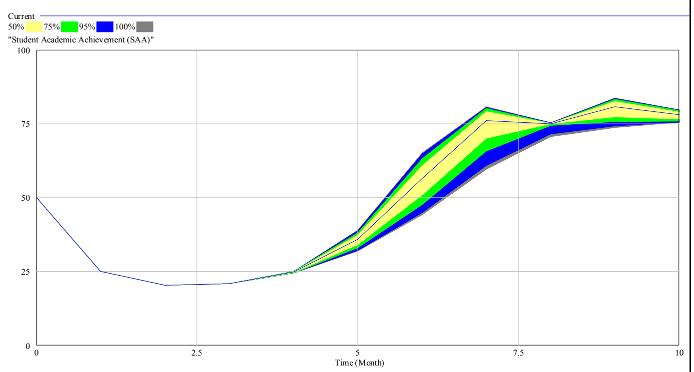
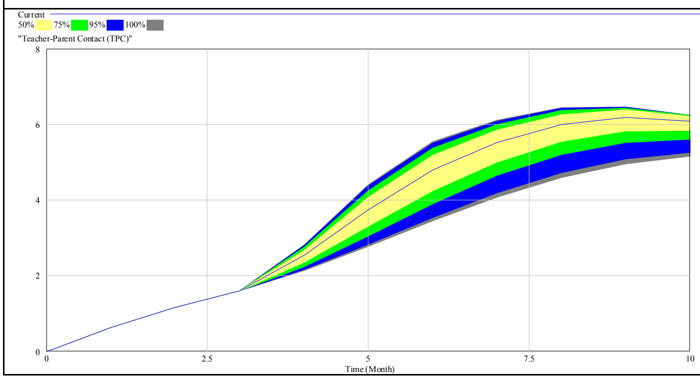
SENSITIVITY SIMULATION RESULTS	**EXPLANATIONS**
	Needed parent involvement per grade has no effect on parent expectation. How much parent involvement is needed to increase student grade by one grade does not affect parent expectation. In addition to that, there is no data and finding about this relation in the literature.
	Parent involvement is highly sensitive to needed parent involvement per grade. There is a strong relationship between them. If more parent involvement is needed to increase student grade by one grade, parent involvement will increase accordingly. In the model, when first report card is issued after two months, parents decide how much they should involve in educational process to increase student academic achievement. Therefore, the parameter has no effect within first two months.
	Needed parent involvement per grade affects also student academic achievement due to the time limitation. If parents need to involve more to increase student academic achievement, this can be to some level due to parent time limitation. Parents spend more time to involve but student grade increases less if needed parent involvement per grade is higher. Student academic achievement is sensitive to that parameter.
	Teacher-parent contact time is also sensitive to needed parent involvement per grade. If more parent involvement is needed to increase student academic achievement, parent have a tendency to get more contact with teachers. Teacher-parent contact is one of the important factors for parent involvement.

Table 17: Dynamic confidence bounds for all stocks from a sensitivity simulation using all the parameters regarding parent dimension.

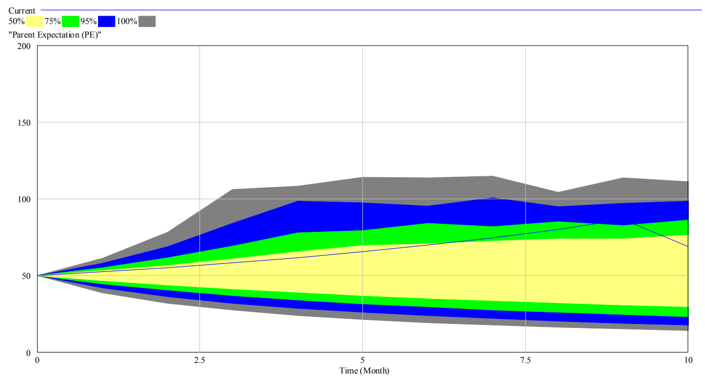
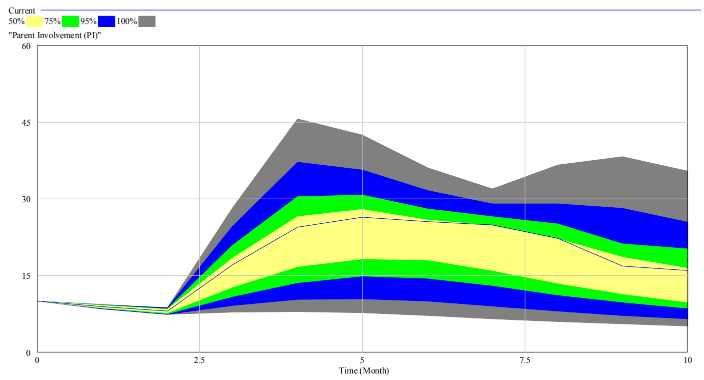
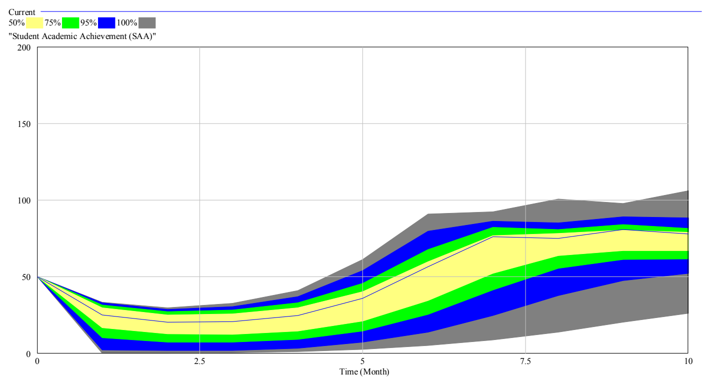
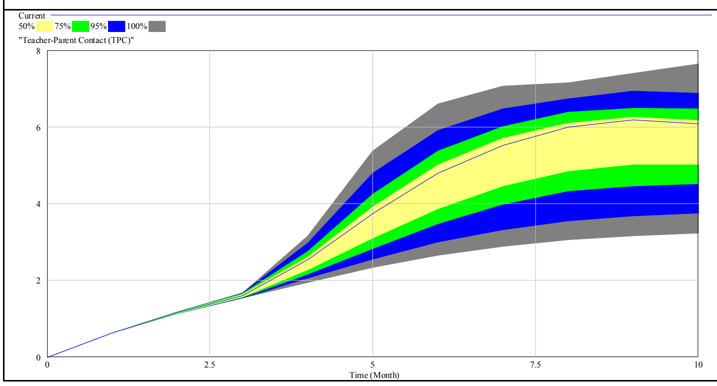
SENSITIVITY SIMULATION RESULTS	EXPLANATIONS
	All parents highly value academic quality. Jacob and Lefgren (2007) claim that "preferences for academic quality changes with parent characteristics." Parameters related with parent dimension highly affect parent expectations. Parents set higher or lower academic expectations depending on parent related parameters.
	According to Tatar and Horenczyk (2000), there is a strong relation between the rise in the parent involvement and the rise in the parent expectations from their kids. Parent involvement is mostly related with parent related factors. Therefore, parent involvement is highly sensitive to all the parameters related with parent dimension.
	Student academic achievement is highly sensitive to all the parameters related with parent dimension. According to Rosenblatt and Peled (2002), "parents contribute significantly to school effectiveness and to students' success." This simulation result is same as the findings in the literature.
	Teacher-parent contact is highly sensitive to all the parameters related with parent dimension. Parent characteristics affect the rate of parent involvement and hence teacher-parent contact. This is same as the findings in the literature. Number of teacher-parent contact time depends on parent characteristics.

Table 18: Dynamic confidence bounds for all stocks from a sensitivity simulation using teacher verbal ability (tv) parameter. Sensitivity analysis is implemented between a range of 0.25 and 0.75 for the parameter whose initial value is 0.50. Its equation is shown in page 185.

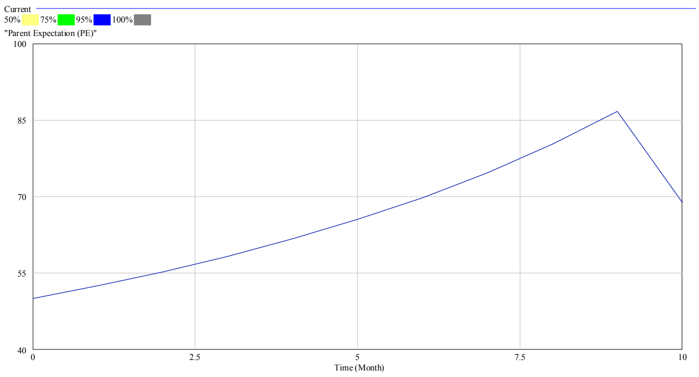
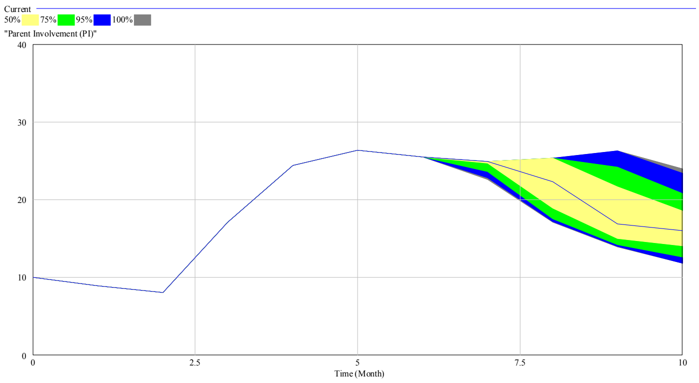
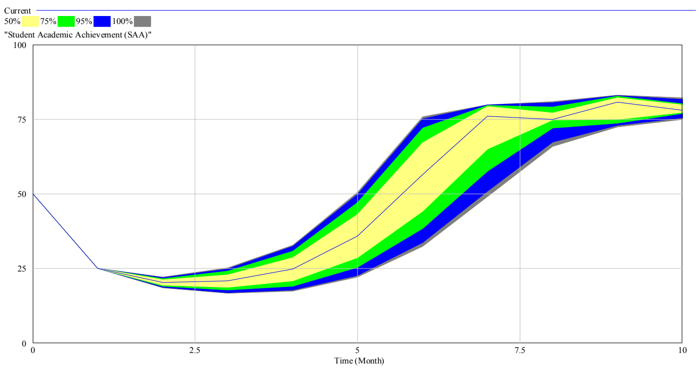
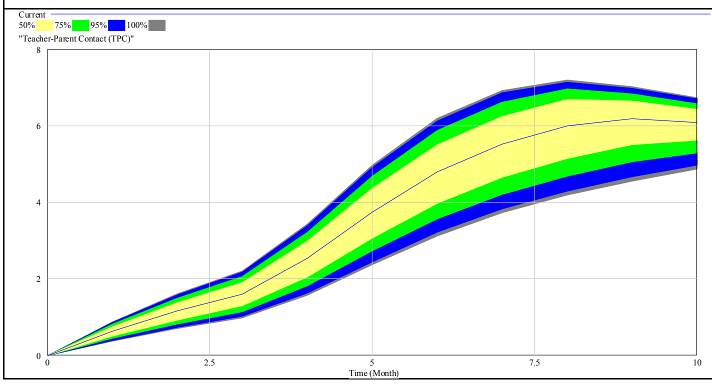
<table>
<tr><th>SENSITIVITY SIMULATION RESULTS</th><th>EXPLANATIONS</th></tr>
<tr><td>
</td><td>Teacher verbal ability has no effect on parent expectation. In the literature, teacher verbal ability has positive correlation with teacher-parent contact and student academic achievement. The relation between majority of teacher related parameters and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to teacher verbal ability.</td></tr>
<tr><td>
</td><td>Teacher verbal ability has effect on parent involvement. Especially parent involvement starts to decline, teacher verbal ability has a significant effect on the slope of the graph. Environmental factors like teacher ones are mostly effective during the decline stage for parent involvement. When parent involvement increases, this is due to parent or student characteristics. Teacher characteristics have especially important effects on parent involvement during the decline stage.</td></tr>
<tr><td>
</td><td>According to Wright, Horn and Sanders (1997), important teacher attributes like high verbal skills and strong subject knowledge are mostly related with the usage of them effectively in the class environment. “Effective teachers appear to be effective with students for academic achievement.” This simulation result is parallel to the findings in the literature. Student Academic Achievement is sensitive to teacher verbal skills.</td></tr>
<tr><td>
</td><td>Teacher verbal ability is an important variable for effectiveness of a teacher in learning envoirnment. According to Aslam and Kingdon (2011), teaching process variables of a teacher matter significantly to the level of contact time with parents. It makes great fluctuations for teacher-parent contact time.</td></tr>
</table>

Table 19: Dynamic confidence bounds for all stocks from a sensitivity simulation using teacher pedagogical knowledge (tp) parameter. Sensitivity analysis is implemented between a range of 0.25 and 0.75 for the parameter whose initial value is 0.50. Its equation is shown in page 185.

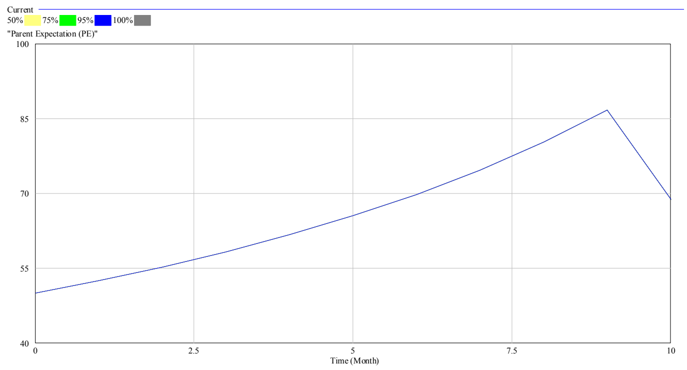
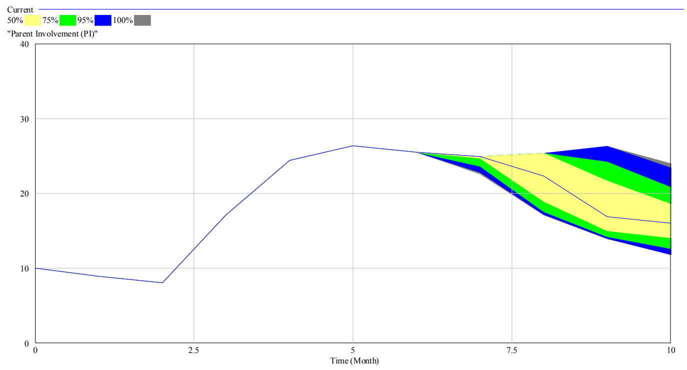
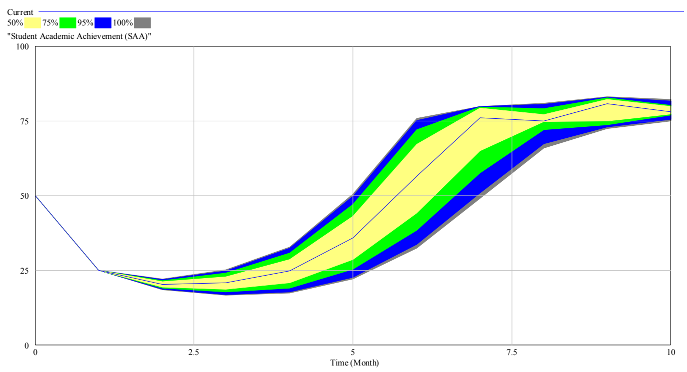
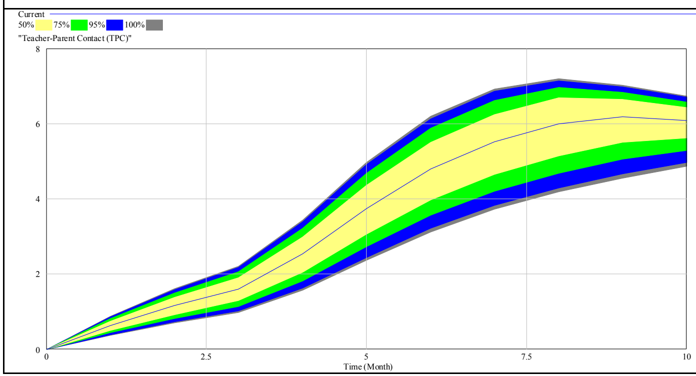
SENSITIVITY SIMULATION RESULTS	**EXPLANATIONS**
	Teacher pedagogical knowledge has no effect on parent expectation. In the literature, teacher pedagogical knowledge has positive correlation with teacher-parent contact and student academic achievement. The relation between majority of teacher related parameters and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to teacher pedagogical knowledge.
	Teacher pedagogical knowledge has effect on parent involvement. Especially parent involvement starts to decline, teacher pedagogical knowledge plays a crucial role on parent involvement. Environmental factors like teacher ones are mostly effective during the decline stage for parent involvement. When parent involvement increases, this is due to parent or student characteristics. Teacher characteristics have especially important effects on parent involvement during the decline stage.
	According to Acevedo (2009), “pedagogical and classroom management skills that are integral to teaching success. Content and pedagogocal knowledge are important to effective teaching that leads to student academic achievement.” This simulation result is same as the findings in the literature. Student Academic Achievement is sensitive to teacher pedagogical knowledge.
	According to Helmke & Schrader (1998), teacher characterisitcs are valuable to make a qualified relations with both parents and students. Teacher pedagogical knowledge is an important one that enables teachers to be feel comfortable themselves during getting contact with parents. Teache pedagogical knowledge has an affect on teacher-parent contact time.

Table 20: Dynamic confidence bounds for all stocks from a sensitivity simulation using teacher caring constant (tc) parameter. Sensitivity analysis is implemented between a range of 0.25 and 0.75 for the parameter whose initial value is 0.50. Its equation is shown in page 185.

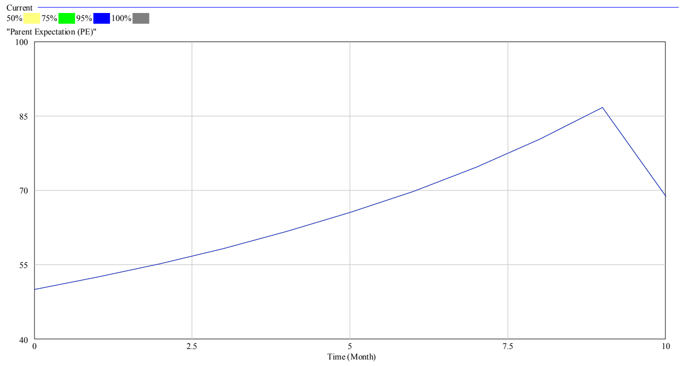
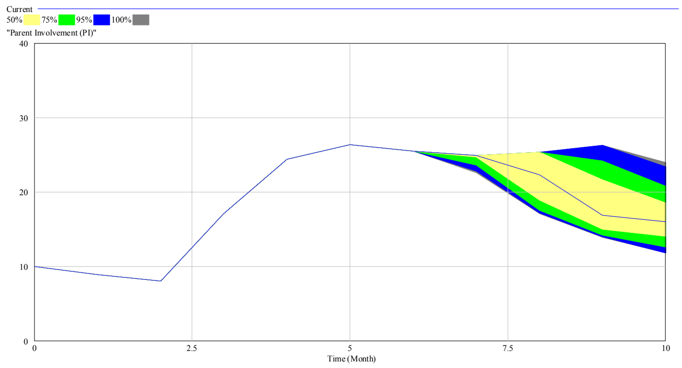
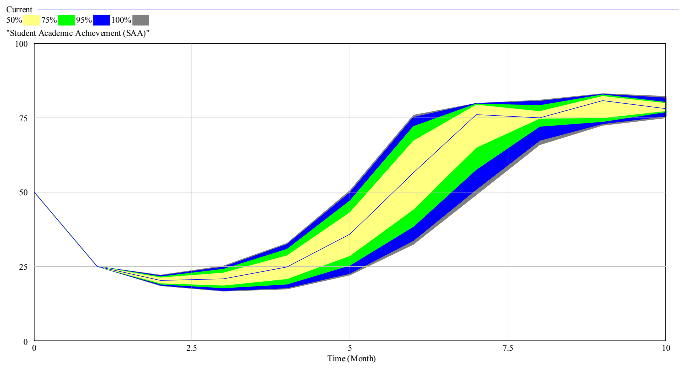
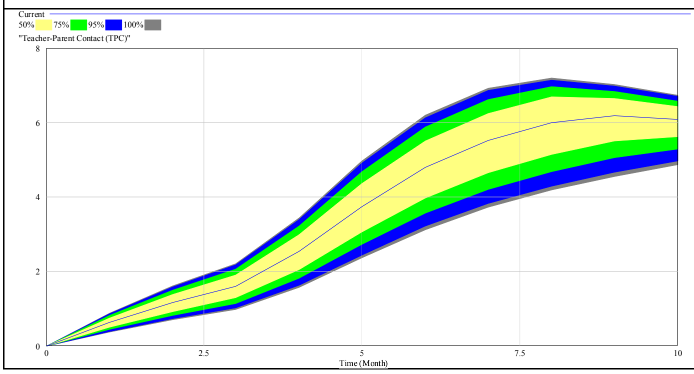
<table>
<tr><th>SENSITIVITY SIMULATION RESULTS</th><th>EXPLANATIONS</th></tr>
<tr><td>
</td><td>Teacher caring has no effect on parent expectation. In the literature, teacher caring has positive correlation with teacher-parent contact and student academic achievement. The relation between majority of teacher related parameters and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to teacher caring.</td></tr>
<tr><td>
</td><td>Teacher caring has effect on parent involvement. Especially parent involvement starts to decline, teacher caring parameter has a significant effect on the slope of the line. Environmental factors like teacher ones are mostly effective during the decline stage for parent involvement. When parent involvement increases, this may be due to parent or student characteristics. Teacher characteristics have especially important effects on parent involvement during the decline stage.</td></tr>
<tr><td>
</td><td>Wentzel (1994) has claimed that "teacher caring has a direct effect on student attitudes towards academic and social goal pursuits. Moreover, caring teachers guide students' academic and social behaviour towards desired outcomes." The research findings have shown the similar findings that it makes valuable range on student academic achievement graph.</td></tr>
<tr><td>
</td><td>Getting contact with parents is an alternative way for teachers to boost student's energy and motivate them. Teacher attitudes are more meaningfull for implementing a parent contact in a learning process (Bruinsma, 2004). Sensitiviy analysis shows similar findings with those in the literatüre that teacher caring has a valuable effect on teacher-parent contact time.</td></tr>
</table>

Table 21: Dynamic confidence bounds for all stocks from a sensitivity simulation using acceptability of achievement by teacher (acoac) parameter. Sensitivity analysis is implemented between a range of 0.25 and 0.75 for the parameter whose initial value is 0.50. Its equation is shown in page 186.

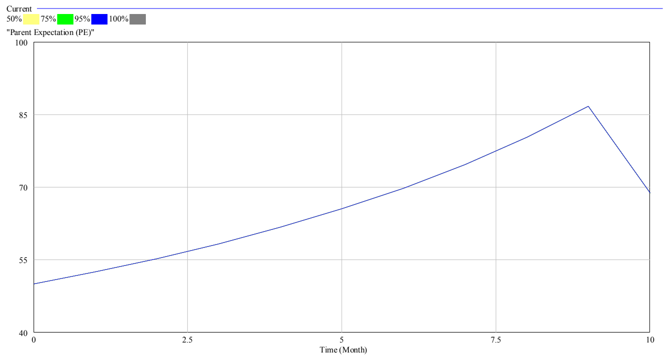
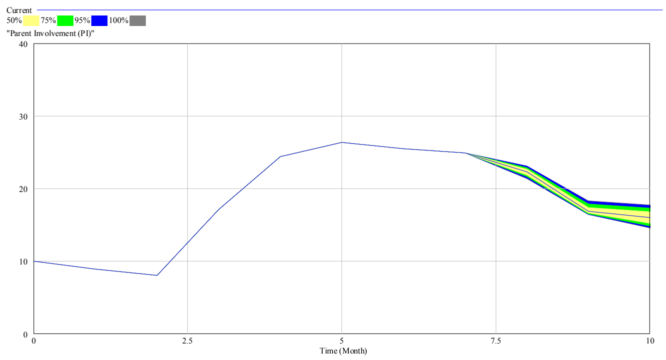
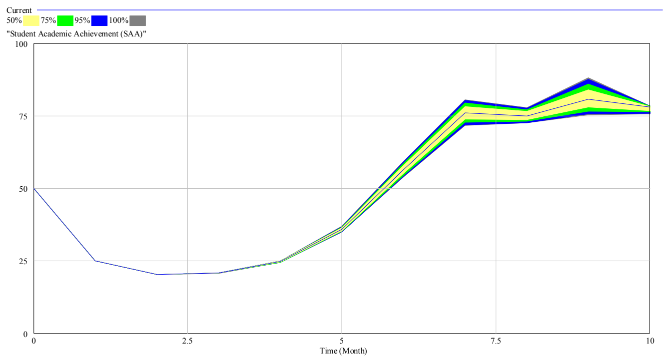
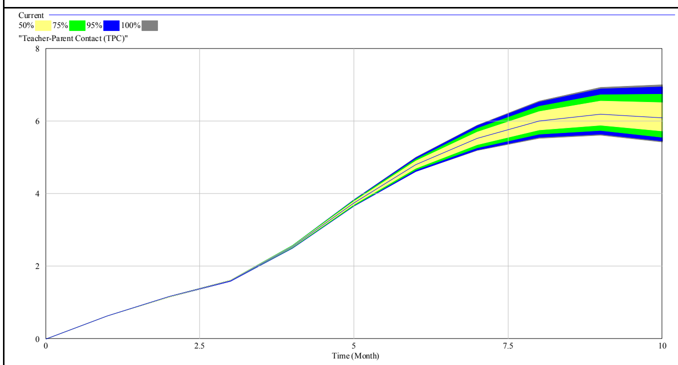
SENSITIVITY SIMULATION RESULTS	**EXPLANATIONS**
	Acceptability of achievement by teacher has no effect on parent expectation. In the literature, teacher beliefs about student academic achievement has positive correlation with teacher-parent contact and student academic achievement. The relation between majority of teacher related parameters and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to teacher beliefs about student academic achievement.
	Acceptability of achievement by teacher has little effect on parent involvement. Especially parent involvement starts to decline, teacher beliefs about student academic achievement plays a crucial role on parent involvement. Environmental factors like teacher ones are mostly effective during the decline stage for parent involvement. When parent involvement increases, this may be due to parent or student characteristics. Teacher characteristics have some effects on parent involvement during the decline stage.
	Acceptability of achievement by teacher has a minimum level of effect on student academic achievement. When a teacher accepts the current student academic achievement, he or she will not try to push student's ability to achieve more. Acceptability of current academic situation puts teachers off showing more extra effort to increase student academic achievement.
	When teachers believe that he or she may not increase student's effort to do best, he or she will get less contact with both students and parents. They show less willingness to motivate students. Acceptability of current student acaddemic achievement has an important effect on teacher-parent contact time.

Table 22: Dynamic confidence bounds for all stocks from a sensitivity simulation using teacher classroom effectiveness (tce) parameter. Sensitivity analysis is implemented between a range of 0.25 and 0.75 for the parameter whose initial value is 0.50. Its equation is shown in page 172.

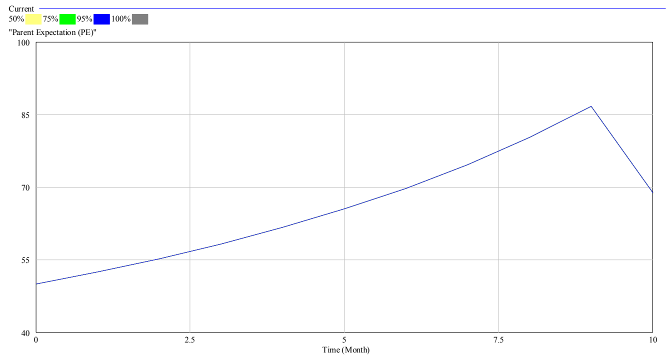
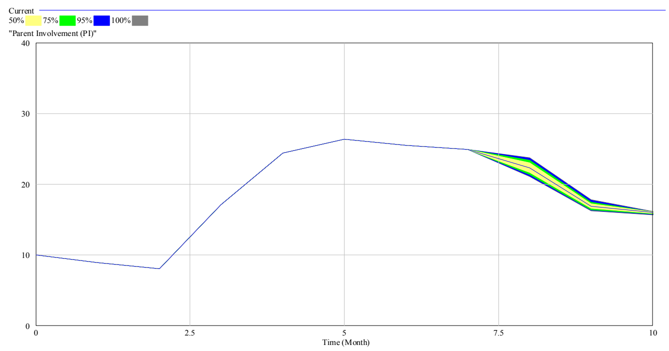
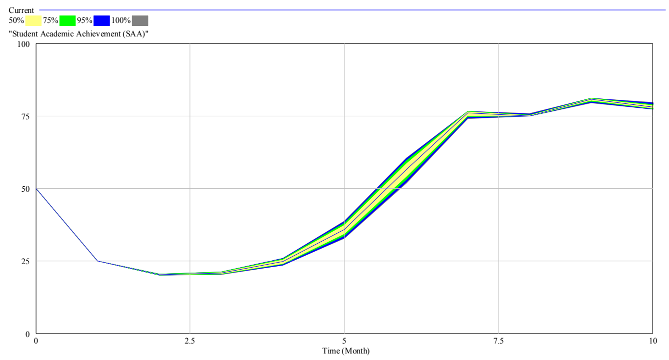
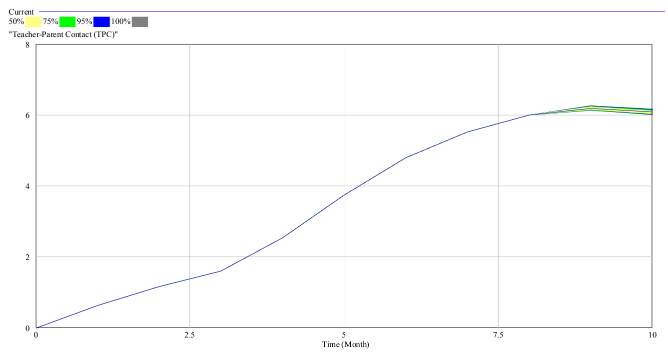
SENSITIVITY SIMULATION RESULTS	**EXPLANATIONS**
	Teacher classroom effectiveness has no effect on parent expectation. In the literature, teacher classroom effectiveness has positive correlation with teacher-parent contact and student academic achievement. The relation between majority of teacher related parameters and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to teacher classroom effectiveness.
	Teacher classroom effectiveness has little effect on parent involvement. Especially parent involvement starts to decline, teacher classroom effectiveness plays a little-effect role on parent involvement. Environmental factors like teacher ones are mostly effective during the decline stage for parent involvement. When parent involvement increases, this may be due to parent or student characteristics. Teacher characteristics have some effects on parent involvement during the decline stage.
	In the literature, teacher classroom effectiveness has been thought as a factor that contributes to student academic achievement. In our research, it seems to have less effect on student academic achievement. Especially when student academic achievement starts to increase, its effect becomes valuable and creates a small fluctuation around the graph line.
	In our finding, there is no strong relationship between teacher classroom effectiveness and teacher-parent contact time. A few research has mentioned some weak relations between them.

Table 23: Dynamic confidence bounds for all stocks from a sensitivity simulation using teacher subject knowledge (tsk) parameter. Sensitivity analysis is implemented between a range of 0.25 and 0.75 for the parameter whose initial value is 0.50. Its equation is shown in page 172.

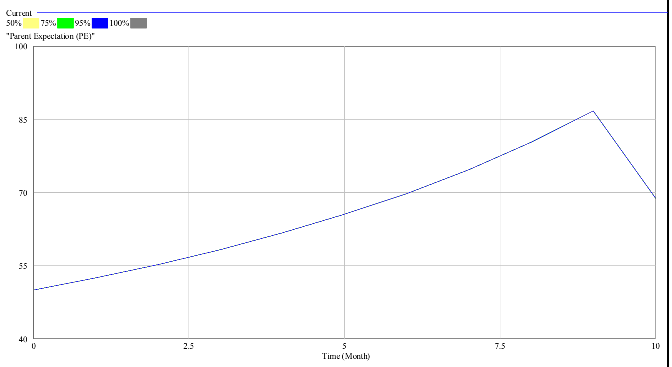
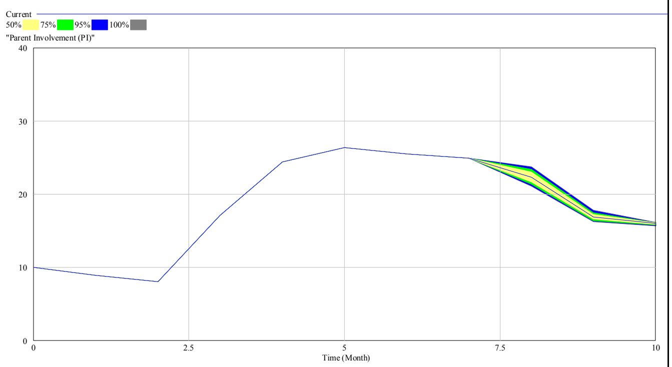
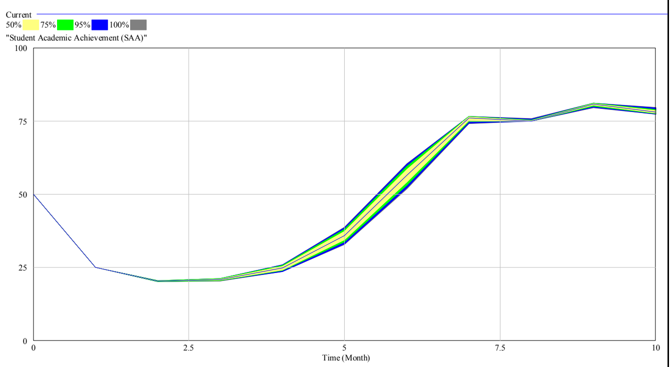
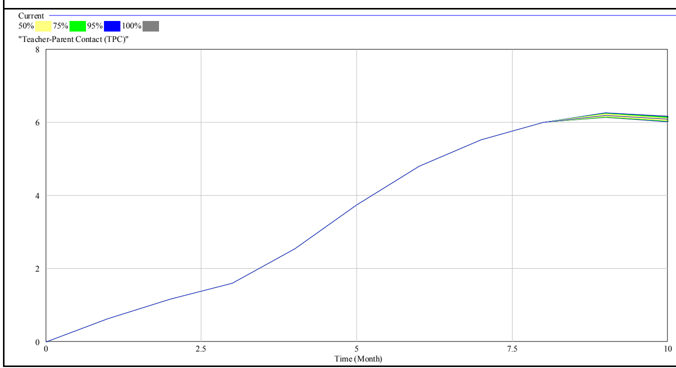
SENSITIVITY SIMULATION RESULTS	**EXPLANATIONS**
	Teacher subject knowledge has no effect on parent expectation. In the literature, teacher subject knowledge has positive correlation with teacher-parent contact and student academic achievement. The relation between majority of teacher related parameters and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to teacher subject knowledge.
	Teacher subject knowledge has little effect on parent involvement. Especially parent involvement starts to decline, teacher subject knowledge plays a little-effect role on parent involvement. Environmental factors like teacher ones are mostly effective during the decline stage for parent involvement. When parent involvement increases, this may be due to parent or student characteristics. Teacher characteristics have some effects on parent involvement during the decline stage.
	"Teachers are extremely important determinants of student academic achievement, but identifying specific teacher attributes that improve student performance is a difficult task" says Jepsen (2005) and he accepts that teacher subject knowledge is among them. Our findings has supported to Jepsen' ideas. Teacher subject knowledge makes a valuable fluctuation around the graph.
	In our finding, there is no strong relationship between teacher subject knowledge and teacher-parent contact time. A few research has mentioned some weak relations between them.

Table 24: Dynamic confidence bounds for all stocks from a sensitivity simulation using usage of various activities and methods (uoam) parameter. Sensitivity analysis is implemented between a range of 0.25 and 0.75 for the parameter whose initial value is 0.50. Its equation is shown in page 172.

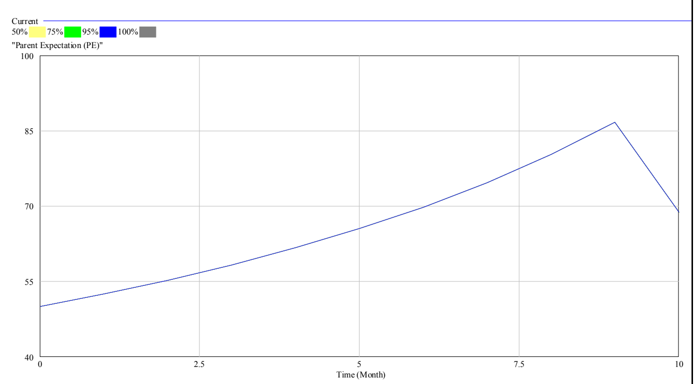
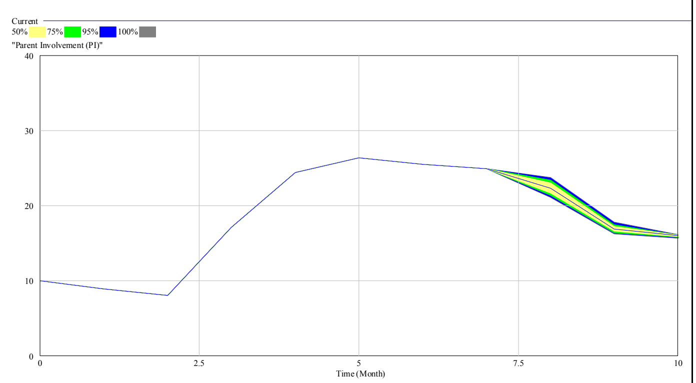
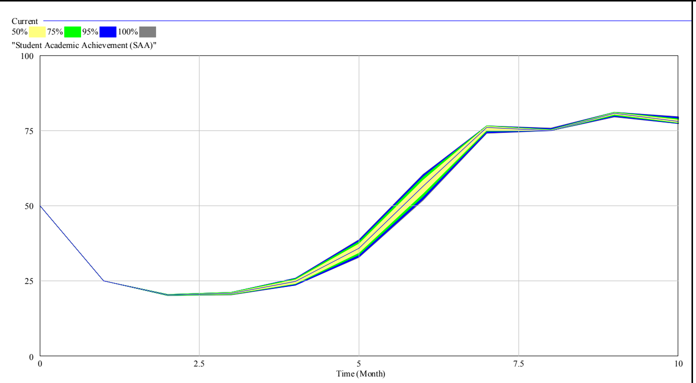
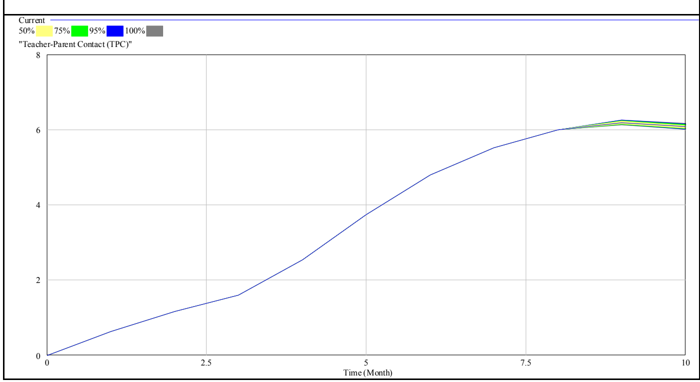
SENSITIVITY SIMULATION RESULTS	EXPLANATIONS
	Usage of various activities and methods has no effect on parent expectation. In the literature, usage of various activities and methods has positive correlation with teacher-parent contact and student academic achievement. The relation between majority of teacher related parameters and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to usage of various activities and methods.
	Usage of various activities and methods has little effect on parent involvement. Especially parent involvement starts to decline, usage of various activities and methods plays a little-effect role on parent involvement. Environmental factors like teacher ones are mostly effective during the decline stage for parent involvement. When parent involvement increases, this may be due to parent or student characteristics. Teacher characteristics have some effects on parent involvement during the decline stage.
	Turner et al. (1999) emphasizes the importance of teacher practices and teaching methodologies in the class in order to contribute to student success. Teachers' methodology has an effect on student academic achievement. The teaching methods and tactics in class keep the students' needs for learning alive and enhance students' motivation towards learning. Our findings support the literature points of view. Especially when student academic achievement starts to increase, its effect becomes observable and valuable.
	In our finding, there is no strong relationship between teacher's various activities and tactics and teacher-parent contact time. A few research has mentioned some weak relations between them.

Table 25: Dynamic confidence bounds for all stocks from a sensitivity simulation using teacher expectation (te) parameter. Sensitivity analysis is implemented between a range of 0.25 and 0.75 for the parameter whose initial value is 0.50. Its equation is shown in page 172.

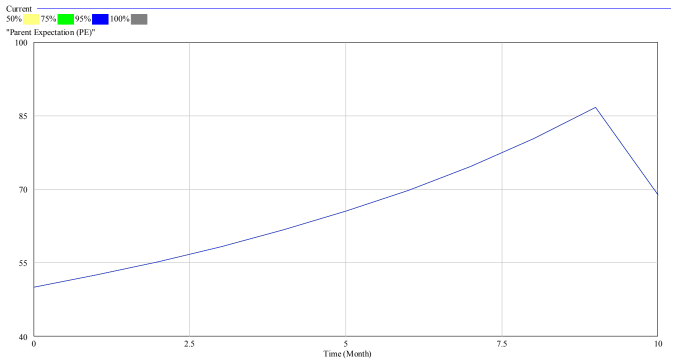
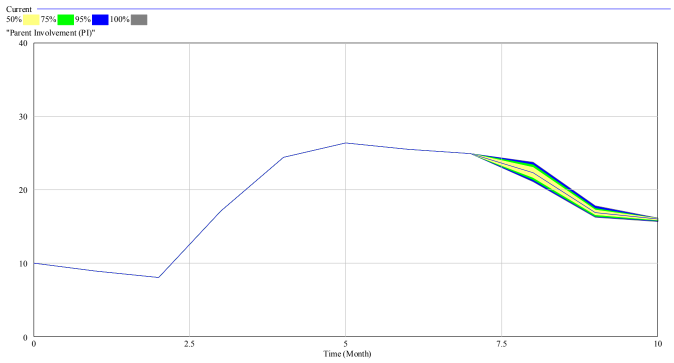
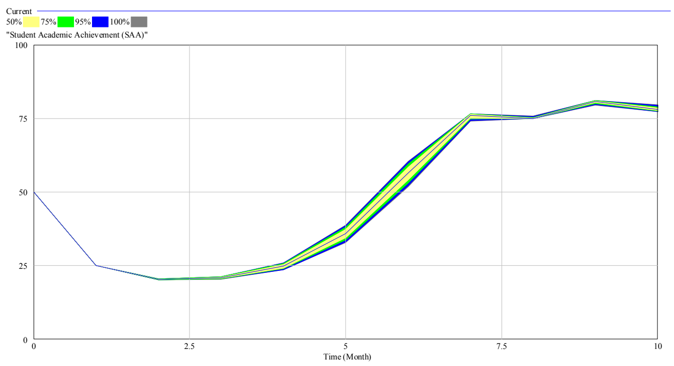
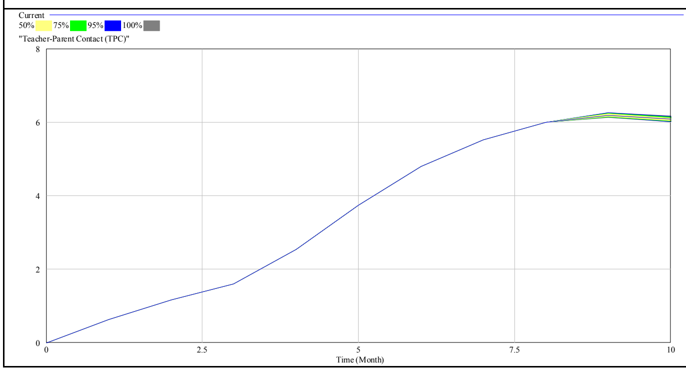
SENSITIVITY SIMULATION RESULTS	**EXPLANATIONS**
	Teacher expectation has no effect on parent expectation. In the literature, teacher expectation has positive correlation with teacher-parent contact and student academic achievement. The relation between majority of teacher related parameters and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to teacher expectation.
	Teacher expectation has little effect on parent involvement. Especially parent involvement starts to decline, teacher expectation plays a little-effect role on parent involvement. Environmental factors like teacher ones are mostly effective during the decline stage for parent involvement. When parent involvement increases, this may be due to parent or student characteristics. Teacher characteristics have some effects on parent involvement during the decline stage.
	According to Gill and Reynolds (1999), teacher expectations influence the later achievement level and they claim that teacher expectations made an educationally meaningful contribution for achievement. This is supported also by our findings. Teacher expectation has a valuable effect on student academic achievment.
	In our finding, there is no strong relationship between teacher expectation and teacher-parent contact time. Generally parent expectation encourages them to get contact with teachers. Teacher expectation generally affects the quality of relationship between teacher and student.

Table 26: Dynamic confidence bounds for all stocks from a sensitivity simulation using all the parameters regarding teacher dimension.

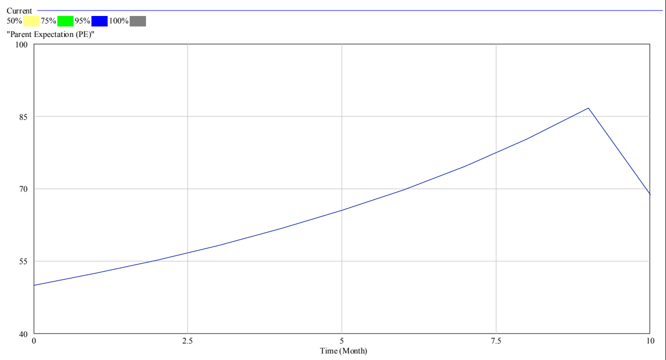
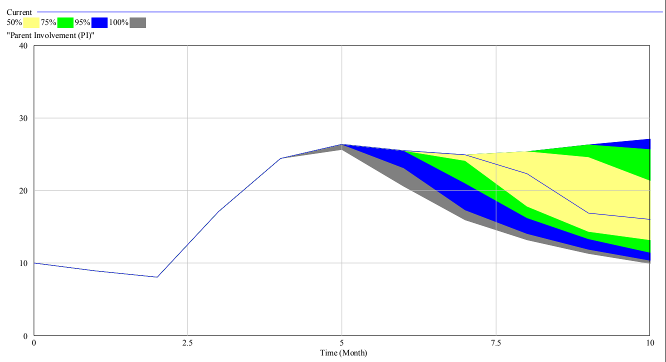
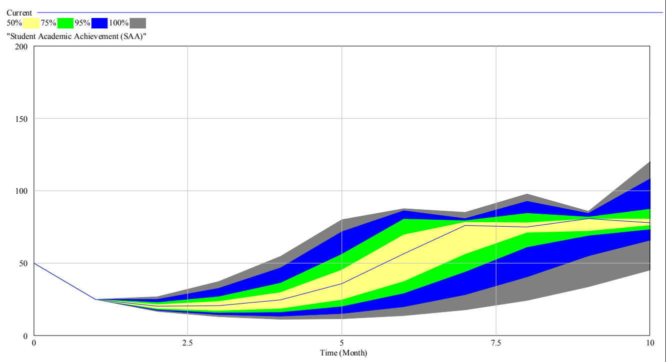
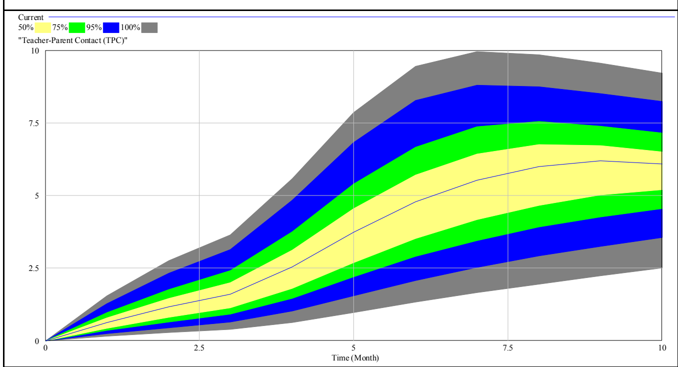
SENSITIVITY SIMULATION RESULTS	EXPLANATIONS
	Parameters related with teacher dimension has no effect on parent expectation. In the literature, parameters related with teacher dimension has positive correlation with teacher-parent contact and student academic achievement. The relation between majority of teacher related parameters and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to parameters related with teacher dimension.
	Parameters related with teacher dimension has effect on parent involvement. Especially parent involvement starts to decline, parameters of teacher dimension play a crucial role on parent involvement. Environmental factors like teacher ones are mostly effective during the decline stage for parent involvement. When parent involvement increases, this may be due to parent or student characteristics. Teacher characteristics have especially important effects on parent involvement during the decline stage.
	"A consistent finding in the research literature is that teachers are important for student learning and that great variation exists in the effectiveness of teachers" (Boyd et al, 2008). Each specific teacher attributes have some small effects on student academic achievement. But when all the variables regarding with teacher quality and effectiveness are taken into consideration, there is a strong correlation between teacher attributes and student academic achievement. This research supports the importance of teacher dimension for student success.
	Since the one side of teacher-parent contact is teacher itself, teacher characteristics have deeply affects teacher-parent contact time and its effect is meaningful.

Table 27: Dynamic confidence bounds for all stocks from a sensitivity simulation using school parent involvement support effectiveness (spis) parameter. Sensitivity analysis is implemented between a range of 0.025 and 0.075 for the parameter whose initial value is 0.050. Its equation is shown in page 163.

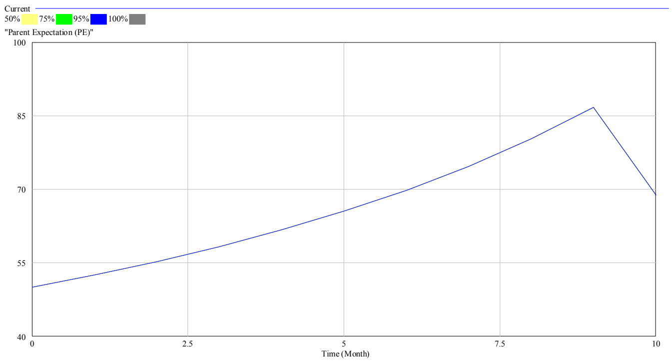
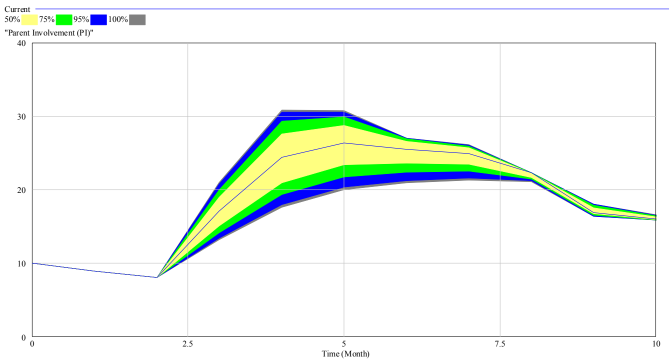
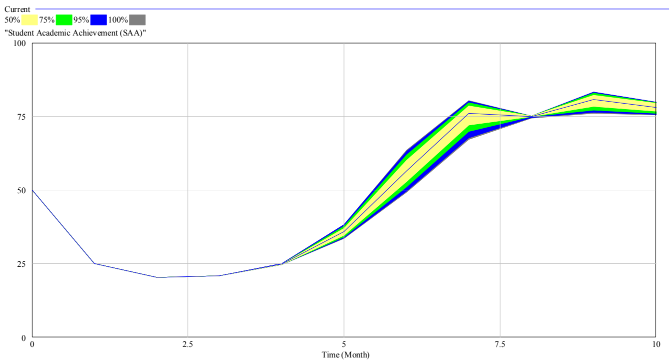
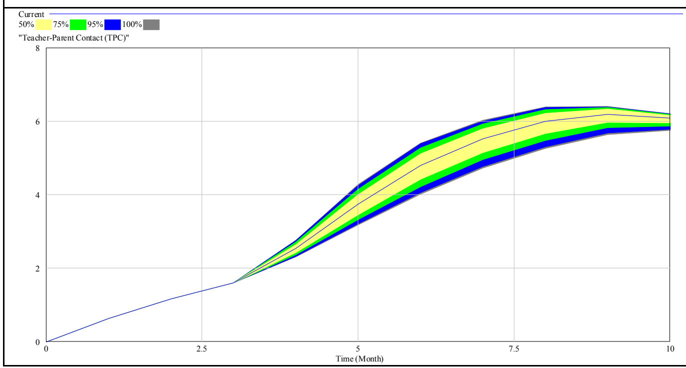
SENSITIVITY SIMULATION RESULTS	EXPLANATIONS
	School parent involvement support effectiveness has no effect on parent expectation. The relation between how schools support parent involvement and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to school parent involvement support effectiveness variable.
	Successful schools establish a constructive relationship with its community. Community engagement is so important for those schools. “This construct describes the degree to which the school can count on involvement and support from parents and community members” (Hoy and Sabo, 1998). School policy towards the parent involvement is an important start up to increase the level of parent involvement. Research finding has supported the literature facts. School support has a meaningful effect on parent involvement.
	DiPaola (2005) says that “a school’s ability to productively engage its community has been found related to student academic achievement.” School policy and attitudes to support parent involvement have valuable effects on student academic achievement. Research findings are parallel to those mentioned in the literature.
	School support obviously encourages both teachers and parents to get contact with each other. It has a strong correlation with teacher-parent contact time.

Table 28: Dynamic confidence bounds for all stocks from a sensitivity simulation using school community awareness constant (sca) parameter. Sensitivity analysis is implemented between a range of 0.25 and 0.75 for the parameter whose initial value is 0.50. Its equation is shown in page 185.

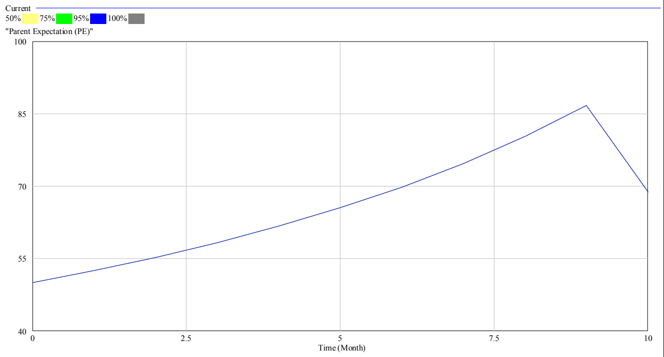
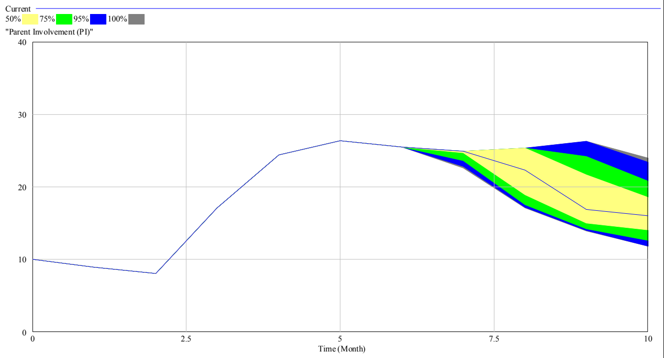
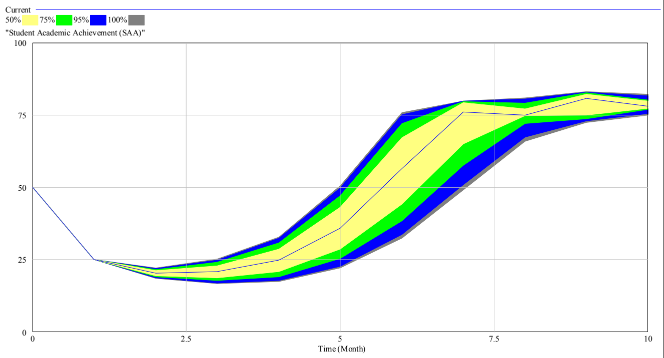
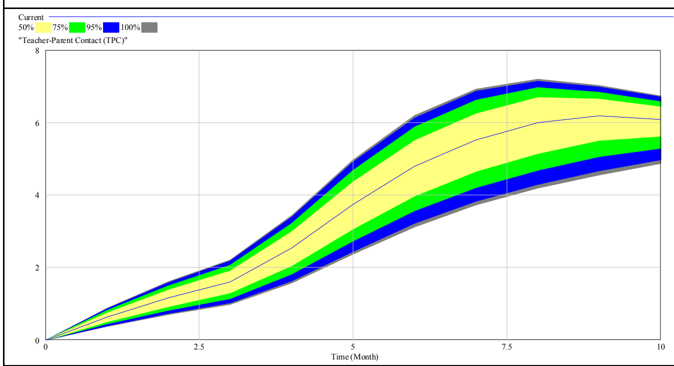
SENSITIVITY SIMULATION RESULTS	**EXPLANATIONS**
	School community awareness constant has no effect on parent expectation. The relation between how schools give more importance towards parent involvement and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to school community awareness constant variable.
	School community awareness plays a crucial role when parent involvement starts to decline. School community support parent involvement and this support makes this decline gradually an with the less rate. The awareness of school community members about the importance of prent involvement has a valuable effect on the rate of parnt involvement and makes a wide fluctuation around the graph.
	According to Uline and Moran (2008), the dynamic of social environment also affects student academic achievement. "The quality of interpersonal relationships and dynamics in a school can influence student learning. School climate is an assessment of the social dynamics in a school; and more than four decades of research provides a well-established link between school climate and student achievement." In our research this variable has been considered as school community awareness and findings support the literature facts. School plays a crucial role on student academic achievement.
	The awareness of school community about the importance of parent involvement in educational process makes teacher-parent contact time more and this awareness encourage teachers to get contact with the parents to boost student energy and increase their motivation. It has a valuable and meaningful effect on teacher-parent contact time. It creates a wide range fluctation around the graph all the time.

Table 29: Dynamic confidence bounds for all stocks from a sensitivity simulation using all the parameters regarding school dimension.

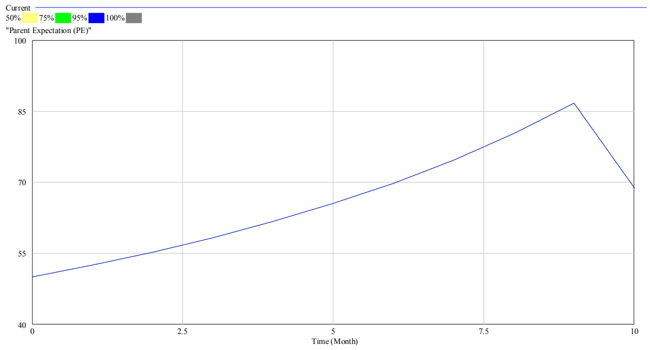
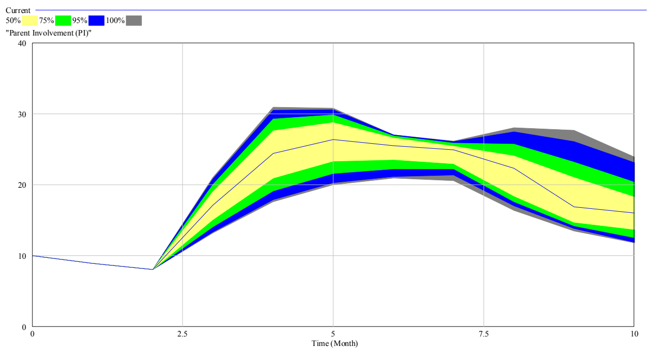
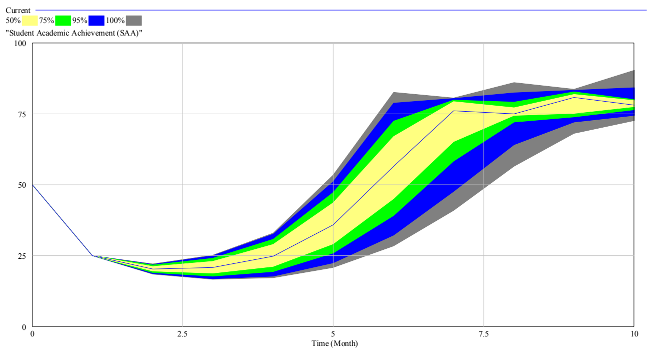
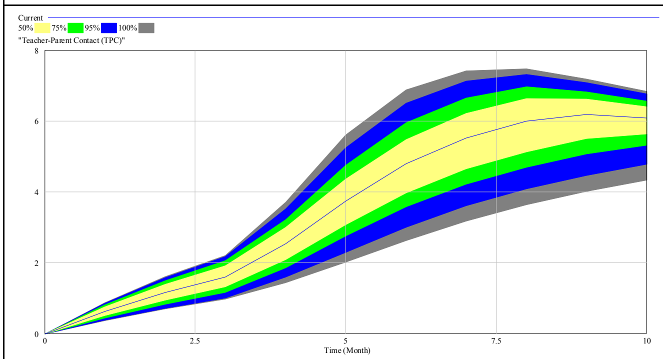
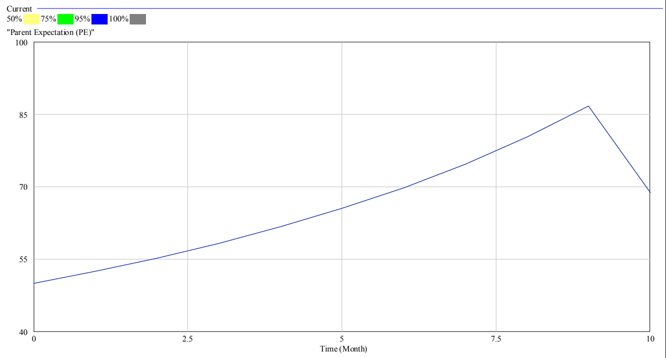
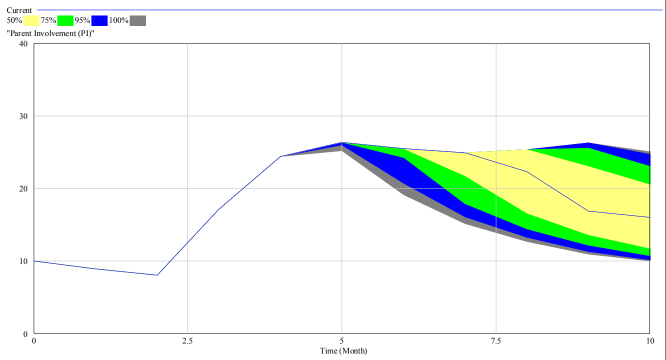
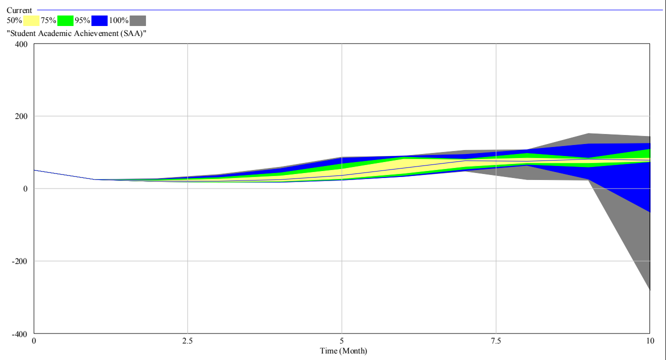
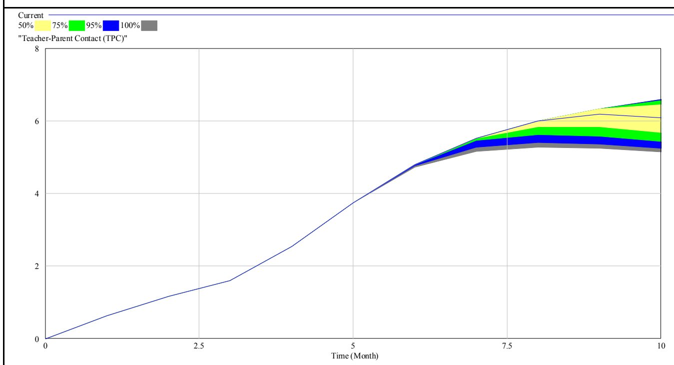
SENSITIVITY SIMULATION RESULTS	EXPLANATIONS
	Parameters related with school dimension has no effect on parent expectation. In the literature, parameters related with school dimension has positive correlation with parent involvement, teacher-parent contact and student academic achievement. The relation between majority of teacher related parameters and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to parameters related with school dimension.
	McBride, Sullian and Ho-Ho (2005) emphasize that school factors such as school setting, the size, academic focus, climate, school governance, school characteristics and policies, teacher practices etc. influence parent involvement. Research findings support these statements mentioned in the literature.
	"School-related resources have a measurable impact on student academic achievement" (Huang, 2010). "Previous research on school effects indicates that schools' structures, academic organization, policies, and resources contribute in various ways to student academic success or failure" (Heck and Mahoe, 2010). School-related variables contribute meaningfully to student academic achievement and it makes more fluctuations around the student academic achievement graph.
	Supportive School environment encourages the community members to get contact with each other. According to the model created by Kohl, Lengua and McMahon (2000), Parent-teacher contact is one of the factors for parent involvement. "Parents can easily contact the school about their children's progress and contact the school to find out how to give extra help" (Eccles & Harold, 1996) if school creates a warm atmosphere for parent involvement.

Table 30: Dynamic confidence bounds for all stocks from a sensitivity simulation using adjustment time for student academic achievement (adjsaa) parameter. Sensitivity analysis is implemented between a range of 0.050 and 0.2 for the parameter whose initial value is 0.125. Its equation is shown in page 173.

SENSITIVITY SIMULATION RESULTS	EXPLANATIONS
	Adjustment time for student academic achievement has no effect on parent expectation. The relation between how quickly students adopts to their current academic achievement and parent expectation is weak and no research was found. In the model, parent expectation is not sensitive to adjustment time for student academic achievement variable.
	Adjustment time for student academic achievement makes meaningful contribution to parent involvement especially when parent involvement starts to decline. It makes this declining process takes more time. How much students react to their current academic achievement influence parent involvement.
	Adjustment time for student academic achievement makes tremendous changes on student academic achievement. In our research, the data was also observed out of the limits. But this sensitivity analysis reports also emphasize the importance of adjustment time over student academic achievement. The relation is not meaningful but enormous. It makes out of range fluctuations on student academic achievment graph.
	Adjustment time for student academic achievement also contributes to teacher-parent contact. Student reaction time towards the current academic achievement situation affect teacher-parent contact time. No research finding emphasizes this relation.

9. CONCLUSION AND FUTURE WORK

In this study, a wide range of documentation was used to assess the appropriateness of the model. Even though no one test is assumed to be adequate, a wide range of literature review and group model building activities are made to illustrate every correlation between the parameters or stock. Testing is an essential part of the modeling. At the end, test and simulations were made to show the appropriate structure of stocks and sensitivity simulations are implemented to test them.

In reality, the events are the results of deeper patterns and systemic structures. This model highlights the interconnected relations in patterns to interpret educational gains in a long – run. All the elements related with education contribute directly or indirectly to student academic achievement and they are also affected with each other due to the dynamic complexity between them. If we can establish that the elements and relationships that make up the structure of a model coincide with same in the real system and that the model generates patterns of response that parallel to those exhibited by the real system, then we know that the model looks and behaves somewhat like the reality it is intended to represent. The model responses towards all the parameter effects as it is in real life depending observations in the field of education and group model building sessions.

All the parameters used in the model affect Parent Involvement, Student Academic Achievement and Teacher-parent contact stocks at different rates. On the other hand, some of parent related parameters and all of the teacher, school and student related parameters have no affect on Parent Expectation Stock. Only parent education level, family size and marital status have effect on Parent Expectation.

Parent education level increases the level of parent expectation. It has a meaningful effect on parent expectation. Parent expectation increases more sharply for the values of higher parent education level. However, if this sharp increase is due to the parent education level, there are some fluctuations at maximum expectations. Parent education level is not alone sufficient to keep the parent expectation at the maximum rate.

Marital status is another variable that affects Parent Expectation. If the couples are divorced, the parent expectation graph line has a tendency to remain the same or decline. If divorced parents are highly educated, parent expectation also increases but at lower rates.

The level of parent involvement has been also affected by the parameters regarding with parent, teacher and school dimensions. Parent engagement increases the level of parent involvement and school support also contributes to parent involvement. When parent engagement and school support have been increased simultaneously, there is a sharp increase in parent involvement. School and parent are two sides to encourage parents to get contact with the school. This is synergy effect on parent involvement.

However, parent workload decreases the rate of parent involvement. Even though parents have higher expectations, parent workload makes the level of parent involvement decrease within the time. Those parents who work more cannot dedicate so much time for their children's education. But this decline does not converge to zero. The graph line decreases and stays the same at a lowest point. Even though parents work hard, they find a way to involve in educational process as much as possible.

Previous parent involvement does not affect maximum parent involvement. Initial values taken in the model did not change the maximum value for parent involvement. However another stock, student academic achievement affects parent involvement inversely. When the student academic achievement reaches at maximum values, the level of parent involvement starts to decline. This can be observed in the model after the simulation of six months. In the model, student academic achievement reaches at its maximum values after six months. First six months are very crucial for parents who want to motivate and encourage their children to reach at maximum gains. At the beginning of an academic year, parents should relentlessly maintain their support and involvement in order to make their children achieve more.

School and teacher parameters affect directly Parent Involvement, Student Academic Achievement and Teacher-parent contact stocks. Especially when parent involvement has a tendency to decline, teacher and school parameters make this decline happen at low rates. When the effectiveness of teacher and parent parameters has been increased, the slope of parent involvement graph is getting smaller and it decreases less.

Parent parameters affect all the stocks. Especially after three months, those parameters affect teacher-parent contact time more. When first report card showing student academic achievement after two months, parents try to increase their contact time with teachers in order to decrease the academic gap between their expectation and student academic achievement. Parents try to involve more in educational process whether at home or at school.

The majority of teacher parameters especially regarding with teacher quality ones have direct effect on student academic achievement. Under any circumstances and simulation, this effect becomes meaningful and it is realistic as mentioned in the literature. If the delay has been increased in the stock, student academic achievement decreases. The delay is called as adjustment time for student academic achievement in the model. Adjustment time is inversely proportional to student academic achievement.

A relation between previous academic achievement and academic achievement has been found in the study as mentioned in the literature. Low initial value for student academic achievement does not change the graph pattern. But, it makes some fluctuations at higher achievement values. Due to the effects of other factors, students can obtain maximum gains, but this is not sustainable if previous academic achievement is low. This is quite similar to literature findings. There is no doubt that teacher, parent and school factors contribute deeply to student academic achievement but how it would remain the same at the same level depends on the other factors such as student characteristics not mentioned in this study in detail. Additionally student can not reach at maximum level of achievement if he has low previous academic achievement and there is a delay in the system.

For teacher-parent contact stock, teachers seem to be more effective than school behavior and structure. Even though both have a positive effect on teacher-parent contact time, teacher parameters become dominant to make an observable change on it. However, for the comparison of teacher and parent effect on teacher-parent contact time, teachers seem to be more influential to implement teacher-parent contact. It is believed that teachers are more dominant factor to initiate a teacher-parent meeting. Teachers are the primary persons to create an available time and encourage parents to meet with them. Teachers seem to initiate and set teacher-parent meetings rather than parents.

There is a relation between two stocks; teacher parent contact and parent expectation. Parent expectation has a correlation with teacher-parent contact. When parent expectation rises up to its maximum level, teacher-parent contact stays the same and it does not increase any more.

Each teacher parameter has direct or indirect effect on teacher-parent contact time. Acceptability of the current student academic achievement among teachers is the key to decide the behaviour of teacher parent contact graph. If teachers believe that students are capable of doing more, they will probably have a tendency to get contact with their parents in order to boost their energy.

In addition to teacher variables, school variables also play an important role to implement teacher-parent contact. School community awareness about the importance of getting contact with parents encourages teachers to share a student progress with his parent. The initial fire must come from the school side to maintain a healthy relation with parents. This is essential and an integral part of academic achievement.

The initial value for teacher-parent contact time has no effect on its maximum value. The graph patterns with different initial values are the same. Teacher-parent contact time is affected by parent involvement and it affects student academic achievement.

However, Parent Involvement has also direct effect on student academic achievement. It is positively correlated with academic achievement. On the other hand, when Parent Involvement declines, student academic achievement still continues to increase due to other parameters effect, but increasing rate decreases. There are also other variables that affect student academic achievement. It is not alone a dominant variable. So student academic achievement does not only depend on parent involvement.

For future consideration, only teacher and parent dimensions are taken into consideration in this study. A few school and student parameters are used in the model since they are strongly related with teacher and parent dimensions. The main intention was not to include school and student related parameters in the model. In the future, researchers may focus on those dimensions to understand the dynamics process from different views.

Moreover, recently so many teachers and school administrators have applied the system dynamics idea and tools to the school curriculum development especially for primary and secondary schools. In this study, we couldn’t focus on the effect of system dynamic modeling in school curriculum. In the future, a research might be made to develop school curriculum using system dynamics tools for teachers. On the other hand, for managers a research might also be made to create a school organizational structure that creates a positive learning culture in order to enhance teacher’s dedication, to encourage parent involvement and boost student motivation.

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APPENDICES

APPENDIX A – Literature Review Statistical Results for Educational Expectations

Figure/table numbers in this appendix are taken from the original work.

A1. Gill and Reynolds (1999)

Table 1
Means and (Standard Deviations) of Selected Variables for Study Sample and Full Sample

Variable	*n*	Study Sample *M* (*SD*)	Full Sample[a] *M* (*SD*)	*t*-Value
Lunch subsidy (1 = full)	712	0.83 (0.38)	0.84 (0.37)	0.58
Family size (no. of children)	712	2.52 (1.63)	2.49 (1.69)	0.40
Parent education (1 = high school)	712	0.59 (0.49)	0.58 (0.49)	0.45
Gender of the child (1 = female)	712	0.55 (0.50)	0.51 (0.50)	1.76
Years of intervention (0–6 years)	712	2.98 (1.98)	2.78 (1.97)	2.23*
Prior achievement (Grade 3)				
Reading	704	98.16 (16.69)	97.01 (16.89)	1.50
Math	704	101.56 (13.18)	100.62 (13.35)	1.56
Parent expectations (PE)	666	14.62 (2.14)	14.59 (2.07)	0.30
Child's perception (CPPE)	435	3.82 (0.46)	3.81 (0.46)	0.40
Teacher expectations (TE)	459	3.55 (0.99)	3.42 (1.03)	2.44*
Child's perception (CPTE)	433	3.73 (0.52)	3.72 (0.53)	0.35
Grade 6 outcomes				
Reading	665	125.11 (17.99)	123.57 (17.96)	1.84
Math	661	130.30 (16.82)	128.71 (16.69)	2.03*

[a]$N = 1{,}539$.
*$p < .05$.

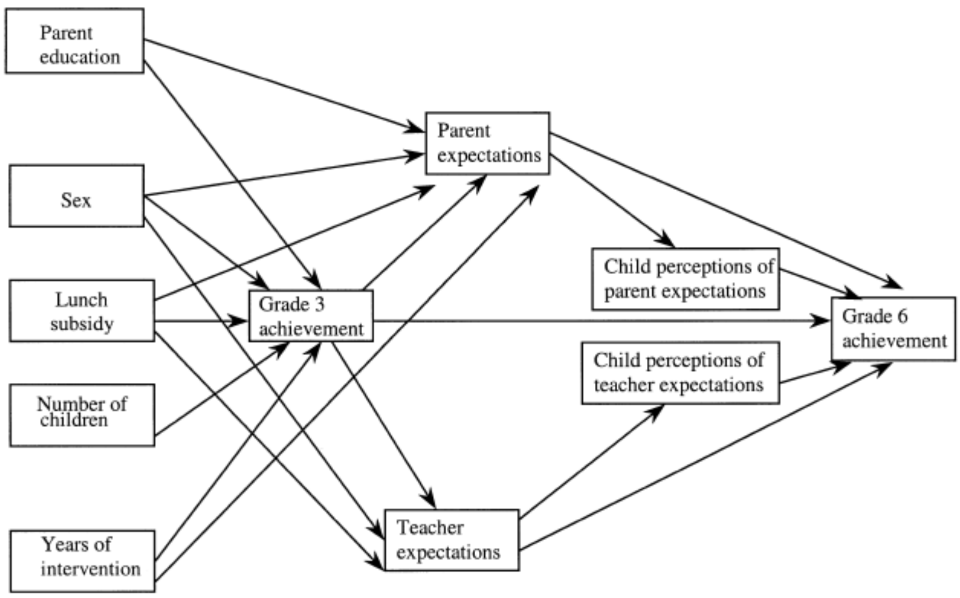

Figure 1. Model of mediated effects on sixth-grade reading and math outcomes.

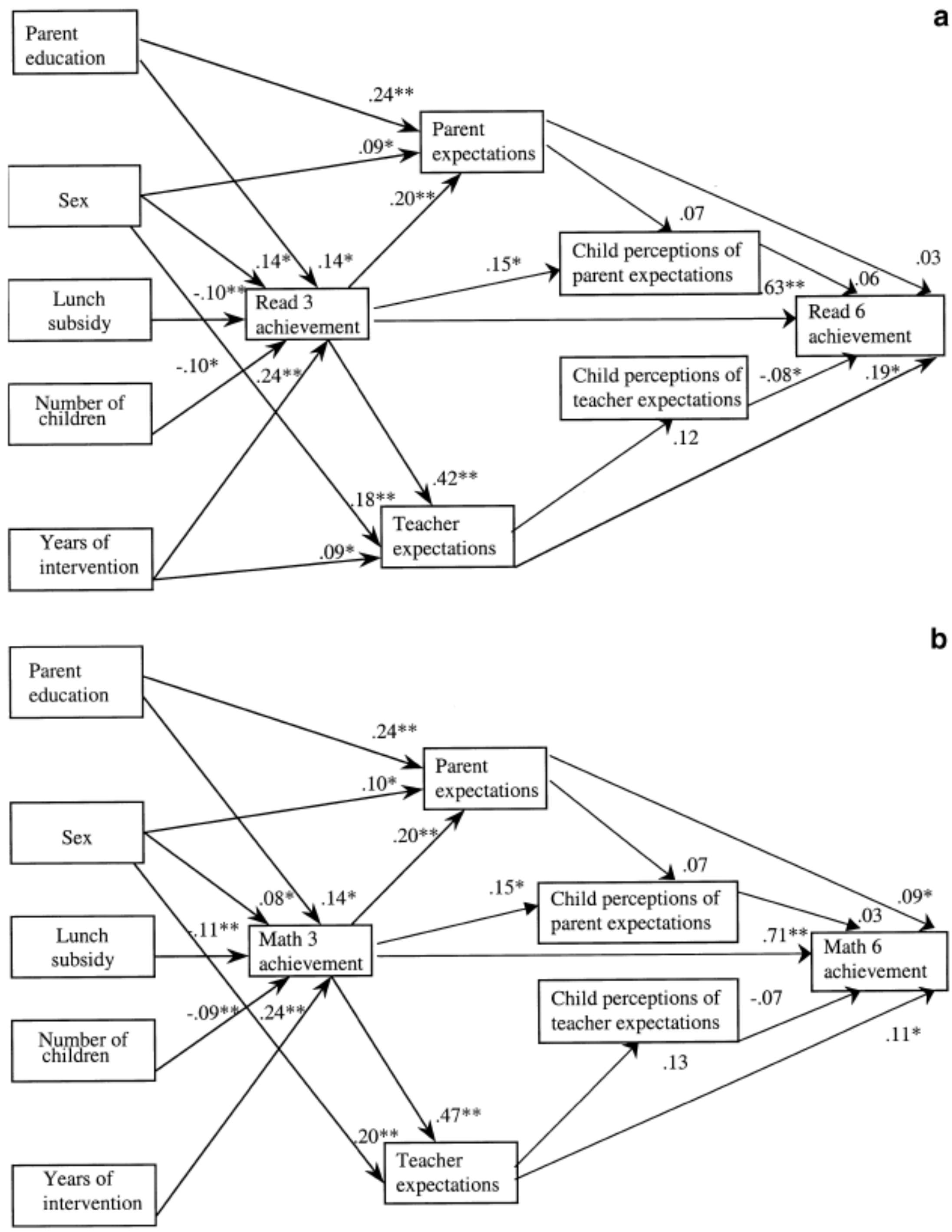

Figure 3. Role of expectations in growth in reading (a) and math (b) achievement.

A2. Tatar and Horenczyk (2000)

Table 2 *Means and standard deviations (in parentheses) of parental expectations* by sex of parent and sex of child*

Sex of parent	Sex of child	Expectations of teachers scale		
		Help	Competence	Fairness
Mothers	Girls (n=291)	4·62 (0·48)	4·43 (0·48)	4·47 (0·45)
	Boys (n=246)	4·62 (0·49)	4·36 (0·52)	4·35 (0·60)
	Total (n=537)	4·62 (0·48)	4·40 (0·50)	4·41 (0·53)
Fathers	Girls (n=107)	4·60 (0·47)	4·46 (0·39)	4·30 (0·57)
	Boys (n=114)	4·40 (0·57)	4·31 (0·57)	4·25 (0·63)
	Total (n=221)	4·49 (0·53)	4·38 (0·50)	4·27 (0·60)
Total	Girls (n=398)	4·61 (0·48)	4·44 (0·46)	4·42 (0·49)
	Boys (n=360)	4·55 (0·52)	4·34 (0·54)	4·32 (0·61)
	Total (n=758)	4·58 (0·50)	4·39 (0·50)	4·37 (0·55)

*Higher values indicate greater expectations.

A3. Jacob and Lefgren (2007)

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TABLE III
SUMMARY STATISTICS FOR INDEPENDENT VARIABLES

	Count	Mean	SD
Teacher characteristics			
Weighted composite rating for student satisfaction (standardized)	295	0.129	0.972
Weighted composite rating for student achievement (standardized)	294	0.051	1.011
Teacher value-added (standardized)	214	0.014	1.002
School fraction eligible for free lunch	307	0.486	0.192
Kindergarten dummy	307	0.094	0.293
Grade	307	3.049	1.920
Teaching in school-grade in request year	307	0.912	0.284
Teaching in school-grade in prior year	307	0.818	0.385
Teaching in school (but not grade) in prior year	307	0.055	0.225
Student characteristics			
Eligible for free lunch	22,033	0.452	0.498
Hispanic	22,033	0.212	0.408
Male	21,048	0.513	0.500
Median household income (divided by 10,000)	18,881	4.724	1.589
Prior achievement (math and reading composite)	14,080	0.060	0.958

Notes: The unit of observation in the top panel is a teacher-school-year. Out of 307 observations total, 262 observations from 12 schools come from requests made for the 2005–2006 school year, 21 observations (1 school) come from requests made for the 2004–2005 school year, and 24 observations (1 school) come from requests made for the 2003–2004 school year. The unit of observation in the bottom panel is student-grade-year, and there are a total of 6,940 students in the analysis sample, 6,047 of whom come from the 2005–2006 request data, 421 of whom come from the 2004–2005 request data, and 472 of whom come from the 2003–2004 request data.

A4. Johnson, McGue and Iacono (2007)

Table 2

Descriptive statistics and effect sizes of mean differences and their significance for biological and adoptive offspring and girls and boys

Measure	Mean	SD	Mean	SD		
	Biological offspring		Adoptive offspring		Differences	
IQ	107.8	13.2	106.3	14.0	−.11	ns
Parenting	.1	.9	−.1	1.0	−.20	.001
PEEA	4.9	.8	4.9	1.0	.01	ns
Engagement	3.2	.5	3.2	.5	.00	ns
Grades	3.3	.7	3.2	.7	−.14	.010
	Girls		Boys		Effect size	*p*-value
IQ	105.1	13.3	109.3	13.8	.31	<.001
Parenting	.1	1.0	−.1	.9	−.14	.025
PEEA	5.0	.8	4.7	1.0	−.33	<.001
Engagement	3.3	.4	3.1	.5	−.43	<.001
Grades	3.4	.6	3.0	.8	−.49	<.001

Note: Effect size is the mean difference divided by pooled standard deviation, stated so that boys higher is positive, and adoptive offspring higher is positive. PEEA is parental expectations of educational attainment. IQ was on the usual scale. Parenting ranged from − 3.5 to 1.5, PEEA from 1 to 6, Engagement from 1.33 to 4, and Grades from .83 to 4.0.

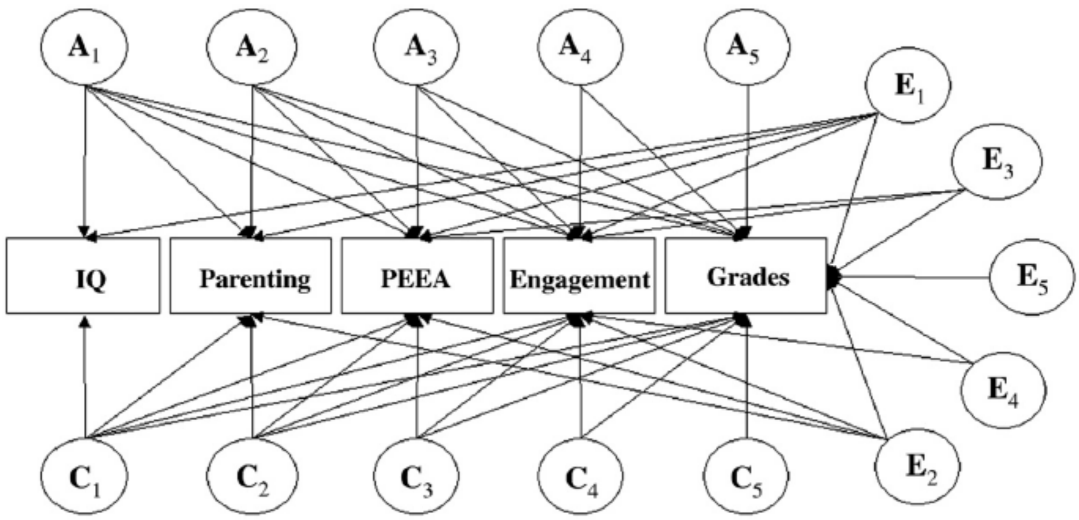

Fig. 1. Basic Cholesky model. A refers to genetic, C and E to shared and non-shared environmental influences. PEEA is parental expectations for educational attainment.

Table 6
Genetic, shared environmental, and non-shared environmental correlations among the variables

	Parenting	PEEA	Engagement	Grades
Genetic				
1. IQ	.32	.73	−.03	.51
	(.06,.58)	(.51,.94)	(−.37,.30)	(.26,.72)
2. Parenting		.19	.75	.29
		(−.07,.43)	(.52,.92)	(.01,.53)
3. PEEA			.19	.61
			(− .18,.46)	(.40,.77)
4. Engagement				.59
				(.29,.79)
Shared environmental				
1. IQ	.31	.34	.48	.45
	(− .08,.73)	(− .01,.62)	(.01,1.00)	(.16,.69)
2. Parenting		.52	.47	.44
		(.14,.93)	(− .23,.88)	(.10,.76)
3. PEEA			.21	.41
			(− .49,.65)	(.09,.62)
4. Engagement				.66
				(.29,.99)
Non-shared environmental				
1. IQ	− .51	− .41	.26	.17
	(− .95,− .09)	(− .84,.04)	(− .02,.55)	(− .21,.47)
2. Parenting		.21	.08	.31
		(− .30,.69)	(− .36,.35)	(− .15,.69)
3. PEEA			.57	.46
			(.28,.82)	(.00,.72)
4. Engagement				.51
				(.26,.70)

Note: Because variances were constrained equal for girls and boys, these correlations were also equal for girls and boys. 95% confidence intervals are in parentheses. PEEA is parental expectations for educational attainment.

Table 7
Proportions of observed phenotypic correlations attributable to genetic and environmental influence

	1	2	3	4
Observed phenotypic correlations				
1. IQ				
2. Parenting	.08			
3. PEEA	.35	.24		
4. Engagement	.15	.43	.33	
5. Grades	.39	.32	.53	.55
Proportions genetic				
1. IQ				
2. Parenting	.65			
3. PEEA	.80	.77		
4. Engagement	.28	.91	.50	
5. Grades	.29	.92	.53	.43
Proportions shared environmental				
1. IQ				
2. Parenting	.04			
3. PEEA	.02	.08		
4. Engagement	.11	.06	.03	
5. Grades	.27	.04	.02	.03
Proportions non-shared environmental				
1. IQ				
2. Parenting	.31			
3. PEEA	.18	.15		
4. Engagement	.61	.03	.47	
5. Grades	.44	.04	.45	.54

PEEA is parental expectations for educational attainment.

APPENDIX B – Literature Review Statistical Results for School Choice

Figure/table numbers in this appendix are taken from the original work.

B1. Tamm (2008)

Table 4
Regression results for entire and siblings sample (West Germany)

	Income at age 10	Average annual income at age 7–10	Average annual income at age 3–6
Panel A			
Ordered logit model (entire sample)			
Equivalent income[a]	**0.051** (0.015)	**0.079** (0.014)	**0.102** (0.020)
Observations	2159	1620	1159
Panel B			
Sibling fixed effects model (siblings sample)			
	Attendance of Gymnasium (versus Realschule or Hauptschule)		
Equivalent income[a]	0.002 (0.032)	−0.009 (0.054)	−0.038 (0.052)
Observations	322	233	160
	Attendance of Gymnasium or Realschule (versus Hauptschule)		
Equivalent income[a]	**−0.072** (0.036)	**−0.239** (0.093)	0.006 (0.064)
Observations	377	268	152

Note. Coefficients printed in *italics* indicate marginal significance (10%-level), and coefficients printed in **boldface** indicate statistical significance at 5%-level. Standard errors in parenthesis. Ordered logit specifications for entire sample include core set of control factors as described in Section 3. Sibling fixed effects specifications control for gender, birth sequence, mother's age and size of town.
[a]Per thousand euros.

Table 5
Ordered logit results for natural experiment (West Germany)

	1995 versus 1996	1994–1995 versus 1996–1997	1993–1995 versus 1996–1998	1992–1995 versus 1996–1999	1991–1995 versus 1996–2000	1990–1995 versus 1996–2001
Panel A						
Before–after comparison						
After reform	0.649 (0.528)	**0.568** (0.289)	**0.458** (0.229)	0.161 (0.203)	0.047 (0.180)	0.005 (0.157)
Observations	203	410	641	849	1095	1339
Panel B						
Before–after comparison by income group						
After reform × low income	−0.445 (0.504)	0.184 (0.352)	0.208 (0.263)	0.039 (0.237)	−0.165 (0.207)	−0.217 (0.189)
After reform × high income	**1.842** (0.848)	**1.296** (0.622)	*0.833* (0.453)	0.272 (0.367)	0.154 (0.327)	0.092 (0.288)
Observations	190	378	596	789	1011	1232

Note. Coefficients printed in *italics* indicate marginal significance (10%-level), and coefficients printed in **boldface** indicate statistical significance at 5%-level. Standard errors in parenthesis. Ordered logit specifications include core set of control factors as described in Section 3. Analysis by income group based on including interaction terms of "after reform" with "above median income" and with "below median income."

B2. Goldring, Kristie and Philips (2008)

Table 1. Independent sample *t*-tests identifying mean differences between parents who considered and did not consider private schools.

	Mean for parents who considered private schools	Mean for parents who did not consider private schools	Mean difference	*p*-values
Background variables				
Family income	2.80	2.48	0.32	***
Parents' highest level of education	2.80	2.46	0.34	***
Child's race is White (ref)	0.55	0.54	0.01	
Childs race is Black	0.45	0.46	–0.01	
Parent satisfaction				
Satisfaction with previous school	3.07	3.02	0.05	
Parent involvement				
Parent assistance at home	2.49	2.38	0.11	†
Parent participation at school	2.30	2.20	0.10	**
Parent communication with child about school	3.56	3.44	0.12	**
Parent–school collaboration	2.86	2.89	–0.03	
Parent self efficacy	3.16	3.07	0.09	***
Priorities in school choice				
Academic priorities	2.72	2.66	0.06	*
Convenience priorities	1.86	1.93	–0.07	†
School characteristics priorities	1.95	1.98	–0.03	
Safety priorities	2.60	2.60	0.00	
Social networks				
Interpersonal networks (uncentred)	0.49	0.42	0.07	†
Formal networks (uncentred)	0.82	0.85	–0.03	

***$p < .001$; **$p < .01$; *$p < .05$; †$p < .10$.

Table 2. Logistic regression models predicting the likelihood of parents choosing a private school versus a public school.

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Log odds	SE	Log odds	SE	Log odds	SE	Log odds	SE	Log odds	SE	Log odds	SE
Constant	−0.434 †	.24	−0.600 †	.36	−2.094 *	.84	−0.922	.68	−0.458 †	.24	−3.314 **	1.13
Background variables												
Family income	0.396 ***	.40	0.414 ***	.08	0.353 ***	.08	0.379 ***	.08	0.406 ***	.08	0.365 ***	.09
Income imputation flag	−0.774 ***	−.77	−0.717 ***	.19	−0.630 ***	.19	−0.716 ***	.18	−0.794 ***	.18	−0.541 **	.20
Child's race is White (ref)												
Child's race is Black	0.225	.23	0.221	.17	0.128	.17	0.255	.17	0.247	.16	0.146	.19
Parent satisfaction												
Satisfaction with previous school	—		0.024	.09	—		—		—		−0.008	.09
Parent involvement												
Parent assistance at home	—		—		0.015	.12	—		—		0.036	.13
Parent participation at school	—		—		0.204	.19	—		—		0.326 †	.20
Parent communication with child about school	—		—		0.206	.14	—		—		0.450 **	.16
Parent–School collaboration	—		—		−0.386 *	.19	—		—		−0.423 *	.21
Parent self-efficacy	—		—		0.535 *	.23	—		—		0.452 †	.24
Priorities in school choice												
Academic priorities	—		—		—		0.265	.23	—		0.202	.25
Convenience priorities	—		—		—		−0.098	.16	—		0.007	.18
School characteristics priorities	—		—		—		−0.068	.17	—		−0.159	.18
Safety priorities	—		—		—		0.041	.15	—		0.033	.16
Social networks												
Interpersonal networks	—		—		—		—		0.234 †	.14	0.306 *	.15
Formal networks	—		—		—		—		−0.024	.11	0.063	.12
N	754		754		754		754		754		754	
Chi-square	34.935	***	32.064	***	48.906	***	37.051	***	38.488	***	60.706	***
df	3		4		8		7		5		15	
−2 Log Likelihood	959.224		882.100		945.254		957.109		955.672		853.457	

*** $p < .001$; ** $p < .01$; * $p < .05$; † $p < .10$.

APPENDIX C – Literature Review Statistical Results for Student Sector

Figure/table numbers in this appendix are taken from the original work.

C1. Silinsand Harvey (2000)

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Variable	PLS loadings[a]	Variables	PLS loadings[a]
Socio-economic status		*Attitude to school* (Ainley, 1990)	
Lower rating = higher status		Higher rating = more positive attitude	
Father's occupation	0.94 (0.03)	General satisfaction	0.89 (0.04)
Mother's occupation	0.93 (0.02)	Social integration	0.78 (0.06)
		Opportunity for success	0.92 (0.02)
Suburb (parents' residence)	0.78 (0.07)	Achievement	0.74 (0.09)
School sector		*Approach to learning* (Biggs, 1987)	
		Higher rating = greater use of the approach	
Independent school (code =0)	0.94 (0.03)	Surface motive	0.42 (0.17)
Government school (code = 1)	–0.94 (0.04)	Deep motive	0.89 (0.04)
Catholic school		Deep strategy	0.85 (0.10)
(coded as dummy variable)		Achieving motive	0.85 (0.06)
		Achieving strategy	0.89 (0.04)
School size		*Retention*	
Size of school (Years 8 to 12)	0.98 (0.01)	School retention rate index (Years 8 to 12)	0.97 (0.02)
Size of senior school (Years 11 and 12)	0.99 (0.01)	SACE participation rate index (Year 8 to SACE Stage 1 entry)	0.97 (0.02)
Self-concept (Marsh and O'Neill, 1984)		*School outcomes*	
Higher rating = more positive self-concept			
Maths	0.81 (0.14)	SACE retention rate index (Stage 1-Stage 2 approximates Year 11-12)	0.93 (0.03)
Verbal	0.55 (0.27)		
General academic	0.67 (0.21)		
Relations with parents	0.74 (0.18)	SACE completion rate index	0.90 (0.02)
General esteem	0.71 (0.06)	Higher education entry success rate index (SATAC)	0.95 (0.02)
		All subjects achievement index (SACE school level aggregated scores)	0.87 (0.04)

Notes: SACE: South Australian Certificate of Education
SATAC: South Australian Tertiary Admissions Centre
[a] Loading < twice their standard error not reported. Standard errors in parentheses

Table I.
Description of variables in the model of factors influencing senior secondary school performance outcomes

Latent variable	Direct effect (p)	Jkn SE	Indirect effect (i)	Total effect (t)	r
Sector					
SES	–0.51	0.12	–	–0.51	–0.51
$R^2 = 0.26$					
School size					
SES	–0.67	0.19	0.32	–0.35	–0.35
Sector	–0.62	0.14	–	–0.62	–0.28
$R^2 = 0.41$					
Self concept					
SES	0.46	0.16	–	0.46	0.46
$R^2 = 0.21$					
Approach to learning					
Attitude to school	–0.46	0.14	–	–0.46	–0.46
$R^2 = 0.21$					
School retention					
SES	–	–	–0.46	–0.46	–0.46
School sector	0.47	0.21	–0.38	0.08	0.29
School size	0.62	0.31	–	0.61	0.49
$R^2 = 0.44$					
Performance outcomes					
SES	–0.51	0.08	–0.22	–0.73	–0.76
School size	–	–	0.30	0.30	0.39
Attitude to school	0.15	0.07	–	0.15	0.26
School retention	0.49	0.18	–	0.49	0.73
$R^2 = 0.79$ ($Q^2 = 0.73$)					

Table II.
Direct, total, indirect effects and correlations (r) of latent variables influencing senior secondary school performance outcomes

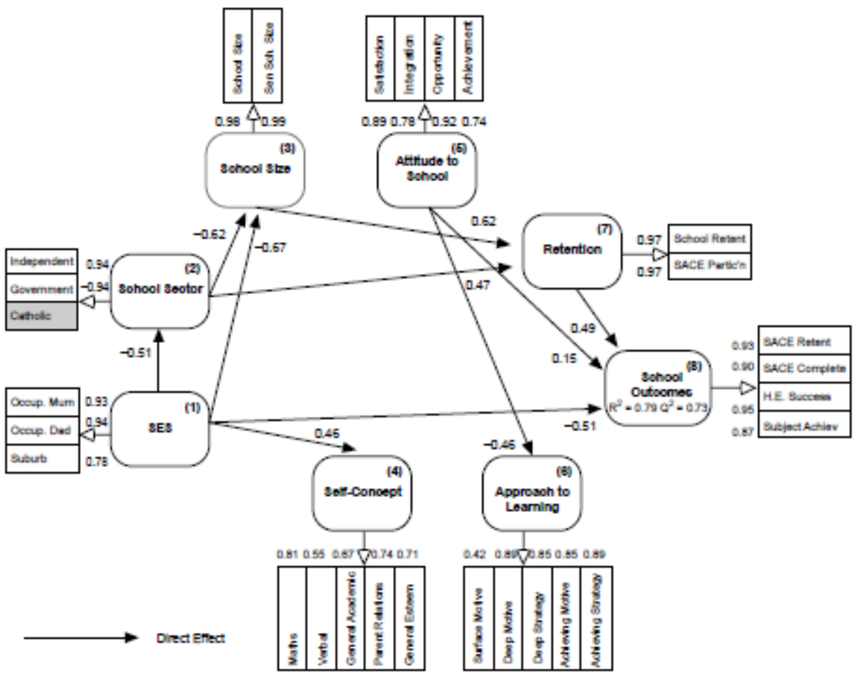


Figure 1.
Path model of variables influencing senior secondary school performance outcomes

C2. Gagne and Pere (2001)

Table 1
Basic descriptive and psychometric statistics

Variables	Mean	S.D.	*N*	Homogeneity
Abilities				
Raven Matrices	74.7	22.08	203	–
Otis–Lennon	81.8	19.72	197	–
Academic achievement 1	79.4	9.12	208	.80
Academic achievement 2	80.1	8.36	208	.86
Motivation-related variables				
Student data				
IM 1	4.08	1.12	208	.91
IM 2	3.88	1.21	205	.94
EM 1	5.46	0.99	208	.77
EM 2	5.52	0.98	205	.80
P 1	4.80	1.00	208	.81
P 2	4.68	1.06	205	.86
Parent data				
IM 1	4.74	1.05	200	.92
IM 2	4.63	1.03	176	.94
EM 1	5.47	1.01	200	.76
EM 2	5.52	1.02	176	.85
P 1	5.26	1.02	203	.87
P 2	5.28	1.01	181	.88
Teacher data (1 item per construct)				
IM 1	4.89	0.99	207	–
IM 2	4.80	1.11	207	–
EM 1	4.66	0.97	207	–
EM 2	4.67	1.04	207	–
P 1	4.97	1.11	207	–
P 2	4.72	1.16	207	–

Intrinsic motivation (IM), extrinsic motivation (EM), and persistence (P). 1, 2 = time periods. Teacher data correspond to pooled independent assessments by two teachers.

Table 2
Partial group by construct multitrait–multimethod matrix of correlations

	Students			Parents			Teachers		
	IM	EM	P	IM	EM	P	IM	EM	P
Students									
IM	(.77)	.13	.43	*.33*			*−.01*		
EM	.11/.03	(.76)	−.02		*.23*			*.15*	
P	.45/.44	−.12/−.05	(.76)			*.22*			*.00*
Parents									
IM	*.32/.42*			(.78)	.36	.39	*.07*		
EM		*.12/.20*		.35/.30	(.68)	−.01		*−.15*	
P			*.26/.38*	.48/.44	.12/.09	(.74)			*.10*
Teachers									
IM	*.15/.14*			*.19/.15*			(.70)	.36	.81
EM		*.07/.03*			*−.19/−.08*		.50/.56	(.46)	−.01
P			*.18/.24*			*.39/.22*	.86/.80	.38/.51	(.70)

Values within parentheses along the main diagonal are short-term (2 months) stability coefficients. Validity coefficients from time periods 1/2 data are placed under the diagonal; the aggregated values (Times 1 + 2) appear above the diagonal. Discriminant validity coefficients surround the diagonal, whereas convergent validity coefficients appear in italics. $N = 169$. Significance levels: $r \geq .15$, $P < .05$; $r \geq .20$, $P < .01$.

Table 3
Repeated measures ANOVA comparing groups, constructs, and time periods

Source	*df*	*F*	η^2
Between subjects			
The groups were introduced as a within subjects variable; see text.			
Within subjects			
Groups (G)	2	17.61***	.10
S within-group error	334	(2.49)	
Constructs (C)	2	77.57***	.32
S within-group error	334	(1.61)	
Time (T)	1	9.54**	.05
S within-group error	167	(0.41)	
G × C	4	66.92***	.29
S within-group error	668	(0.94)	
C × T	2	7.12***	.04
S within-group error	334	(0.27)	
G × C × T	4	2.73*	.02
S within-group error	668	(0.27)	

Values enclosed in parentheses represent mean square errors. Only statistically significant interactions are shown.
* $P<.05$.
** $P<.01$.
*** $P<.001$.

Table 5
Multiple hierarchical regressions of ability and motivation-related indices on school achievement

Variables	*B*	β	sr^2	*R* & R^2
Time 1				
1. Raven Matrices	0.085	.204	.13***	$R=.63$
2. Otis–Lennon	0.185	.388	.17***	$R^2=.40$
3. Persistence (students)	1.120	.120	.04*	adj. $R^2=.39$
4. Persistence (parents)	2.390	.271	.06***	
Time 2				
1. Raven Matrices	0.067	.171	.14***	$R=.65$
2. Otis–Lennon	0.205	.466	.22***	$R^2=.42$
3. Persistence (parents)	2.136	.257	.06***	adj. $R^2=.41$
Times pooled				
1. Raven Matrices	0.071	.179	.15***	$R=.68$
2. Otis–Lennon	0.203	.455	.21***	$R^2=.46$
3. Persistence (students)	0.684	.075	.03	adj. $R^2=.45$
4. Persistence (parents)	2.555	.288	.07***	
Times and aptitudes pooled				
1. Raven + Otis–Lennon	0.263	.506	.33***	$R=.66$
2. Persistence (students)	0.618	.068	.03	$R^2=.43$
3. Persistence (parents)	2.547	.288	.07***	adj. $R^2=.42$

* $P<.05$.
*** $P<.001$.

C3. Hakkinen, Kirjavainen and Uusitalo (2003)

Table 1
Determinants of teaching expenditure[a]

	RE (1)	RE (2)	FE (3)
Tax revenue / inhabitant	**0.23** (0.09)	**0.27** (0.10)	–0.04 (0.11)
Local unemployment rate	**–65.60** (24.12)	**–64.05** (24.31)	**–208.91 (26.71)**
Municipality's gross margin	–0.07 (0.07)	–0.08 (0.07)	0.01 (0.07)
Municipality's educational level	–3.28 (8.66)	4.45 (9.95)	
Urban area		–854.62 (563.02)	
Densely populated area		**–1,224.04** (438.17)	
Number of observations	2,464	2,464	2,464
Number of municipalities	274	274	274
R^2	0.74	0.74	0.66

[a] The dependent variable is teaching expenditure per student. All models include year dummies and year dummies interacted with the inverse of the number of students. Tax revenue per inhabitant, unemployment rate and municipality's gross margin are lagged by one year. Standard errors are in parentheses.

Table 2
Determinants of student achievement[a]

	(1)	(2)	(3)	(4)
Comprehensive school GPA	**7.89 (0.06)**	**7.90 (0.06)**	**7.90 (0.09)**	**7.91 (0.09)**
Mother's education	**0.32 (0.02)**	**0.32 (0.02)**	**0.30 (0.03)**	**0.30 (0.03)**
Father's education	**0.19 (0.01)**	**0.19 (0.01)**	**0.18 (0.02)**	**0.18 (0.02)**
Teaching exp./student(in thousands)	0.02 (0.03)	0.02 (0.03)	0.02 (0.04)	0.006 (0.04)
Male	**0.15 (0.07)**	**0.16 (0.07)**	–0.08 (0.11)	–0.07 (0.11)
Work during senior secondary school	-	**–0.62 (0.10)**	-	**–0.52 (0.14)**
Unemployment rate	-	–0.03 (0.02)	-	0.003 (0.03)
Number of students in school	-	–0.0002 (0.0002)	-	**–0.003 (0.001)**
Number of observations	20,505	20,504	9,442	9,442
Number of schools	444	444	245	245
R^2	0.530	0.531	0.535	0.536

[a] Dependent variable is sum of test scores in six exams (mother tongue, the other national language, mathematics, compulsory foreign language, additional foreign language, science and humanities). Standard errors corrected for the school-year clustering are in parentheses. In columns (3) and (4) only private schools and municipalities with one school are included. Work during senior secondary school is a dummy variable indicating that the student worked during the school year (1 if work months >2, 0 otherwise). All columns include the year dummies and the school fixed effects.

C4. Bruinsma (2004)

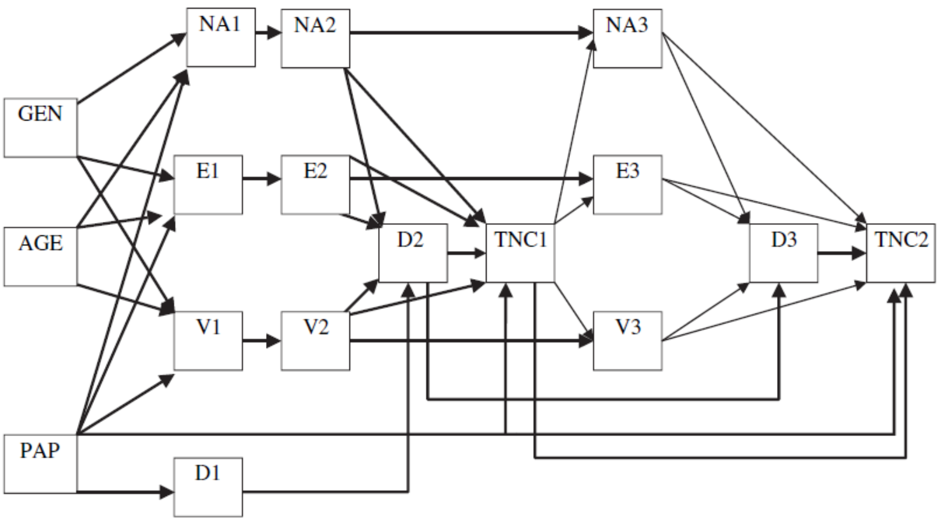


Fig. 1. Theoretical model for the variables gender (GEN), age (AGE), prior academic performance (PAP), expectancy (E), values (V), negative affect (NA), deep information processing (D) and total number of credits (TNC).

Table 2
Zero-order correlations and summary statistics

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	*M*	SD	*N*
1. Gender	1.00																–	–	416
2. Age	–0.04	10.00															19.0	–	416
3. Prior academic performance	0.11*	–0.17**	1.00														6.87	0.64	374
4. Negative affect t1	0.36**	0.14**	–0.07	1.00													2.08	0.64	280
5. Expectancy	–0.11	0.08	–0.14*	0.19**	1.00												2.68	0.59	280
6. Values	0.23**	0.06	0.01	0.03	–0.24**	1.00											3.58	0.62	280
7. Negative affect t2	0.33**	0.17*	–0.05	0.72**	0.20*	0.14	1.00										2.09	0.60	211
8. Expectancy t2	–0.17*	0.06	–0.13	0.17*	0.72**	–0.10	0.20**	1.00									2.70	0.56	211
9. Values t2	0.08	0.09	–0.14*	0.10	–0.15*	0.56**	0.12	–0.12	1.00								3.50	0.64	211
10. Negative affect t3	0.40**	0.29**	–0.07	0.71**	0.11	0.09	0.73**	0.07	0.13	1.00							2.10	0.57	208
11. Expectancy t3	–0.26**	0.09	–0.12	0.12	0.65**	–0.14	0.11	0.77**	–0.18*	0.15*	1.00						2.72	0.60	208
12. Values t3	0.17*	0.09	0.11	0.13	–0.24**	0.51**	0.11	–0.17	0.52**	0.03	–0.24**	1.00					3.60	0.57	208
13. Deep information processing t1	0.11	0.16*	0.05	0.00	–0.28**	0.37**	–0.02	–0.11	0.30**	0.16*	–0.25**	0.35**	1.00				72.50	10.42	270
14. Deep information processing t2	–0.01	0.16*	0.05	–0.11	–0.16*	0.29**	–0.09	–0.13	0.33**	0.06	–0.22*	0.32**	0.74**	1.00			73.25	8.82	203
15. Deep information processing t3	0.06	0.17*	0.12	0.05	–0.08	0.22**	0.00	–0.04	0.31**	0.09	–0.18*	0.35**	0.68**	0.72**	1.00		73.51	9.40	193
16. Total number of credits year 1	0.14**	–0.25**	0.41**	–0.04	–0.26**	0.09	–0.07	–0.28**	–0.07	–0.21**	–0.21**	0.09	0.01	–0.13	–0.05	1.00	1240	499	416
17. Total number of credits year 2	0.20**	–0.22**	0.43**	0.00	–0.31**	0.12*	–0.04	–0.31**	–0.01	–0.20**	–0.36**	0.17*	–0.01	–0.10	–0.06	0.90**	2342	954	416

Note: * $p < 0.05$, 2-tailed, ** $p < 0.01$, 2-tailed.

Table 3
Standardised direct effects

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Gender																
2. Age																
3. Prior academic performance																
4. Expectancy t1	**−0.09***	**0.05 ns**	**−0.14*****		−0.23***											
5. Values t1	**0.19*****	**0.02 ns**	**−0.01 ns**													
6. Negative affect t1	**0.35*****	**0.06 ns**	**−0.07 ns**	0.23***												
7. Expectancy t2				**0.81***[a]**	0.11***											
8. Values t2					**0.69*****											
9. Negative affect t2						**0.79*****	0.10***									
10. Expectancy t3	−0.07**				−0.11		**0.84*****									
11. Values t3			0.18***		0.31***			**0.47*****								
12. Negative affect t3	0.07**					0.40***			**0.50*****							
13. Deep information processing t1			**0.00 ns**	−0.23***	0.32***											
14. Deep information processing t2			0.11***	0.28***			**−0.11****	**0.17*****	**−0.12*****				**0.82*****			
15. Deep information processing t3					−0.11**		0.29***			**−0.19*****	**0.07***	**0.08****	0.35***	**0.55*****		
16. Total number of credits t1		−0.18***	**0.37*****				**−0.12****	**0.07 ns**	**0.00 ns**					**−0.11***		
17. Total number of credits t2			**0.06****							**−0.09*****	**0.06****	**0.02 ns**			**−0.07*****	**0.85*****

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
[a] The value 0.81 indicates the standardised coefficient for the path E1–E2, effect sizes in bold typeface indicate the expected effects, effect sizes in regular typeface indicate the modified effects.

C5. Spinath, B., Spinath, F.M., Harlaar and Plomin(2006)

Table 1
Means (M), standard deviations (SD), and internal consistencies (α), and intercorrelations among all measures

	Descriptives			Intercorrelations								
	M	SD	α	MASP	EASP	SASP	MIV	EIV	SIV	MSA	ESA	SSA
Intelligence	.03	.74	–	.25	.22	.18	.13	.08	.08	.49	.44	.44
Ability self-perceptions (ASP)												
Mathematics (MASP)	3.78	1.02	.81	–	.31	.25	.74	.13	.16	.40	.22	.25
English (EASP)	4.09	0.70	.61		–	.31	.19	.56	.17	.28	.39	.27
Science (SASP)	3.99	0.78	.65			–	.17	.26	.64	.10	.15	.11
Intrinsic values (IV)												
Mathematics (MIV)	3.46	1.18	.83				–	.26	.22	.26	.08	.13
English (EIV)	3.80	0.87	.64					–	.32	.10	.20	.09
Science (SIV)	3.95	0.90	.69						–	.02	*.03*	.04
School achievement (SA)												
Mathematics (MSA)	3.00	0.65	.95							–	.73	.75
English (ESA)	3.04	0.68	.89								–	.75
Science (SSA)	2.99	0.57	.94									–

Note. $N>1602$; All scales range from 1 to 5 with 1 indicating lower ability perceptions, intrinsic values, and achievement. Intelligence scores are aggregated over four z-standardized subtest scores. All correlations are significant on the 0.01% level except those printed in italics.

Table 2
Stepwise regression of teacher-assessed school achievement in three domains on measured intelligence, children's ability self-perceptions, and intrinsic values

		Beta	T	p	R	R^2	ΔR^2	$\Delta F(df)$	Δp
Mathematics ($n=1611$)									
Model 1	Intelligence	.49	22.79	.000	.49	.24	.24	519.27 (1, 1609)	.000
Model 2	Intelligence	.42	19.80	.000	.57	.32	.08	183.86 (1, 1608)	.000
	Ability self-perceptions	.29	13.56	.000					
	Intrinsic values	*−.03*	*−.98*	*.33*					
English ($n=1625$)									
Model 1	Intelligence	.44	19.98	.000	.44	.20	.20	399.01 (1, 1623)	.000
Model 2	Intelligence	.38	17.63	.000	.54	.29	.09	212.92 (1, 1622)	.000
	Ability self-perceptions	.31	14.59	.000					
	Intrinsic values	*.00*	*.09*	*.93*					
Science ($n=1616$)									
Model 1	Intelligence	.44	19.84	.000	.44	.20	.20	393.78 (1, 1615)	.000
	Ability self-perceptions	*.03*	*1.48*	*.14*					
	Intrinsic values	*−.01*	*−.50*	*.61*					

Note. Variables printed in italics were not included in the prediction.

Table 3
Stepwise regression of teacher-assessed school achievement in three domains on measured intelligence, and intrinsic values

		Beta	T	p	R	R^2	ΔR^2	$\Delta F(df)$	Δp
Mathematics ($n=1627$)									
Model 1	Intelligence	.49	22.79	.000	.49	.24	.24	516.86 (1, 1613)	.000
Model 2	Intelligence	.47	21.96	.000	.53	.28	.04	81.96 (1, 1612)	.000
	Intrinsic values	.19	9.05	.00					
English ($n=1627$)									
Model 1	Intelligence	.44	19.99	.000	.44	.20	.20	399.63 (1, 1626)	.000
Model 2	Intelligence	.43	19.72	.000	.48	.23	.03	59.03 (1, 1625)	.000
	Intrinsic values	.17	7.68	.000					

Note. Results for Science equal those depicted in Table 1.

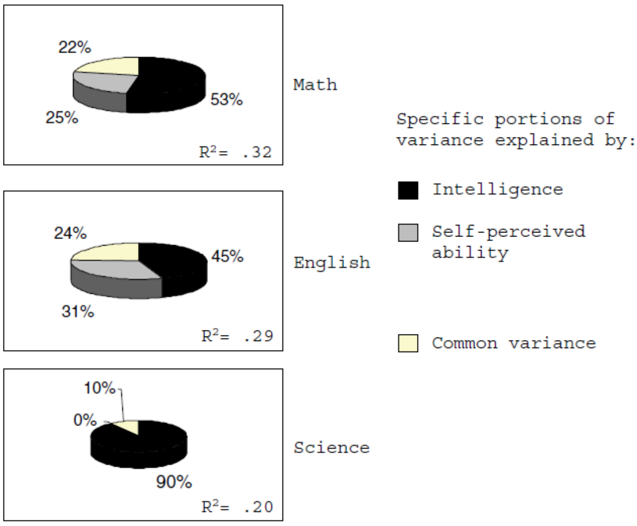


Fig. 1. Results of a commonality analysis with intelligence and ability self-perceptions as predictors of school achievement in three domains.

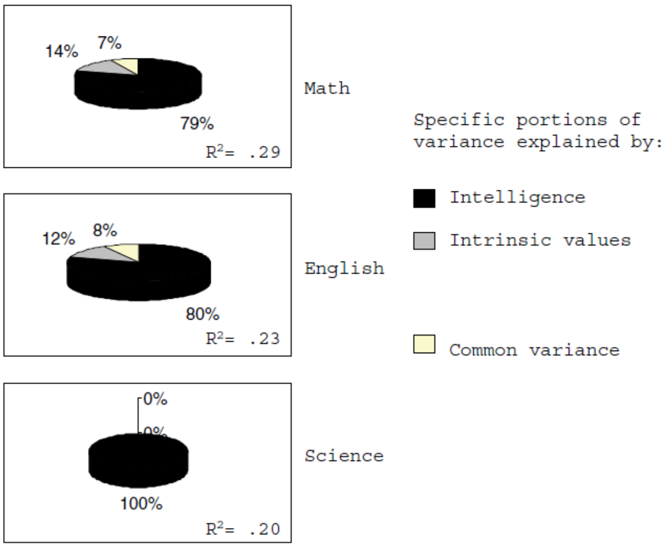


Fig. 2. Results of a commonality analysis with intelligence and intrinsic values as predictors of school achievement in three domains.

C6. Laidra, Pullmann and Allik (2007)

Table 1
Number of valid cases, mean age, and descriptive statistics for GPA, SPM and personality scales

Grade	*N*	Mean age	GPA		SPM		Neuroticism			Extraversion			Openness			Agreeableness			Conscientiousness		
			M	SD	*M*	SD	*M*	SD	α	*M*	SD	α	*M*	SD	α	*M*	SD	α	*M*	SD	α
2	364	8.3	4.5	0.4	31.5	9.1	12.6	2.6	.60	19.1	2.6	.47	16.3	2.6	.57	22.7	2.9	.67	21.8	3.3	.72
3	388	9.5	4.4	0.5	35.7	8.2	12.6	2.8	.65	19.1	2.7	.53	15.7	2.4	.48	22.4	3.1	.71	21.3	3.5	.75
4	430	10.4	4.3	0.6	38.9	8.5	12.4	2.5	.59	19.8	2.6	.58	15.5	2.6	.57	22.7	2.8	.64	21.5	3.4	.75
6	609	12.4	4.0	0.7	46.3	7.0	23.9	8.5	.76	29.2	7.5	.70	23.1	8.0	.69	31.1	6.9	.70	30.6	7.6	.77
8	697	14.4	3.9	0.7	49.3	6.1	25.2	9.2	.82	29.5	8.6	.80	23.0	8.5	.76	29.0	6.7	.67	29.1	8.0	.80
10	642	16.1	3.8	0.6	52.4	4.9	23.1	9.1	.86	30.7	8.5	.86	24.2	8.3	.81	28.6	5.9	.67	29.0	7.7	.84
12	488	17.8	3.8	0.6	53.2	4.7	22.8	8.8	.86	29.8	8.9	.87	25.4	8.8	.83	27.4	5.9	.67	28.4	7.8	.83

Note: *N* = number of valid cases, GPA = grade point average, SPM = Standard Progressive Matrices, *M* = mean, SD = standard deviation, α = Cronbach's alpha.
Different personality inventories were used in Grades 2 to 4 and Grades 6 to 12.

Table 2
Pearson's correlations between predictors and GPA

Grade	SPM	*N*	*E*	*O*	*A*	*C*
2	0.54 (0.54)***	−0.15**	0.03	0.26***	0.23***	0.14**
3	0.46 (0.50)***	−0.13*	0.06	0.25***	0.29***	0.19***
4	0.49 (0.53)***	−0.12*	0.07	0.28***	0.25***	0.23***
6	0.53 (0.64)***	−0.25***	0.14**	0.12**	0.23***	0.32***
8	0.48 (0.63)***	−0.16***	−0.00	0.13**	0.08*	0.21***
10	0.43 (0.65)***	−0.19***	−0.01	0.18***	0.12**	0.30***
12	0.32 (0.54)***	−0.11*	−0.04	0.11*	0.00	0.20***

Note: GPA = grade point average, SPM = Standard Progressive Matrices, *N* = Neuroticism, *E* = Extraversion, *O* = Openness, *A* = Agreeableness, *C* = Conscientiousness.
Correlations corrected for restriction of range are shown in parentheses.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Table 3
Regression results: Prediction of GPA

Predictors	Grades 2 to 4		Grades 6 to 12	
	Beta	*t*	Beta	*t*
SPM	0.46	18.6***	0.42	23.4***
Neuroticism	−0.04	−1.5	−0.05	−2.2*
Extraversion	−0.06	−2.2*	−0.07	−3.6***
Openness	0.09	3.0**	0.06	3.4***
Agreeableness	0.15	4.6***	−0.00	−0.1
Conscientiousness	0.07	2.1*	0.21	10.1***
Age	−0.00	−0.1	−0.03	−1.9
SPM*Age	0.02	0.7	−0.05	−2.5*
Neuroticism*Age	0.01	0.3	−0.01	−0.5
Extraversion*Age	−0.02	−0.6	−0.05	−2.5*
Openness*Age	−0.05	−1.7	0.04	2.4*
Agreeableness*Age	0.04	1.3	−0.03	−1.4
Conscientiousness*Age	0.09	2.7**	0.02	1.1

Note: GPA = grade point average, SPM = Standard Progressive Matrices.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

APPENDIX D – Literature Review Statistical Results for Teacher Sector

Figure/table numbers in this appendix are taken from the original work.

D1. Wright, Horn and Sanders (1997)

Table 1. z-Values for Analyses of Third-Grade Gains.

Source	*Set*	*Math*	*Reading*	*Language*	*Social Studies*	*Science*
System (*S*)	1	6.12	2.26	4.34	4.03	3.13
	2	4.86	3.55	5.39	5.55	3.92
Heterogeneity (*H*)	1	1.39	0.25	0.61	0.81	0.05
	2	1.54	0.09	1.64	0.61	0.30
Class size (*C*)	1	0.57	0.02	1.45	0.14	1.92
	2	1.03	0.64	0.16	0.97	0.38
H*C	1	0.58	0.49	0.29	0.45	1.83
	2	0.20	0.47	2.21	0.20	0.83
Teacher (*S*H*C*) (*T*)	1	12.48	7.85	11.04	6.09	7.76
	2	13.14	8.69	12.06	8.33	8.88
Achievement level (*A*)	1	17.00	12.65	8.49	10.04	6.76
	2	28.04	20.14	8.96	14.53	8.41
*A*S*	1	2.19	1.88	2.70	2.49	2.19
	2	1.25	5.31	1.46	3.34	3.26
*A*H*	1	2.05	4.64	1.15	4.36	0.53
	2	1.41	0.76	1.29	3.78	4.27
*A*C*	1	1.37	0.53	0.40	0.18	1.53
	2	0.12	0.67	1.14	2.33	1.19
*A*H*C*	1	0.07	0.22	0.32	0.10	0.70
	2	2.05	0.94	0.37	2.12	2.18
*A*T*	1	2.35	4.88	2.02	0.61	1.05
	2	0.73	0.68	1.27	1.69	2.39
N	1	10751	10564	10916	10005	9939
	2	13632	13506	14079	13651	13624

Set: 1 = 30 East Tennessee school systems.
2 = 24 Middle Tennessee school systems.
N = total number of students.

Table 2. z-Values for Analyses of Fourth-Grade Gains.

Source	*Set*	*Math*	*Reading*	*Language*	*Social Studies*	*Science*
System (*S*)	1	5.63	3.66	5.68	4.23	2.55
	2	5.56	5.07	4.62	4.02	3.00
Heterogeneity (*H*)	1	0.20	0.03	0.13	2.53	0.62
	2	1.84	1.32	0.94	1.47	1.00
Class size (*C*)	1	1.65	1.00	1.30	2.83	1.47
	2	0.39	1.14	1.14	0.81	0.49
H*C	1	2.29	0.80	0.98	2.30	0.75
	2	1.31	0.69	0.62	2.40	1.11
Teacher (*S*H*C*) (*T*)	1	11.17	6.04	9.24	7.17	7.93
	2	12.49	5.72	10.48	6.69	7.62
Achievement level (*A*)	1	2.45	13.04	8.61	3.37	10.99
	2	6.70	11.92	8.36	4.59	10.91
*A*S*	1	2.63	3.01	1.86	2.14	1.55
	2	3.50	4.50	1.43	5.27	3.74
*A*H*	1	0.28	1.32	2.53	2.01	0.12
	2	0.59	0.89	1.02	0.55	2.06
*A*C*	1	2.96	0.84	1.18	1.53	0.34
	2	1.09	1.99	0.99	0.42	1.68
*A*H*C*	1	1.13	1.33	0.02	0.73	1.25
	2	1.50	0.18	0.05	1.09	0.78
*A*T*	1	1.75	0.56	1.40	2.45	1.24
	2	2.14	2.61	1.10	1.06	0.47
N	1	10344	10477	10497	9438	9329
	2	13102	13102	13498	12320	12406

Set: 1 = 30 East Tennessee school systems.
2 = 24 Middle Tennessee school systems.
N = total number of students.

Table 3. *z*-Values for Analyses of Fifth-Grade Gains.

Source	*Set*	*Math*	*Reading*	*Language*	*Social Studies*	*Science*
System (*S*)	1	1.30	3.52	3.18	1.04	1.30
	2	5.69	3.50	2.49	4.20	3.02
Heterogeneity (*H*)	1	0.55	0.57	1.44	0.37	2.56
	2	0.66	0.33	1.41	0.12	0.59
Class size (*C*)	1	2.19	0.72	0.59	1.58	2.35
	2	1.13	1.40	0.71	0.14	0.01
H*C	1	0.29	0.82	0.23	1.13	1.77
	2	0.66	0.79	1.37	0.10	0.11
Teacher (*S*H*C*) (*T*)	1	9.70	5.80	6.29	5.65	6.24
	2	9.13	6.33	9.68	6.62	6.27
Achievement level (*A*)	1	1.94	4.42	1.51	0.14	5.20
	2	3.88	5.12	2.26	1.29	2.24
*A*S*	1	2.60	2.03	2.64	0.91	2.15
	2	3.36	2.15	0.98	4.24	0.59
*A*H*	1	2.81	1.07	1.10	0.78	1.18
	2	0.70	2.40	0.91	1.22	0.97
*A*C*	1	2.07	1.09	1.70	0.94	0.93
	2	2.35	1.18	0.13	0.86	0.88
*A*H*C*	1	1.49	0.06	1.31	0.24	1.63
	2	1.46	0.39	1.43	0.45	3.04
*A*T*	1	1.79	2.52	1.52	0.05	0.63
	2	3.48	0.64	0.00	0.00	1.87
N	1	8259	8874	8615	6527	6662
	2	9939	9629	10141	9136	8569

Set: 1 = 30 East Tennessee school systems.
2 = 24 Middle Tennessee school systems.
N = total number of students.

Table 4. Estimated Mean Gains by Four Achievement Levels with Standard Errors in Parentheses.

		Achievement Level				
	Set	*Lowest*			*Highest*	*z*
Third grade	1	64.2 (1.6)	56.0 (1.4)	45.2 (1.4)	35.9 (1.4)	17.0
	2	75.4 (1.2)	59.3 (1.2)	47.5 (1.1)	36.6 (1.1)	28.0
Fourth grade	1	20.8 (1.4)	19.3 (1.1)	19.9 (1.1)	16.1 (1.2)	2.5
	2	28.7 (1.1)	25.7 (1.1)	21.4 (1.0)	20.5 (1.0)	6.7
Fifth grade	1	23.6 (1.4)	26.1 (1.2)	27.0 (1.2)	24.0 (1.3)	1.9
	2	25.9 (1.1)	27.2 (1.0)	25.9 (1.1)	21.2 (1.2)	3.9
Reading:						
Third grade	1	42.5 (1.5)	34.0 (1.2)	27.7 (1.3)	19.4 (1.3)	12.7
	2	45.3 (1.2)	33.0 (1.0)	26.6 (1.0)	16.4 (1.0)	20.1
Fourth grade	1	10.5 (1.1)	16.8 (0.9)	20.4 (1.0)	28.5 (1.0)	13.0
	2	16.7 (1.0)	20.8 (0.9)	22.9 (0.9)	32.6 (1.0)	11.9
Fifth grade	1	9.7 (1.3)	9.7 (1.1)	16.0 (1.1)	13.6 (1.1)	4.4
	2	11.6 (1.1)	10.3 (1.1)	16.0 (1.0)	17.4 (1.1)	5.1
Language:						
Third grade	1	29.7 (1.1)	25.1 (1.0)	18.4 (1.0)	23.0 (1.0)	8.5
		30.7 (0.9)	26.6 (0.8)	21.3 (0.8)	23.4 (0.8)	9.0
Fourth grade	1	10.7 (1.1)	20.0 (1.0)	18.5 (1.0)	23.4 (1.1)	8.6
	2	16.2 (1.0)	21.7 (1.0)	21.1 (0.9)	27.3 (1.0)	8.4
Fifth grade	1	14.8 (1.1)	16.9 (1.1)	15.8 (1.0)	17.9 (1.1)	1.5
	2	13.5 (1.0)	14.6 (1.1)	15.8 (1.0)	17.5 (1.1)	2.3
Social studies:						
Third grade	1	40.8 (2.0)	46.9 (1.7)	37.1 (1.6)	24.4 (1.6)	10.0
	2	46.2 (1.7)	49.0 (1.4)	39.8 (1.3)	23.6 (1.4)	14.5
Fourth grade	1	26.7 (1.9)	27.5 (1.6)	26.3 (1.6)	19.5 (1.7)	3.4
	2	28.5 (1.6)	31.4 (1.4)	29.4 (1.4)	22.3 (1.4)	4.6
Fifth grade	1	30.2 (1.8)	30.1 (1.6)	29.1 (1.6)	30.8 (1.8)	0.1
	2	28.9 (1.6)	28.3 (1.5)	25.6 (1.5)	25.7 (1.3)	1.3
Science:						
Third grade	1	18.1 (1.9)	28.5 (1.5)	24.5 (1.5)	15.9 (1.5)	6.8
	2	23.3 (1.5)	30.1 (1.3)	25.2 (1.2)	15.8 (1.3)	8.4
Fourth grade	1	24.9 (1.7)	22.6 (1.4)	17.6 (1.4)	5.6 (1.4)	11.0
	2	25.0 (1.5)	24.4 (1.2)	20.0 (1.2)	8.3 (1.3)	10.9
Fifth grade	1	19.6 (1.7)	10.2 (1.5)	8.2 (1.4)	11.8 (1.6)	5.2
	2	13.7 (1.6)	9.4 (1.4)	9.3 (1.3)	12.9 (1.3)	2.2

Set: 1 = 30 East Tennessee school systems.
2 = 24 Middle Tennessee school systems.

D2. Boyd, Lankford, Loeb, Rockoff and Wyckoff (2008)

Table 1. Qualifications of teachers by poverty status of schools in which they taught in 2000.

	Lowest 10%	>10th to 25th percentile	2nd quartile	3rd quartile	>75th to 90th percentile	Highest 10%
Percent with less than 3 years of NYC teaching experience	14.7	18.6	20.8	22.9	25.1	25.4
SAT math score	490	477	468	461	451	447
SAT verbal score	506	487	481	472	465	461
Percent who failed LAST exam on first attempt	12.20	16.80	23.50	29.60	35.30	34.20
Percent not certified to teach	4.00	8.20	11.50	17.00	21.00	21.90
Percent who attended least competitive undergraduate institutions	23.50	22.90	23.50	25.30	27.50	27.40
Expenditures per pupil**	$8,002	$8,335	$8,338	$8,738	$9,093	$9,479
Percent eligible for free lunch	21.6	50.4	67.6	81.6	90.5	96.3

*All 2000 dollars adjusted to 2005 school-year dollars using CPI.

Table 2. Average school qualifications of teachers by student poverty, 2000 and 2005.

	2000			2005			Change from 2000 to 2005		
	Lowest 10%	Highest 10%	Gap: Highest 10% – Lowest 10%	Lowest 10%	Highest 10%	Gap: Highest 10% – Lowest 10%	Lowest 10%	Highest 10%	Change in Gap
Percent with less than 3 years of NYC teaching experience	14.7	25.4	10.7	15.1	21	6	0.4	−3	−4
SAT math score	490	447	−43	495	471	−23	5	24	19
SAT verbal score	506	461	−45	503	485	−18	−3	23	26
Percent who failed LAST exam on first attempt	12.2	34.2	22.0	13.4	24	11	1.2	−9	−10
Percent not certified to teach	4.0	21.9	17.9	1	3	1	−2	−18	−16
Percent who attended least competitive undergraduate institutions	23.5	27.4	3.9	26	24	−2	3	−3	−6
Number of Teacher Absences	na	na		10.0	10.8	0.7	na	na	na
Expenditures per pupil*	$8,002	$9,479	$1,477	$9,711	$11,866	$2,155	$1,709	$2,387	$677
Teacher Salary	na	na		$59,314	$53,830	−$5,484	na	na	na

*All 2000 dollars adjusted to 2005 school-year dollars using CPI.

Table 3. Percentage of New York City students failing to meet proficiency on achievement exams by test and poverty decile, 2000 and 2005.

	2000			2005			Change from 2000 to 2005		
	Lowest 10%	Highest 10%	Gap: High 10% – Lowest 10%	Lowest 10%	Highest 10%	Gap: High 10% – Lowest 10%	Lowest 10%	Highest 10%	Change in Gap
Percent failing to meet proficiency									
ELA grade 4	29.6	73.7	44.2	18.1	50.5	32.4	−11.5	−23.2	−11.8
Math grade 4	24.3	71.1	46.8	7.7	29.2	21.5	−16.6	−41.8	−25.2
ELA grade 8	37.5	78.4	40.9	41.3	76.2	35.0	3.7	−2.2	−5.9
Math grade 8	51.9	85.6	33.7	38.9	69.4	30.5	−13.1	−16.2	−3.2
Percent achieving highest level									
ELA grade 4	25.6	2.8	−22.8	32.0	8.1	−23.9	6.4	5.4	−1.1
Math grade 4	26.8	2.5	−24.3	56.0	19.3	−36.7	29.2	16.8	−12.4
ELA grade 8	18.9	3.1	−15.8	13.7	1.6	−12.1	−5.2	−1.5	3.8
Math grade 8	10.1	1.2	−8.9	15.0	2.4	−12.6	4.9	1.2	−3.7
Mean test scores									
ELA grade 4	665.3	620.3	−44.9	679.8	643.4	−36.4	14.5	23.1	8.6
Math grade 4	657.7	617.3	−40.4	684.6	651.4	−33.2	26.9	34.1	7.3
ELA grade 8	710.3	668.3	−42.1	706.0	681.2	−24.8	−4.4	12.9	17.3
Math grade 8	711.8	676.2	−35.6	725.0	698.3	−26.7	13.2	22.1	8.9

Table 4. Base model for math, grades 4 and 5 with student fixed effects, 2000–2005.

Variable	Coefficient (t-value)
Constant	0.17147 [1.51]
Student changed schools	−0.03712 [6.60]**
Class Variables	
Proportion Hispanic	−0.4576 [12.89]**
Proportion Black	−0.57974 [16.16]**
Proportion Asian	−0.07711 [1.75]
Proportion other	−0.56887 [3.95]**
Class size	0.002 [3.36]**
Proportion Eng. lang. learn.	−0.42941 [14.16]**
Proportion home lang. Eng.	−0.02902 [1.16]
Proportion free lunch	−0.00181 [0.01]
Proportion reduced lunch	0.10521 [3.40]**
Mean absences $t-1$	−0.01367 [15.10]**
Mean suspensions $t-1$	0.14069 [2.78]**
Mean ELA score $t-1$	0.33811 [31.29]**
Mean math score $t-1$	−0.88479 [58.78]**

Variable	Coefficient (t-value)
SD ELA score $t-1$	−0.02332 [1.91]
SD math score $t-1$	−0.11722 [8.27]**
Teacher Variables	
Experience	
2	0.06549 [10.61]**
3	0.1105 [16.56]**
4	0.13408 [17.91]**
5	0.117 [14.24]**
6	0.13365 [14.58]**
7	0.12307 [12.27]**
8	0.11898 [10.81]**
9	0.12433 [10.04]**
10	0.13693 [9.85]**
11	0.12592 [9.41]**
12	0.10209 [7.66]**
13	0.11831 [8.23]**

Variable	Coefficient (t-value)
14	0.1263 [8.21]**
15	0.1252 [6.82]**
16	0.12464 [6.36]**
17	0.08298 [3.10]**
18	0.14161 [4.02]**
19	0.13686 [2.62]**
20	0.24658 [2.50]*
21 or more	0.38977 [3.89]**
Cert pass first	0.00657 [0.94]
Imputed LAST score	0.00025 [0.57]
LAST missing	0.00188 [0.26]
Certified math	0.07086 [1.30]
Certified science	−0.04852 [0.95]
Certified special ed.	0.01086 [1.05]
Certified other	−0.00521 [0.62]

Variable	Coefficient (t-value)
Not certified	−0.04235 [5.72]**
Barrons undergrad college	
Most competitive	0.01498 [1.48]
Competitive	0.01426 [2.24]*
Least Competitive	0.00686 [1.25]
Imputed math SAT	0.00043 [9.05]**
Imputed verbal SAT	−0.00034 [6.06]**
SAT missing	−0.01535 [2.94]**
Initial path into teaching	
College recommended	0.03108 [4.95]**
NYC Teaching Fellows	0.01173 [1.10]
Teach for America	0.02364 [1.20]
Individual evaluation	0.00866 [1.00]
Other	−0.00138 [−0.09]
Teacher LAST* class proportion free lunch	−0.00024 [0.49]
Observations	578,630

* Significant at .05 level; ** Significant at .01 level.

Table 5. Effect of observed teacher qualifications on student grades 4 and 5 math achievement, most affluent and poorest deciles of schools, 2001 and 2005 for various model specifications.*

		Imputed SAT and LAST		Drop SAT	Drop Missing		No
		All Obs.	Exp. < 3	Variables	SAT Obs.	School FE	Experience
Most affluent decile							
	2001	0.049	−0.011	0.093	0.129	0.074	0.050
	2005	0.056	−0.008	0.102	0.125	0.077	0.048
Change		0.007	0.003	0.009	−0.004	0.004	−0.002
Poorest decile							
	2001	−0.040	−0.106	−0.053	−0.083	−0.047	−0.032
	2005	−0.011	−0.062	−0.015	−0.027	−0.014	−0.016
Change		0.029	0.044	0.038	0.056	0.033	0.016
Gap between most affluent and poorest decile							
	2001	0.089	0.095	0.146	0.212	0.121	0.082
	2005	0.067	0.054	0.117	0.152	0.091	0.064
Change		−0.022	−0.041	−0.029	−0.060	−0.029	−0.018
Percentage reduction in gap		24.8	43.0	19.7	28.4	24.3	21.9

*Base model is as shown in Table 4; Exp. <3 includes only teachers in their first two years of teaching; Drop SAT variables omits the SAT variables from the estimation; Drop Missing SAT Obs. omits any teacher for whom we do not observe SAT scores, which has the effect of eliminating about 45 percent of the observations; School Fixed Effect substitutes school fixed effects for student fixed effects in the base model; No Experience is the base model with teacher experience omitted from the predictions.

Table 6a. Average qualifications of teachers in poorest quartile of schools by math achievement quintiles predicted solely from teacher qualifications, 2000–2005, with experience.

								Barron's Ranking of Undergraduate College			
VA Quintile	Mean VA	Years Experience	LAST Pass First	Not Certified	LAST Score	Math SAT	Verbal SAT	Most Competitive	Competitive	Less Competitive	Not Competitive
1	−0.103	2.054	0.653	0.626	238	423	478	0.135	0.136	0.442	0.287
2	−0.033	5.324	0.638	0.272	242	421	466	0.102	0.096	0.493	0.308
3	−0.003	6.867	0.715	0.063	244	433	469	0.078	0.095	0.516	0.312
4	0.021	6.546	0.777	0.022	247	446	461	0.105	0.153	0.415	0.327
5	0.059	5.944	0.872	0.007	252	489	459	0.162	0.229	0.389	0.219
Range	0.162	3.890	0.219	−0.619	14	66	−18	0.027	0.093	−0.052	−0.068

Table 6b. Average qualifications of teachers in poorest quartile of schools by math achievement quintiles predicted solely from teacher qualifications, 2000–2005, without experience.

							Barron's Ranking of Undergraduate College			
VA Quintile	Mean VA	LAST Pass First	Not Certified	LAST Score	Math SAT	Verbal SAT	Most Competitive	Competitive	Less Competitive	Not Competitive
1	−0.068	0.460	0.731	227	355	440	0.036	0.065	0.548	0.351
2	−0.032	0.656	0.141	239	414	467	0.052	0.069	0.539	0.340
3	−0.010	0.779	0.076	245	423	462	0.094	0.130	0.440	0.336
4	0.010	0.851	0.031	252	450	470	0.156	0.196	0.374	0.274
5	0.045	0.908	0.013	254	512	474	0.245	0.249	0.354	0.152
Range	0.113	0.448	−0.718	27	157	34	0.208	0.184	−0.193	−0.199

D3. Smith (2008)

Table 1
School performance under NCLB, according to school district poverty quartile

	Schools making AYP		Schools not making AYP	
	N	%	*N*	%
First poverty quartile (least poor)	1450	82	320	18
Second poverty quartile	1514	70	644	30
Third poverty quartile	1341	61	870	39
Fourth poverty quartile (most poor)	1233	55	1004	45
All schools	5538	66	2838	34

Source: California Department of Education (2005c).

Table 2
Number of classes in the core academic subjects being taught by 'highly qualified' teachers

School type	Total number of core academic classes	Percentage of core academic classes taught by 'highly qualified' teachers
All schools	630,647	52
High-poverty schools	153,922	40
Low-poverty schools	165,591	60

Source: California Department of Education (2005a, p. 37).

Table 3
Teacher qualifications in California, according to school type

	Schools making AYP		Schools not making AYP		All schools	
	N	Mean	*N*	Mean	*N*	Mean
Classes taught by NCLB compliant teachers (%)	5872	54	3048	47	8920	52
Completed a teacher preparation programme (%)	5969	94	3149	89	9118	92
Teaching with emergency credentials (%)	5969	4	3149	6	9118	4
Teachers with an MA degree or higher (%)	5974	35	3155	34	9129	35

Source: California Department of Education (2005c).

Table 4
Teacher experience in California, according to school type

	Schools making AYP ($N = 5999$) (years)	Schools not making AYP ($N = 3164$) (years)	All schools ($N = 9163$) (years)
Mean teaching experience (district)	11	10	11
Mean teaching experience (total)	14	13	14
Mean age of teachers	44	44	44

Source: California Department of Education (2005c).

Table 5
Mean percentage of students enrolled for English Language Arts tests, according to poverty quartile

	First quartile (most wealthy) $N = 1752$ (%)	Second quartile $N = 2120$ (%)	Third quartile $N = 2176$ (%)	Fourth quartile (least wealthy) $N = 2203$ (%)
African-American	4	7	10	10
Asian	12	7	5	5
Hispanic	21	36	45	58
White	56	43	33	21
Economically disadvantaged	21	44	60	77
English learners	15	23	32	43
SEN	10	11	11	11

Source: California Department of Education (2005c).

Table 6
Mean percentage of students enrolled for English Language Arts tests

	Schools making AYP ($N = 5916$) (%)	Schools not making AYP ($N = 3144$) (%)	All schools ($N = 9060$) (%)
African-American	7	11	8
Asian	8	4	7
Hispanic	34	54	41
White	44	25	37
Economically disadvantaged	46	66	53
English learners	24	37	28
SEN	10	12	11

Source: California Department of Education (2005c).

Table 7
Mean percentage of students making AYP (English Language Arts test)

	Number of schools	Students making AYP (%)
African-American	4314	30
Asian	4194	58
Hispanic	7420	29
White	6900	51
Economically disadvantaged	7599	27
English learners	6790	23
SEN	6999	16
All students	8340	39

Source: California Department of Education (2005c).

Table 8
Standardised beta coefficients for proficiency in English Language Arts tests[a]

	Standardized beta coefficients	t	Sig.
Block 1: Student characteristics			
Constant		222.2	0.000
% Free school meal students in school	–0.6	–66.2	0.000
% English learners	0.1	9.9	0.000
Number of students in school	0.08	12.9	0.000
% Hispanic students	–0.3	–28.1	0.000
Block 2: Teacher characteristics			
Constant		38.5	0.000
% free school meal students in school	–0.6	–56.9	0.000
% English learners	0.08	6.7	0.000
Number of students in school	0.1	21.6	0.000
% Hispanic students	–0.3	–29.9	0.000
% African-American teachers	–0.1	–14.0	0.000
% Female teachers	0.1	21.1	0.000
% Teachers with MA or higher	0.05	7.3	0.000
% Completed a teacher preparation programme	–0.01	–2.0	0.048
% Classes taught by NCLB compliant teachers	0.02	2.7	0.007

Block 1: Student variables only $R^2 = 0.69$
Block 2: Student and teacher variables $R^2 = 0.72$

[a]Descriptive statistics related to this model are presented in Appendix A.

D4. O'Connor (2010)

Table 1
Descriptive statistics for predictor and outcome variables (n=1364).

Variable	Mean	SD	%
Student Teacher Relationship Scale (teacher report)			
First grade	65.04	8.16	
Third grade	63.46	9.31	
Fifth grade	62.42	9.13	
Family resources			
Income-to-needs (parent report)			
First grade	3.79	3.11	
Third grade	4.15	3.59	
Fifth grade	4.31	3.81	
Maternal education (parent report)	14.23	2.51	
Family functions			
Secure (observation, 36 m.)			67.80
Insecure (observation, 36 m.)			26.00
Insecure/other (observation, 36 m.)			6.20
Support and stimulation at home (observed, average 3rd and 5th grade)	40.18	6.59	
Family–school relationship			
Family–school contact (teacher report)			
First grade	2.57	1.36	
Third grade	2.47	1.48	
Fifth grade	2.47	1.53	
Quality of parent–school interaction (mother report)			
First grade	3.84	.89	
Third grade	3.58	.89	
Fifth grade	3.52	.88	
School system			
Percentage of students on free/reduced lunch (principal report)			
First grade	.26	.19	
Third grade	.23	.20	
Fifth grade	.25	.21	
Principal involvement (teacher report, average 3rd and 5th grade)	27.61	4.57	
Professional development (teacher report, average 3rd and 5th grade)	33.40	4.80	
Teacher salary (teacher report, average 3rd and 5th grade)	3814.48	1247.77	
Classroom system			
Positive classroom environment (observation)			
First grade	5.35	1.26	
Third grade	5.06	.76	
Fifth grade	5.11	.68	
Quality of classroom instruction (observation, average 3rd and 5th grade)	4.85	.80	
Classroom management (observation, average 3rd and 5th grade)	4.85	.81	
Child–teacher ratio (observation)			
First grade	15.53	11.76	
Third grade	14.32	8.90	
Fifth grade	15.01	6.21	

Table 1 (*continued*)

Variable	Mean	SD	%
Teacher system			
Education (teacher report)			
First grade	4.21	.79	
Third grade	3.86	.91	
Fifth grade	3.96	.90	
Experience (teacher report)			
First grade	13.63	8.62	
Third grade	7.43	5.41	
Fifth grade	7.97	5.69	
Self-efficacy (teacher report, average 3rd and 5th grade)	133.28	15.19	
Child system			
Female		51.70	
African-American		12.70	
Latino-American		6.10	
Language ability (test)			
First grade	460.67	17.74	
Third grade	494.94	13.79	
Fifth grade	509.52	13.07	
Behavior problems (maternal report)			
First grade	13.02	9.75	
Third grade	12.55	10.10	
Fifth grade	11.85	10.27	
Temperament (maternal report, 54 m.)	4.65	.77	
Hours in child care (maternal report, average 6 to 54 months)	26.29	15.03	
Kindergarten teacher–child relationship (teacher report, kindergarten)	65.53	8.67	

Table 2
Model summary.

Parameters	Unconditional	Level-1	Final model
		Regression coefficients (fixed effects)	
Intercept (γ_{00})	63.35 (.12)***	62.23 (.27)***	25.23 (2.78)***
Time (γ_{10})		−.66 (.08)***	−.48 (.83)
Family–school contact (γ_{01})			.08 (.13)
Quality of parent–school interaction (γ_{02})			3.38 (.24)***
Teacher salary (γ_{03})			.10 (.01)**
Positive classroom climate (γ_{04})			.43 (.28)*
Classroom management (γ_{05})			1.03 (.22)***
Teacher self-efficacy (γ_{06})			.08 (.01)***
Female (γ_{07})			3.93 (.33)***
African-American (γ_{08})			−3.50 (.52)***
Latino-American (γ_{09})			−1.39 (.69)
Behavior problems (γ_{010})			−.12 (.02)***
Kindergarten teacher–child relationship (γ_{011})			.16 (.02)***
Family–school contact*time (γ_{11})			.23 (.05)***
Quality of parent–school interaction*time (γ_{12})			−.07 (.09)
Teacher salary*time (γ_{13})			.02 (.01)***
Positive classroom climate*time (γ_{14})			.10 (.03)**
Classroom management*time (γ_{15})			.23 (.08)**
Teacher self-efficacy*time (γ_{16})			.02 (.004)***
Female*time (γ_{17})			.03(.01)
African-American*time (γ_{18})			−.52 (.17)
Latino-American*time (γ_{19})			−.24 (.22)
Behavior problems*time (γ_{110})			−.001 (.006)
Kindergarten teacher–child relationship*time (γ_{111})			.06 (.01)
		Variance components (random effects)	
Residual (σ^2)	37.12(1.01)***	34.96 (1.34)***	28.46 (.76)***
Intercept (τ_{00})	24.07(1.44)***	23.98 (2.52)***	11.46 (1.09)***
Slope (τ_{11})		.80 (.24)*	.13 (.01)
Covariance (τ_{01})		1.38 (.62)*	1 .23 (.20)*
		Model summary	
Deviance statistic	27,875.66	27,725.23	26,379.90
Number of estimated parameters	3	6	28

Note *=p<.05. **=p<.01, ***=p<.001: Parameter estimate standard errors in parentheses.

D5. Heck and Mahoe (2010)

	Math	Science
Between schools		
Context		
Public	−0.06	−0.04
Urban	0.03	0.00
Small school	0.04	0.04
Percent low SES	−0.08**	0.10***
Percent students of color	−0.28***	−0.37***
Academic and social organization		
Attendance problems (grade 12)	−0.05	−0.04
Academic press (grade 12)	0.04	0.06*
Mean teacher quality (12)	0.08**	0.08***
Mean number of math and science courses	0.56***	0.49***
Variability in math and science course taking	−0.11**	−0.08**
Changes to improve learning during last three years	0.04	0.06*
Within schools		
Student background		
Male	0.10***	0.18***
Asian	0.01	−0.01
Hispanic	−0.01	−0.03**
African American	−0.01	−0.02
Native American	0.00	−0.00
SES	0.08***	0.10***
Retained (K-8)	−0.08***	−0.08***
GPA (grade 8)	0.13***	0.13***
GPA (grade 11)	0.12***	0.13***
Academic orientation		
High academic	0.23***	0.19***
Academic	0.21***	0.21***
Perceptions of teacher quality		
Teachers (grades 11-12)	0.23***	0.20**
Interactions		
High academic * teachers	−0.09***	−0.07***
Academic * teachers	−0.10***	−0.08***
Academic * African American	−0.04**	−0.06**

Notes: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Table I.
Final simultaneous standardized between- and within-school effects on student 12th grade achievement in math and science

	Math	Science
Between schools		
Context		
Public	−0.03	−0.01
Urban	0.03	0.07
Small school	0.07	0.06
Percent low SES	0.00	−0.05
Percent minority	−0.01	−0.10**
Academic and social organization		
Mean number of math and science courses	0.25***	0.28***
Variability in math and science course taking	−0.03	−0.05
Changes to improve learning during last three years	0.08*	0.07*
Academic press (grade 10)	−0.04	−0.02
Class expectations (grade 10)	0.05	0.07
Mean faculty quality (grade 10)	−0.05	−0.04
Within schools		
Student background		
Male	0.10***	0.18***
Asian	0.03	0.02
Hispanic	0.02	−0.01
African American	0.01	−0.01
Native American	−0.01	−0.02
SES	0.05**	0.09***
Retained (K-8)	−0.07***	−0.10***
GPA (grade 8)	0.01	0.05
GPA (grade 11)	0.05**	0.11***
Academic orientation		
High academic	0.12***	0.13***
Academic	0.24***	0.30***
Social integration		
Teachers (grades 9-10)	0.03***	0.03**
Teachers (grades 11-12)	0.22***	0.20***
Interactions		
High academic * teachers (grades 11-12)	−0.10***	−0.10***
Academic * teachers (grades 11-12)	−0.11***	−0.10**
Academic * African American	−0.03	−0.08**

Notes: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

Table II.
Final simultaneous standardized between- and within-school effects on growth rates in math and science

D6. Aslam and Kingdon (2011)

Table 1
OLS (across school) achievement production functions by subject.

Pupil characteristics	Language (1) Coefficient (Robust *t*)	Language (2) Coefficient (Robust *t*)	Language (3) Coefficient (Robust *t*)	Mathematics (1) Coefficient (Robust *t*)	Mathematics (2) Coefficient (Robust *t*)	Mathematics (3) Coefficient (Robust *t*)
AGE_YRS	−0.109 (−0.4)	−0.071 (−0.2)	−0.033 (−0.1)	0.063 (0.2)	0.049 (0.2)	0.059 (0.2)
AGE2	0.001 (0.1)	0.000 (0.0)	−0.002 (−0.1)	−0.002 (−0.2)	−0.001 (−0.1)	−0.002 (−0.2)
FEMALE	0.243 (0.9)	0.220 (0.8)	0.234 (0.9)	−0.392 (2.7)***	−0.389 (−3.2)***	−0.322 (−2.5)**
NUMSIS	−0.038 (−2.0)**	−0.038 (2.1)**	−0.038 (−2.1)**	−0.057 (−4.0)***	−0.065 (−4.6)***	−0.061 (−4.3)***
NUMBRO	−0.028 (−1.5)	−0.024 (−1.3)	−0.027 (−1.4)	−0.005 (−0.3)	−0.014 (−0.8)	−0.008 (−0.5)
EDUWISH	0.106 (3.7)***	0.118 (5.1)***	0.113 (4.3)***	0.073 (3.8)***	0.083 (4.0)***	0.073 (3.7)***
MEDYRS	0.004 (0.6)	0.004 (0.5)	0.002 (0.3)	0.009 (1.7)*	0.011 (2.0)**	0.009 (1.7)*
RAVEN	0.035 (10.7)***	0.035 (10.9)***	0.034 (11.2)***	0.034 (9.9)***	0.034 (9.8)***	0.033 (9.7)***
TIRED	−0.114 (−3.7)***	−0.138 (−4.7)***	−0.129 (−4.6)***	−0.007 (−0.3)	−0.002 (−0.1)	−0.015 (−0.5)
BOOKS	0.146 (2.2)**	0.135 (2.3)**	0.119 (2.2)**	0.245 (5.2)***	0.266 (5.8)***	0.234 (5.6)***
LNFINCOME	−0.010 (−0.6)	−0.010 (−0.6)	−0.012 (−0.8)	−0.002 (−0.1)	0.011 (0.7)	−0.001 (−0.1)
HTUTAKEN	−0.065 (−0.7)	−0.079 (−0.9)	−0.091 (−0.9)	−0.160 (−1.8)*	−0.209 (−2.3)**	−0.148 (−1.7)*
Teacher characteristics						
FEMTEACH	0.422 (1.4)	0.264 (0.8)	0.289 (0.9)	−0.085 (−0.6)	−0.176 (−1.3)	−0.061 (−0.4)
FEMSTUDTEACH	−0.204 (−0.6)	−0.081 (−0.2)	−0.079 (−0.3)	0.309 (1.6)	0.327 (1.9)*	0.156 (0.9)
TMA_PROF	0.117 (0.8)	0.143 (0.9)	0.100 (0.6)	−0.028 (−0.3)	−0.061 (−0.7)	−0.003 (0.0)
TTRAINYRS	0.031 (0.2)	−0.075 (−0.6)	−0.060 (−0.5)	0.046 (1.0)	0.038 (0.7)	0.035 (0.6)
TEXP	0.019 (0.5)	0.034 (0.9)	0.043 (1.1)	0.012 (0.7)	−0.012 (−0.7)	−0.001 (0.0)
TEXP2	−0.001 (0.7)	−0.002 (−1.2)	−0.002 (−1.4)	−0.001 (−1.4)	0.000 (−0.3)	0.000 (0.6)
TTENURE	0.007 (0.5)	0.022 (1.6)	0.015 (1.0)	0.024 (2.4)**	0.029 (2.8)***	0.025 (2.2)**
TTABSENT	−0.003 (−1.9)*	−0.002 (−1.6)	−0.003 (−1.9)*	0.000 (0.0)	−0.006 (−1.3)	−0.003 (−0.5)
TOTHJOB	0.115 (0.9)	0.046 (0.3)	−0.030 (−0.2)	−0.006 (−0.1)	−0.012 (−0.1)	−0.046 (−0.4)
TSCORE	0.089 (0.9)	0.005 (0.0)	0.022 (0.2)	0.045 (0.5)	−0.023 (−0.3)	0.020 (0.2)
TSPECIAL	−0.039 (−0.2)	−0.085 (−0.5)	−0.094 (−0.5)	0.205 (2.5)**	0.302 (3.6)***	0.210 (2.2)**
MINS_QUIZ/10	–	0.040 (2.4)**	0.030 (1.8)*	–	−0.020 (−1.2)	−0.011 (−0.7)
MINS_HWORK/10	–	−0.021 (−0.9)	0.002 (0.1)	–	0.002 (0.1)	0.010 (0.7)
LESSON_PLN	–	0.236 (0.9)	0.291 (1.0)	–	−0.296 (−1.6)	−0.192 (−1.0)
EXPLAIN	–	0.211 (1.6)	0.242 (1.6)	–	0.366 (2.6)***	0.328 (2.1)**
QUESTIONS	–	−0.266 (−1.3)	−0.278 (−1.4)	–	0.004 (0.0)	0.042 (0.4)
School characteristics						
GIRLS_SCHOOL	0.070 (0.3)	–	0.061 (0.3)	−0.112 (−0.6)	–	−0.030 (−0.2)
RESOURCE	0.002 (0.4)	–	0.004 (0.8)	0.012 (3.1)***	–	0.009 (2.0)**
LENGTH_STUDY/1000	0.439 (1.3)	–	0.567 (1.7)*	−0.318 (−1.6)	–	−0.472 (−2.9)**
CLASSIZE/100	0.007 (0.0)	–	0.070 (0.2)	−0.499 (2.2)**	–	−0.368 (−1.5)
CONSTANT	−1.344 (−0.6)	–	−2.293 (−1.0)	−1.990 (−0.9)	–	−1.511 (−0.7)
N	1353	1353	1353	1353	1353	1353
R2	0.3702	0.3877	0.3978	0.4547	0.4633	0.4633

Note: * denotes significance at 10%, ** at 5% and *** at 1%.

Table 2A
Achievement production functions (two subjects, pooled without and with 'teaching process' variables).

	OLS (1) Coefficient (Robust *t*)	OLS (2) Coefficient (Robust *t*)	School fixed effects (3) Coefficient (Robust *t*)	School fixed effects (4) Coefficient (Robust *t*)	Pupil fixed effects (5) Coefficient (Robust *t*)	Pupil fixed effects (6) Coefficient (Robust *t*)
FEMTEACH	−0.014 (−0.1)	−0.016 (−0.1)	−0.388 (−2.7)***	−0.486 (−3.8)***	−0.427 (−5.8)***	−0.537 (−7.1)***
FEMSTUDTEACH	0.274 (1.9)*	0.222 (1.7)*	0.560 (4.7)***	0.610 (4.8)***	0.656 (6.7)***	0.733 (7.3)***
TMA_PROF	0.035 (0.4)	−0.008 (−0.1)	0.005 (0.0)	−0.076 (−0.6)	0.008 (0.1)	−0.075 (−1.2)
TTRAINYRS	0.000 (0.0)	−0.069 (−1.2)	0.038 (0.6)	0.016 (0.2)	0.043 (1.5)	0.022 (0.8)
TEXP	0.014 (0.8)	0.027 (1.6)	−0.035 (−2.0)**	−0.020 (−1.4)	−0.036 (−3.8)***	−0.022 (−2.1)**
TEXP2	−0.001 (−1.3)	−0.001 (−1.7)*	0.001 (1.2)	0.001 (1.4)	0.001 (2.3)**	0.001 (2.2)**
TTENURE	0.021 (2.8)***	0.019 (2.6)***	0.018 (3.1)***	0.010 (1.7)*	0.018 (4.9)***	0.010 (2.4)**
TTABSENT	−0.001 (−0.4)	0.000 (0.0)	0.000 (0.2)	0.000 (−0.5)	0.000 (0.3)	−0.001 (−0.7)
TOTHJOB	0.064 (0.7)	0.069 (0.7)	0.085 (0.6)	0.169 (1.5)	0.086 (1.6)	0.170 (3.3)***
TSCORE	0.116 (1.7)*	0.092 (1.1)	0.087 (1.8)*	0.095 (2.0)*	0.086 (3.0)***	0.092 (2.8)***
TSPECIAL	0.179 (2.3)**	0.129 (1.5)	0.029 (0.4)	−0.044 (−0.6)	0.024 (0.7)	−0.048 (−1.2)
MINS_QUIZ/10	–	0.032 (3.1)***	–	0.030 (2.2)**	–	0.030 (3.8)***
MINS_HWORK/10	–	−0.012 (−0.8)	–	−0.020 (−2.0)**	–	−0.021 (−3.8)***
LESSON_PLN	–	0.144 (1.1)	–	0.219 (1.4)	–	0.230 (2.7)***
EXPLAIN	–	0.141 (1.6)	–	0.040 (0.5)	–	0.043 (0.9)
QUESTIONS	–	−0.161 (−1.7)*	–	0.210 (2.1)**	–	0.210 (3.8)***
Subject dummy	Yes	Yes	Yes	Yes	Yes	Yes
Pupil variables	Yes	Yes	Yes	Yes	No	No
School variables	Yes	Yes	No	No	No	No
N	2706	2694	2706	2694	2706	2694
R2/R2 within	0.3879	0.4048	0.1988	0.2114	0.0825	0.1197
No. of groups	–	–	50	50	1353	1353
F (*p*-value)	23.31 (0.000)	37.86 (0.000)	43.24 (0.000)	33.68 (0.000)	11.57 (0.000)	11.97 (0.000)

Note: * denotes significance at 10%, ** at 5% and *** at 1%.

Table 2B
Robustness check – achievement production functions (Urdu and Mathematics, with 'teaching process' variables).

	Pupil fixed effects (full sample)		Pupil fixed effects (restricted sample i.e. schools with only one section of class 8 and where the language test was taken in Urdu only)	
	(1) Coefficient (Robust *t*)	(2) Coefficient (Robust *t*)	(3) Coefficient (Robust *t*)	(4) Coefficient (Robust *t*)
FEMTEACH	−0.427 (−5.8)***	−0.537 (−7.1)***	−0.084 (−0.68)	−0.230 (−1.2)
FEMSTUDTEACH	0.656 (6.7)***	0.733 (7.3)***	.410 (2.2)**	0.212 (1.1)
TMA_PROF	0.008 (0.1)	−0.075 (−1.2)	−0.000 (−0.0)	−0.030 (−0.1)
TTRAINYRS	0.043 (1.5)	0.022 (0.8)	0.028 (0.4)	−0.236 (−1.6)
TEXP	−0.036 (−3.8)***	−0.022 (−2.1)**	−0.002 (−0.1)	0.062 (1.8)*
TEXP2	0.001 (2.3)**	0.001 (2.2)**	0.001 (1.0)	−0.001 (−1.1)
TTENURE	0.018 (4.9)***	0.010 (2.4)**	−0.033 (−1.9)*	−0.019 (−0.74)
TTABSENT	0.000 (0.3)	−0.001 (−0.7)	−0.003 (−0.3)	−0.009 (−0.7)
TOTHJOB	0.086 (1.6)	0.170 (3.3)***	−0.259 (−1.9)*	−0.275 (−2.0)**
TSCORE	0.086 (3.0)***	0.092 (2.8)***	0.011 (0.1)	0.069 (0.3)
TSPECIAL	0.024 (0.7)	−0.048 (−1.2)	−0.127 (−1.5)	−0.053 (−0.3)
MINS_QUIZ/10	–	0.030 (3.8)***	–	0.052 (2.2)**
MINS_HWORK/10	–	−0.021 (−3.8)***	–	−0.034 (−2.1)**
LESSON_PLN	–	0.230 (2.7)***	–	0.433 (0.7)
EXPLAIN	–	0.043 (0.9)	–	−0.253 (−1.3)
QUESTIONS	–	0.210 (3.8)***	–	0.214 (1.7)*
Subject dummy	Yes	Yes	Yes	Yes
Pupil variables	No	No	No	No
School variables	No	No	No	No
N	2706	2694	798	798
R2/R2 within	0.0825	0.1197	0.100	0.102
No. of groups	1353	1353	399	399
F (*p*-value)	11.57 (0.000)	11.97 (0.000)	3.21 (0.000)	3.29 (0.000)

Note: * denotes significance at 10%, ** at 5% and *** at 1%.

Table 3
Pupil fixed effects achievement function by school type.

	Private Coefficient (Robust *t*)	Government Coefficient (Robust *t*)
TMA_PROF	−0.585 (−4.3)***	0.069 (0.8)
TTRAINYRS	−0.146 (−3.9)***	−0.004 (0.0)
TEXP	0.026 (1.1)	−0.025 (1.1)
TEXP2	−0.003 (−2.9)***	0.001 (1.0)
TTENURE	0.043 (2.4)**	0.009 (1.3)
TTABSENT	0.006 (1.7)*	0.001 (0.6)
TOTHJOB	0.407 (4.9)***	−0.216 (−1.8)*
TSCORE	0.047 (0.8)	0.169 (1.8)*
TSPECIAL	−0.176 (−2.8)**	0.107 (1.0)
MINS_QUIZ/10	0.048 (4.2)***	0.037 (2.7)**
MINS_HWORK/10	−0.013 (−1.8)*	0.010 (0.5)
LESSON_PLN	0.222 (0.8)	−0.053 (−0.3)
EXPLAIN	0.063 (0.9)	0.070 (0.6)
QUESTIONS	0.569 (5.6)***	0.065 (0.7)
Subject dummy	Yes	Yes
N	1424	1270
No. of groups	718	635
R2 within	0.1380	0.1768

Note: * denotes significance at 10%, ** at 5% and *** at 1%.

Table 4
Regression of log of teacher pay (government and private, pooled).

	Across school (OLS)		Within school (school fixed effects)
	(1) Coefficient (Robust *t*)	(2) Coefficient (Robust *t*)	(3) Coefficient (Robust *t*)
FEMTEACH	−0.080 (−0.9)	−0.1292 (−1.3)	0.0652 (0.6)
TMA_PROF	0.314 (4.8)***	0.3698 (5.0)***	0.1537 (3.1)***
TTRAINYRS	−0.046 (−1.6)	0.0270 (0.9)	0.0166 (0.7)
TEXP	0.027 (2.6)***	0.0554 (4.3)***	0.0267 (2.9)***
TEXP2	−0.000 (−0.9)	−0.0008 (−2.1)**	−0.0004 (−1.4)
TTENURE	0.005 (0.6)	0.0028 (0.3)	0.0084 (1.5)
TTABSENT	0.002 (1.8)*	0.0037 (3.2)***	0.0008 (1.1)
PRIVATE	−1.072 (−6.7)***	–	
Average student mark			
STDMARK1	0.337 (3.7)***	0.1836 (1.9)*	–
CONSTANT	8.416 (23.5)***	7.8213 (15.7)***	7.9382 (96.7)***
Subject dummies	Yes	Yes	Yes
School variables	Yes	Yes	No
N	336	336	336
No. of groups	–	–	65
Mean dependent var.			
Adjusted R2/R2 between	0.685	0.5721	0.5149

Note: * denotes significance at 10%, ** at 5% and *** at 1%.

Table 5
Regression of log of teacher pay, by school-type.

	Private		Government	
	Across school Coefficient (Robust *t*)	Within school (school fixed-effects) Coefficient (Robust *t*)	Across school Coefficient (Robust *t*)	Within school (school fixed-effects) Coefficient (Robust *t*)
FEMTEACH	−0.1494 (−1.5)	0.0060 (0.6)	−0.0895 (−3.2)***	–
TMA_PROF	0.2485 (2.7)***	0.1325 (1.8)*	0.1803 (2.9)***	0.1739 (2.4)**
TTRAINYRS	−0.0579 (−1.2)	−0.0143 (−0.4)	0.0408 (1.6)	0.0547 (1.9)*
TEXP	0.0077 (0.5)	0.0034 (0.4)	0.0562 (4.0)***	0.0508 (3.0)***
TEXP2	−0.0001 (−0.2)	−0.0001 (−0.4)	−0.0008 (−1.9)	−0.0007 (−1.4)
TTENURE	0.0224 (1.3)	0.0282 (3.3)***	−0.0023 (−0.7)	−0.0024 (−0.4)
TTABSENT	−0.006 (−0.3)	0.0007 (0.4)	0.0009 (1.4)	0.0012 (1.7)*
Average student mark				
STDMARK1	0.2523 (2.6)***	–	0.1340 (2.9)***	–
CONSTANT	6.7184 (11.6)***	7.8348 (99.7)***	7.9934 (48.9)***	8.0587 (57.5)***
Subject dummies	Yes	Yes	Yes	Yes
School variables	Yes	No	Yes	No
N	218	218	118	118
No. of groups	–	40	–	25
Mean dependent var.				
Adjusted R2/R2 between	0.6658	0.1840	0.5837	0.6162

Note: * denotes significance at 10%, ** at 5% and *** at 1%.

Table A1
Description of variables used.

Variable	Description
Individual characteristics	
READING	Pupil's score in language (Urdu or English test), maximum score 25
MATHS	Pupil's score in mathematics test, maximum score 25
STDMARK	Standardised mark
AGEYRS	Pupil's age in years
AGE2	Age squared
FEMALE*	Dummy variable, equals 1 if female, 0 otherwise
NUMSIS	Number of sisters
NUMBRO	Number of brothers
EDUWISH	Child's educational aspirations, index from 1 to 6, for example 1 = aspires to complete grade 8 only, 2 = aspires completion till grade 10th, etc.
MEDYRS	Mother's education (completed years)
RAVEN	Score on Raven's ability test, maximum possible 60
TIRED	Index of how often child feels tired in class, 1 = very rarely, 2 = sometimes, 3 = quite often, 4 = most of the times
BOOKS	Number of books in child's home (divided by 1000)
LOGINCOME	Natural log of father's income (Rupees/month)
HOMETUITION	Number of hours of paid home tuition taken by child (divided by 1000)
Teacher characteristics	
FEMTEACH*	Teacher is female = 1, 0 otherwise
FEMALE_TEACH*	Interaction between FEMALE and FEMTEACH
TSALARY	Teacher salary (Rupees/month)
TLOGSALARY	Natural log of teacher's monthly salary
TEACHER_MA	Teacher has MA/MSc. Or MPhil. Or PhD (equals 1, 0 otherwise)
TTRAINYRS	Years of teacher training
TEXP	Years of total experience
TEXP2	Teacher experience squared
TTENURE	Teacher's experience in current school
TTABSENT	Total days of absence in past year (including paid/unpaid sick/other leave)
TOTHJOB	Equals 1 if teacher has evening/weekend job, 0 otherwise
TSCORE	Teacher's score in English language test, maximum 5
TSPECIAL*	Teacher 's highest degree is in subject she teaches currently in school
MINS_QUIZ	Minutes per week spent in quizzing students on past material (divided by 10)
MINS_HWORK	Minutes per week spent in discussing homework given to students (divided by 10)
LESSON_PLN*	Equals 1 if teacher plans lessons in advance, 0 otherwise
EXPLAIN*	Equals 1 if teacher explains in-class questions while lecturing, 0 otherwise
QUESTIONS*	Equals 1 if teachers asks a lot of random questions while teaching, 0 otherwise
School characteristics	
GIRLS_SCHOOL*	Equals 1 if school is a girls school, 0 otherwise
RESOURCE	Index of school resources
LENGTH_STUDY	Minutes per week school time is spent in studying (excluding breaks, etc.), divided by 1000
CLASSIZE	Actual class size of 8th grade pupils, divided by 100

Note: Variables marked by * are 0/1 indicator variables with Yes = 1 and No = 0.

Table A2
Process variables by teacher age, gender, experience, education and tenure.

Process variables:	Teacher's: Gender		Age		Experience				Education			Tenure			
	Male	Female	Young	Old	<5 years	5–10 years	10–20 years	>20 yrs	College or less	Bachelors	Masters or more	<1 year	1–5 years	5–10 years	>10 years
MINS_QUIZ	46.8	46.8	55.1	40.2	56.8	46.9	47.4	28.6	55.0	46.3	42.5	51.8	46.3	44.7	48.4
MINS_HWORK	42.8	40.2	42.9	39.5	38.1	47.2	39.4	42.5	51.0	42.1	34.0	42.5	35.7	45.7	45.4
LESSON_PLN	0.21	0.12	0.25	0.10	0.28	0.17	0.08	0	0.07	0.08	0.27	0.12	0.25	0.11	0
EXPLAIN	0.44	0.44	0.55	0.35	0.52	0.43	0.40	0.35	0.39	0.36	0.55	0.18	0.52	0.36	0.42
QUESTIONS	0.64	0.66	0.59	0.70	0.62	0.59	0.70	0.70	0.68	0.66	0.62	0.39	0.61	0.64	0.81

Note: A "Young" teacher is defined as someone aged 35 or less and old otherwise.

Table A3
Descriptive statistics of variables, by school type.

Variable	Government		Private		Govt–private
	Mean (1)	SD (2)	Mean (3)	SD (4)	Difference (5)=(1)−(3)
Individual characteristics					
READING	13.19	0.15	15.90	0.15	−2.71***
MATHS	7.27	0.12	10.94	0.16	−3.67***
STDMARK	0.00	1.00	0.00	1.00	0.00
AGEYRS	13.59	1.21	13.51	0.93	0.08
AGE2	186.04	34.78	183.27	25.74	2.77*
FEMALE	0.69	0.46	0.55	0.50	0.14***
NUMSIS	2.10	1.51	1.72	1.31	0.38***
NUMBRO	2.12	1.27	1.74	1.21	0.37***
EDUWISH	4.57	1.34	5.16	1.26	−0.59***
MEDYRS	6.19	4.91	8.92	4.91	−2.73***
RAVEN	26.12	9.81	33.03	10.10	−6.90***
TIRED	1.43	0.69	1.50	0.74	−0.07*
BOOKS	0.14	0.26	0.23	0.39	−0.09***
LOGINCOME	8.55	1.62	9.42	1.39	−0.87***
HOMETUITION	0.25	0.30	0.25	0.30	0.00
Teacher characteristics					
FEMTEACH	0.76	0.43	0.88	0.33	−0.12***
FEMALE_TEACH	0.69	0.46	0.52	0.50	0.17***
TSALARY	6777.44	2105.93	3871.32	3625.75	2906.11***
TLOGSALARY	8.78	0.29	7.97	0.74	0.80***
TEACHER_MA	0.34	0.48	0.43	0.50	−0.08
TTRAINYRS	1.16	0.72	0.54	0.88	0.62***
TEXP	16.41	8.18	6.52	5.84	9.89***
TEXP2	334.03	288.90	76.11	118.49	257.92***
TTENURE	9.16	7.27	4.61	5.62	4.54***
TTABSENT	29.03	33.94	9.10	8.79	19.93***
TOTHJOB	0.22	0.42	0.46	0.50	−0.24**
TSCORE	0.56	0.80	0.31	0.58	0.25*
TSPECIAL	0.31	0.47	0.58	0.49	−0.27**
MINS_QUIZ	43.50	38.74	52.79	37.53	−9.29
MINS_HWORK	44.78	35.03	42.43	37.57	2.35
LESSON_PLN	0.16	0.37	0.13	0.34	0.02
EXPLAIN	0.38	0.49	0.44	0.50	−0.07
QUESTIONS	0.63	0.49	0.59	0.49	0.04
School characteristics					
GIRLS_SCHOOL	0.63	0.50	0.19	0.40	0.43***
RESOURCE	54.94	11.85	68.03	13.28	−13.09***
LENGTH_STUDY	1591.88	220.11	1704.17	208.08	−112.29*
CLASSIZE	51.81	25.28	23.36	10.86	28.45***

Note: Variables marked by * are 0/1 indicator variables with Yes = 1 and No = 0.

Table A4
Regression of log of teacher pay (school fixed-effects), by school-type excluding tenure.

	Private		Government	
	Coefficient	Robust *t*	Coefficient	Robust *t*
FEMTEACH	0.0555	0.5	–	
TMA_PROF	0.1004	1.2	0.1781	2.7
TTRAINYRS	−0.0149	−0.4	0.0536	1.8
TEXP	0.0292	3.7	0.0493	2.9
TEXP2	−0.0005	−1.9	−0.0007	−1.4
TTABSENT	0.0008	0.4	0.0012	1.7
CONSTANT				
Subject dummies	Yes		Yes	
School variables	No		No	
N	218		118	
No. of groups	40		25	
Mean dependent var.				
Adjusted R2/R2 between	0.2866		0.6097	

D7. Behrman, Khan, Ross and Sabot (1997)

Table 4. Correlation of cognitive skills with primary school characteristics: Controlling for schooling attainment, pre-school ability, gender and region

	Math score			Reading score		
Variables	Coef.†	*t*-stat	R^2	Coef.†	*t*-stat	R^2
Continuous scale variables						
Average teacher math score	0.707	1.57	27.2	−0.438	0.98	13.2
Average teacher reading score	0.172	0.96	26.3	0.625	1.41	13.6
Average teacher Raven score	0.213	0.45	26.7	−0.233	1.61	13.9
Average teacher monthly pay	0.373	0.85	26.5	−0.178	0.36	12.8
Average teacher schooling level	0.765	1.11	26.7	0.032	0.04	12.8
Average teacher experience	0.604	1.43	27.0	1.218	2.81***	16.1
Average teacher tenure at school	0.145	0.30	26.3	−0.470	0.91	13.1
Average teacher degree	−1.616	3.86***	31.1	−0.608	1.34	13.6
Total number of teachers	0.426	1.04	26.7	0.237	0.65	13.0
Average student–teacher ratio	−0.341	0.86	26.5	−0.072	0.17	12.8
Nonsalary expenditures	0.003	0.01	26.3	0.177	0.40	12.8
Visits by school inspector	−1.613	2.07**	27.8	0.152	0.19	12.8
Fraction of teachers born in village	0.783	2.38**	28.8	0.042	0.10	12.8
Fraction of teachers with training	−0.799	1.15	26.8	0.649	0.90	13.1
Fraction of teachers with in-service training	−1.012	1.62	27.2	−1.446	2.23**	14.9
Fraction of rooms with useable black boards	−0.730	1.64	27.2	−0.550	1.17	13.4
0/1 indicator variables						
Instruction in language spoken at home	4.473	1.96*	27.7	5.301	2.10**	14.7
Sectioning based on ability	−2.355	1.15	26.8	−3.892	1.83*	14.2
Multiple grades in one class	0.567	0.513	26.4	1.283	1.11	13.3
Fewer than 10 days lost to bad weather	0.965	1.06	26.7	−1.297	1.37	13.6
Enough chalk	−1.638	1.571	27.2	−2.655	2.46**	15.4
Library	−0.737	0.85	26.5	−0.342	0.28	12.8
Boundary wall	0.533	0.32	26.3	0.710	0.41	12.8
Electricity	2.800	2.67***	28.9	0.318	0.29	12.8
Own water supply	0.565	0.58	26.4	1.878	1.85*	14.3
Toilets for teachers	3.340	2.31**	28.2	3.220	2.12**	14.7
Toilets for students	2.677	1.95*	27.7	3.752	2.63***	15.7

Notes: †Continuous scale coefficients are standardized to measure the impact of a one standard deviation change in the variable on the respondent test score.
*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.

D8. Bedi and Edwards (2002)

Table 2
Impact of school quality on earnings (S.E.)

	(1)	(2)	(3)	(4)	(5)	(6)
CONSTANT	3.962 (0.052)	3.993 (0.088)	3.746 (0.144)	3.746 (0.150)	3.792 (0.214)	3.456 (0.301)
Years of Schooling (SCHOOL)	0.138 (0.003)	0.122 (0.004)	0.147 (0.013)	0.147 (0.017)	0.117 (0.005)	0.168 (0.032)
Percentage of teachers with professional degrees	–	–	–	–	− 0.114 (0.115)	− 0.017 (0.220)
Percentage of schools with electricity	–	–	–	–	0.223 (0.110)	0.109 (0.135)
Student / teacher ratio *10	–	–	–	–	− 0.042 (0.023)	0.003 (0.004)
Class / student ratio	–	–	–	–	1.086 (0.301)	1.485 (0.525)
SCHOOL*Percentage of teachers with professional degrees	–	–	− 0.013 (0.013)	− 0.013 (0.015)	–	− 0.011 (0.028)
SCHOOL*Percentage of schools with electricity	–	–	0.017 (0.009)	0.017 (0.010)	–	0.012 (0.013)
SCHOOL*Student / teacher ratio *10	–	–	− 0.008 (0.002)	− 0.008 (0.003)	–	− 0.010 (0.005)
SCHOOL*Table / student ratio	–	–	0.091 (0.039)	0.091 (0.039)	–	− 0.058 (0.072)
R^2	0.362	0.387	0.394	0.394	0.394	0.396
Returns to education at $\overline{Q}$	–	–	0.117 (0.004)	0.117 (0.004)	0.117 (0.005)	0.117 (0.004)
Returns to education at $\overline{Q}+\sigma_Q$	–	–	0.129 (0.004)	0.129 (0.004)	0.117 (0.005)	0.124 (0.005)
Returns to school quality at $\overline{S}$ and $\overline{Q}$						
$(\partial Y/Y)\partial$ Percentage of teachers with professional degrees	–	–	− 0.097 (0.096)	− 0.097 (0.106)	− 0.114 (0.115)	− 0.099 (0.114)
$(\partial Y/Y)\partial$ Percentage of schools with electricity	–	–	0.124 (0.068)	0.124 (0.070)	0.223 (0.110)	0.194 (0.107)
$(\partial Y/Y)\partial$ Student / teacher ratio *10			− 0.055 (0.020)	− 0.055 (0.020)	− 0.042 (0.023)	− 0.044 (0.020)
$(\partial Y/Y)\partial$ Table / student ratio			0.651 (0.281)	0.651 (0.279)	1.086 (0.301)	1.073 (0.301)

Sample size—3691. Estimates in columns 2–6 include controls for experience, marriage, migratory status, region of residence and a selection correction term for migrant endogeneity. In addition, estimates in columns 3–6 include five variables that control for inter-municipal variation in wealth. Standard errors in columns 4–6 are corrected for heteroscedasticity and for intra-municipal error correlation. Returns to education and school quality are computed at the means of the schooling ($\overline{S}$) and school quality ($\overline{Q}$) variables.

D9. Brunello and Ghecchi (2005)

Table 1
Educational attainment. Ordered probit and OLS estimates. Dependent variable: educational attainment

Method of estimation	Oprobit (1)	Oprobit (2)	OLS (3)	OLS (4)
Pupil/teacher ratio Q	−0.0451**	−0.0440**	−0.0232**	−0.0220**
	(0.0063)	(0.0063)	(0.0041)	(0.0041)
Family educational background W	0.0240		0.0329**	
	(0.0139)		(0.0085)	
$Q \times W$	0.0066**		0.0035**	
	(0.0007)		(0.0004)	
Father years of education W_f		0.0380*		0.0334**
		(0.0154)		(0.0092)
$Q \times W_f$		0.0033**		0.0018**
		(0.0008)		(0.0004)
Mother years of education W_m		−0.0233		−0.0030
		(0.0183)		(0.0111)
$Q \times W_m$		0.0052**		0.0027**
		(0.0009)		(0.0005)
Dummies				
Gender	Yes	Yes	Yes	Yes
Age cohort	Yes	Yes	Yes	Yes
Region of birth (19)	Yes	Yes	Yes	Yes
Region of residence (19)	Yes	Yes	Yes	Yes
Educational reform in 1969 (born 1951)	Yes	Yes	Yes	Yes
Number of obs	31594	31594	31594	31594
R^2	0.163	0.171	0.341	0.353

Note: Robust cluster adjusted standard errors in parentheses with $p<0.05 = *$, $p<0.01 = **$.

D10. Buddin and Zamarro (2009)

Table 2
Comparison of student and teacher characteristics in schools with lowest and highest test scores in 2004.

School characteristic	Lowest quartile schools	Highest quartile schools
Reading percentile	34.10	53.66
Math percentile	40.79	62.31
Student characteristics		
Black	0.15	0.10
Hispanic	0.83	0.36
LEP	0.64	0.20
Parents not high school graduates	0.47	0.11
Teacher characteristics		
Years of experience	6.36	9.37
Experience <3 yrs	0.44	0.30
Black	0.21	0.08
Hispanic	0.37	0.14
Master's/doctorate	0.16	0.23
CBEST (standardized)	−0.52	−0.08
CSET (standardized)	−0.43	0.06
RICA (standardized)	−0.31	−0.01

Note. All factors differ significantly between the two groups of schools.

Table 3
Comparison of student, teacher, and school fixed effects.

	Reading	Math
#1. *Student & teacher fixed effects*		
Student ($\sigma_{Student}$)	16.75	18.33
Teacher ($\sigma_{Teacher}$)	4.99	6.25
#2. *Student & school fixed effects*		
Student ($\sigma_{Student}$)	16.97	18.69
School (σ_{School})	2.15	2.57

Table 4
Estimates of contemporaneous value-added and value-added gains models.

Variable	Levels		Gains	
	Reading	Math	Reading	Math
Test year 2001	4.7992*	4.7409*	NA	NA
	(0.0539)	(0.0621)		
Test year 2002	8.7472*	10.1358*	−1.82*	0.6902*
	(0.0813)	(0.0999)	(0.118)	(0.1139)
Test year 2003	8.8283*	11.2429*	−5.7058*	−3.6568*
	(0.1221)	(0.1406)	(0.2197)	(0.2042)
Test year 2004	11.4256*	14.5627*	−0.3141	−0.5286
	(0.1454)	(0.1647)	(0.3033)	(0.2965)
Class size	−0.1677*	−0.2224*	−0.0795*	−0.1306*
	(0.0065)	(0.0059)	(0.0148)	(0.0157)
Percent female in class	0.4042*	1.0647*	0.248	1.2103
	(0.2029)	(0.2117)	(0.4413)	(0.6601)
Percent black in class	−1.3819*	−1.8051*	−0.5991	−2.3175*
	(0.4378)	(0.4616)	(1.0337)	(1.0983)
Percent Hispanic in class	−0.9909*	−0.1097	−1.2005	0.5385
	(0.3318)	(0.3819)	(0.973)	(0.9165)
Percent Asian/Pacific Islander	0.0988	−0.0768	−1.3636	−0.5706
in Class	(0.4465)	(0.5338)	(1.2689)	(1.239)
Hispanic student & teacher	−0.0755	0.0856	−0.066	0.1476
	(0.1322)	(0.1332)	(0.284)	(0.2923)
Black student & teacher	0.1833	0.2393*	0.5294	0.3505
	(0.1327)	(0.1169)	(0.3705)	(0.3631)
Asian/Pacific Islander student	−0.1925	−0.0576	−0.677	0.0635
& teacher	(0.1538)	(0.1918)	(0.3707)	(0.3737)
Female student & teacher	−0.1982*	−0.3269*	−0.0445	0.0176
	(0.0614)	(0.0556)	(0.0982)	(0.1474)
College parents & teacher	0.0242	0.0029	0.0286	0.0576
Masters/Ph.D.	(0.0736)	(0.0878)	(0.2207)	(0.2213)
Standard deviation of student effects	17.08	18.82	8.98	10.32
Standard deviation of teacher effects	5.07	6.65	11.04	14.02
Number of observations	935,775	935,775	585,325	585,325
Number of students	332,538	332,538	325,521	325,521
Number of teachers	16,412	16,412	13,047	13,047

Note. Bootstrapped standard errors are in parenthesis. An asterisk indicates significance at a 95% level. Controls for grades are also included.

Table 5
Distributions of teacher effects.

	Levels		Gains	
	Reading	Math	Reading	Math
Mean	0.04	−0.12	2.19	1.25
S.D	4.67	6.16	9.52	12.47
Skewness	−0.074	0.68	0.64	0.90
Kurtosis	7.25	4.52	12.84	9.30
Percentile				
5%	−6.73	−9.07	−10.09	−15.32
25%	−2.72	−4.20	−2.68	−5.64
50%	−0.14	−0.66	1.50	0.27
75%	2.61	3.35	5.90	6.41
95%	7.72	10.71	17.72	22.83
99%	12.37	17.86	35.32	42.52

Table 6
Correlation coefficients for licensure tests.

	CSET	CBEST	RICA
CSET	1.00		
CBEST	0.58	1.00	
RICA	0.44	0.46	1.00

Table 7
Determinants of teacher unobserved reading heterogeneity in levels model.

	ALL tests	CBEST	CSET	RICA
Years of teaching experience	0.5366*	0.5444*	0.5620*	0.5449*
	(0.1200)	(0.1009)	(0.1176)	(0.1092)
Teaching experience squared	−0.0347*	−0.0361*	−0.0360*	−0.0376*
	(0.0086)	(0.0070)	(0.0083)	(0.0082)
Female teacher	0.4371	0.6641*	0.5946*	0.7345*
	(0.2759)	(0.2103)	(0.2526)	(0.2186)
Black/African American teacher	−0.1118	0.2646	−0.1202	0.5172
	(0.4609)	(0.4368)	(0.4501)	(0.4373)
Hispanic teacher	0.1585	0.1187	0.1527	0.4169
	(0.3136)	(0.2858)	(0.3022)	(0.2764)
Asian/Pacific Islander teacher	0.5689	0.5248	0.5567	0.5946
	(0.4130)	(0.3726)	(0.4087)	(0.3697)
Teacher has MA or Ph.D	−0.5091	−0.9107	−0.8205	−0.9751
	(0.5506)	(0.5520)	(0.5511)	(0.5722)
CBEST (standardized)	−0.4181*	−0.1531		
	(0.1747)	(0.1214)		
CSET (standarized)	−0.0577		−0.1454	
	(0.2059)		(0.1469)	
RICA (standardized)	0.2497			0.1056
	(0.1767)			(0.1075)
Constant	−1.5235*	−1.6211*	−1.5956*	−1.7990*
	(0.3734)	(0.3352)	(0.3661)	(0.3422)
Adj. R-squared	0.0179	0.0175	0.0172	0.0164
Obs.	1981	2727	2033	2630

Note. Standard errors are in parenthesis. Standard errors are adjusted by the fact that teachers are clustered within schools. An asterisk indicates significance at a 95% level.

Table 8
Determinants of teacher unobserved math heterogeneity in levels model.

	ALL tests	CBEST	CSET	RICA
Years of teaching experience	0.5433*	0.5138*	0.5893*	0.5131*
	(0.1308)	(0.1158)	(0.1297)	(0.1186)
Teaching experience squared	−0.0330*	−0.0333*	−0.0360*	−0.0342*
	(0.0080)	(0.0071)	(0.0079)	(0.0074)
Female teacher	0.0950	0.6945*	0.3352	0.8227*
	(0.3754)	(0.3197)	(0.3545)	(0.3219)
Black/African American teacher	−0.3778	−0.0762	−0.4040	0.4464
	(0.5139)	(0.4661)	(0.5054)	(0.4633)
Hispanic teacher	0.3322	0.4185	0.3892	0.9285*
	(0.4134)	(0.3548)	(0.3948)	(0.3489)
Asian/Pacific Islander teacher	0.8964	0.8677	0.8250	1.1622*
	(0.5760)	(0.4832)	(0.5684)	(0.4945)
Teacher has MA or Ph.D	−1.3310	−1.8775*	−1.8666*	−2.1120*
	(0.7555)	(0.7780)	(0.7246)	(0.8124)
CBEST (standardized)	−0.6508*	−0.4353*		
	(0.2193)	(0.1680)		
CSET (standarized)	−0.3777		−0.4187*	
	(0.2193)		(0.1743)	
RICA (standardized)	0.5771*			0.1961
	(0.1850)			(0.1423)
Constant	−1.7059*	−1.9358*	−1.8276*	−2.2185*
	(0.4659)	(0.4136)	(0.4610)	(0.4166)
Adj. *R*-squared	0.0217	0.0159	0.0183	0.0136
Obs.	1981	2727	2033	2630

Note. Standard errors are in parenthesis. Standard errors are adjusted for the fact that teachers are clustered within schools. An asterisk indicates significance at a 95% level.

Table 9
Determinants of Teacher Unobserved Reading Heterogeneity in Gains Model.

	ALL tests	CBEST	CSET	RICA
Years of teaching experience	1.2603*	1.3478*	1.3651*	1.2964*
	(0.2109)	(0.2009)	(0.2193)	(0.1987)
Teaching experience squared	−0.0679*	−0.0697*	−0.0723*	−0.0742*
	(0.0111)	(0.0124)	(0.0115)	(0.0123)
Female teacher	1.6442*	1.3242*	1.8706*	1.5517*
	(0.5748)	(0.4915)	(0.5625)	(0.4901)
Black/African American teacher	−3.5697*	−3.2342*	−3.5759*	−2.6969*
	(1.1121)	(0.9788)	(1.1116)	(0.9545)
Hispanic teacher	0.1141	0.1405	0.1502	0.7697
	(0.6900)	(0.6367)	(0.6807)	(0.5845)
Asian/Pacific Islander teacher	0.0792	0.3183	0.0091	0.3908
	(0.9871)	(0.8834)	(0.9722)	(0.8588)
Teacher has MA or Ph.D	−2.4319*	−1.5259	−1.8945	−2.5685*
	(0.8856)	(1.0413)	(1.0973)	(0.8664)
CBEST (standardized)	−0.5197	−0.4383		
	(0.4509)	(0.2750)		
CSET (standarized)	−0.5345		−0.5563	
	(0.4473)		(0.3016)	
RICA (standardized)	0.1974			−0.0759
	(0.3335)			(0.2579)
Constant	−1.0450	−1.0012	−1.3542	−1.2711
	(0.7895)	(0.6763)	(0.7785)	(0.6616)
Adj.*R*-squared	0.0327	0.0288	0.0338	0.0277
Obs.	1720	2334	1764	2261

Note. Standard errors are in parenthesis. Standard errors are adjusted for the fact that teachers are clustered within schools. An asterisk indicates significance at a 95% level.

D10. Marshall (2009)

Table 3
Academic achievement decompositions

Variables	Indigenous test score gap		PRONADE test score gap	
	Spanish gains	Math gains	Spanish gains	Math gains
Raw difference in standard deviations	0.21	0.25	0.14	0.07
By variable category				
Student/family background	−0.47	−0.11	−0.31	−0.24
Community characteristics	0.40	0.46	0.09	0.13
Selection controls	−0.01	0.04	0.11	−0.02
School characteristics	0.04	−0.16	0.02	0.04
Unexplained "direct" parameter	0.25	0.02	0.23	0.17
Select school quality differences				
School days	0.04	0.01	−0.04	−0.01
Teacher is Indigenous	−0.02	−0.06	−0.02	−0.04
Teacher content knowledge	0.00	0.01	0.00	0.05
Teacher PCK	–	0.02	–	0.02
Teaching segments				
Group work	−0.10	−0.05	−0.06	−0.03
Teacher-centered	0.03	−0.15	0.02	−0.10
Transition/discipline	0.05	0.07	0.07	0.21
Teacher checks all work	0.03	0.04	0.03	0.05

Source: HCRG, 2003. *Notes*: Decompositions based on achievement levels are available on request from author. Gains refer to difference between 2002 and 2001 scores. Students are classified as indigenous when they report speaking a Mayan language in the home. The top row refers to the raw difference in average achievement between each group (in standard deviations). This total difference is decomposed into the five variable categories listed in the top half (Student-family background, community, etc.). The incoming (2001) test score is included in the student-family background category. The decomposition uses a single estimation equation and focuses only on endowment differences between the two groups. All coefficients refer to standard deviation changes in achievement. Negative coefficients refer to areas where the low scoring group (indigenous and PRONADE) have more favorable endowments. See text for more information, Table 2 for the coefficients and Table 1 for the means for each group.

D11. Gutman (2006)

Table 2
Student goal orientations as predictors of mathematics self-efficacy and GPA

Variables	R^2	ΔR^2	*B*	*SEB*	β
Self-efficacy					
Step 1	.49				
Math self-efficacy (8th)			.73	.16	.55***
Student mastery (9th)			.23	.11	.27*
Student performance (9th)			−.07	.08	−.10
Step 2	.51	.02			
Math self-efficacy (8th)			.74	.16	.56**
Student mastery (9th)			.34	.13	.39**
Student performance (9th)			−.03	.11	−.05
Student mastery (8th)			−.19	.13	−.21
Student performance (8th)			−.00	.11	−.01
GPA					
Step 1	.36				
Math GPA (8th)			.48	.17	.40**
Student mastery (9th)			1.29	.57	.32*
Student performance (9th)			−.66	.46	−.19
Step 2	.41	.05			
Math GPA (8th)			.49	.17	.41**
Student mastery (9th)			1.87	.69	.46**
Student performance (9th)			−.71	.59	−.21
Student mastery (8th)			−1.08	.67	−.27
Student performance (8th)			.38	.56	.12

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 3
Perceived classroom goal structures as predictors of mathematics self-efficacy

Variables	R^2	ΔR^2	B	SEB	β
Self-efficacy					
Step 1	.57				
Math self-efficacy (8th)			.76	.14	.58***
Classroom mastery (9th)			.22	.10	.24*
Classroom performance (9th)			−.17	.08	−.23*
Step 2	.60	.03			
Math self-efficacy (8th)			.79	.18	.60**
Classroom mastery (9th)			.21	.10	.24*
Classroom performance (9th)			−.12	.08	−.16
Classroom mastery (8th)			−.09	.11	−.12
Classroom performance (8th)			−.16	.10	−.19

* $p < .05$.
** $p < .01$.
*** $p < .001$.

D12. Caprara, Barbaranelli, Steca and Malone (2006)

Table 3
Parameter estimates from the unstandardized solution

Measurement model

Constructs	Items	Loading	Standard error	t
Self-efficacy beliefs	1	.815	.028	28.75
	2	. 815	.028	28.75
	3	. 815	.028	28.75
	4	. 815	.028	28.75
	5	1	–	–
Job satisfaction	1	.848	.042	20.295
	2	. 848	.042	20.295

Structural model

Path	beta	Standard error	t
Time 1 Achievement → time 3 achievement	.538	.064	8.45
Time 1 achievement → time 2 self-efficacy beliefs	.321	.157	2.054
Time 1 achievement → time 2 job satisfaction	−.438*	.345	−1.27
Time 2 self-efficacy beliefs → time 3 achievement	.024	.008	3.123
Time 2 self-efficacy beliefs → time 2 job satisfaction	.741	.078	9.511
Time 2 job satisfaction → time 3 achievement	−.011*	.008	−1.413

Note. Underlined coefficients were fixed to 1 for identification purposes. All coefficients are statistically significant ($p<.05$), except those marked with asterisks.

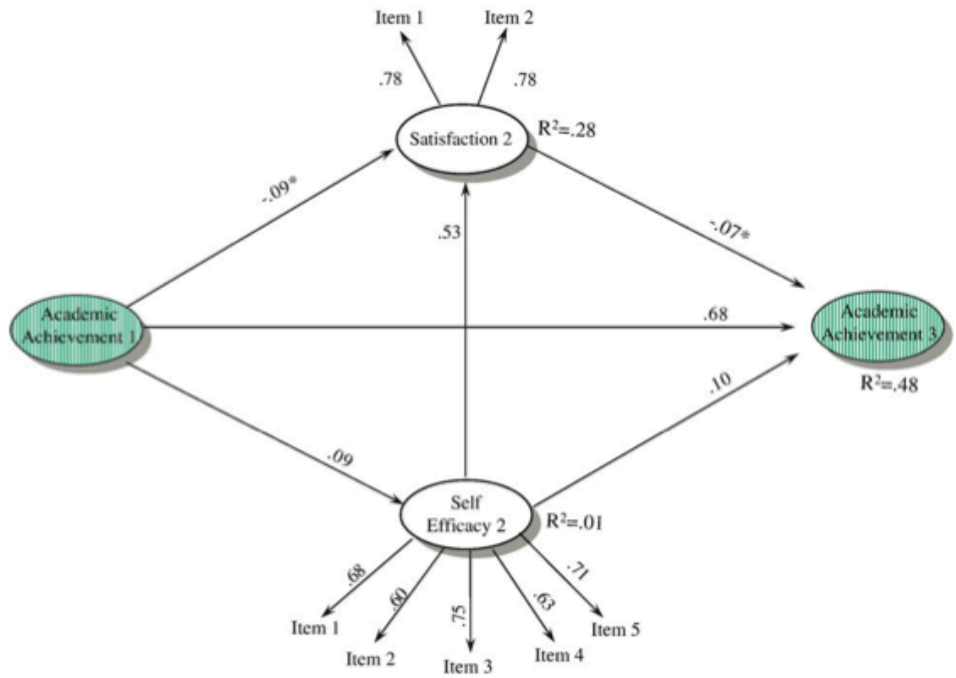


Fig. 2. Parameter estimates of the verified model. *Note*. The numbers refer to standardized structural coefficients. All coefficients are significant (p<.05), except those marked with asterisks.

D13. Lam (2005)

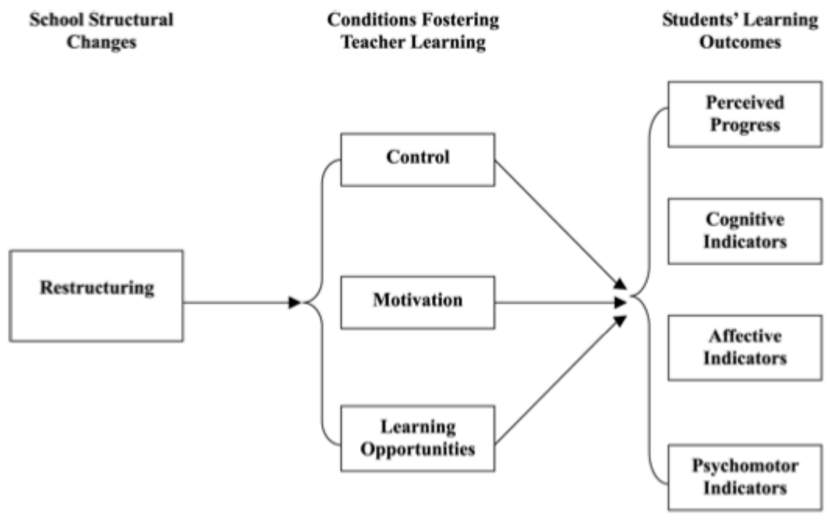


Figure 1.
1 A conceptual framework showing teacher and student learning under restructuring

Table I.
ANOVA of indicators of teacher and student learning under different structural conditions

		Sum of squares	df	Mean square	F	Sig.
Control autonomy	Between groups	15.635	2	7.817	28.196	0.000
	Within groups	341.853	1,233	0.277		
	Total	357.487	1,235			
Motivate	Between groups	23.742	2	11.871	36.606	0.000
	Within groups	417.034	1,286	0.324		
	Total	440.776	1,288			
Learning opportunities	Between groups	41.361	2	20.680	59.734	0.000
	Within groups	449.374	1,298	0.346		
	Total	490.734	1,300			
Student outcomes	Between groups	19.209	2	9.605	29.768	0.000
	Within groups	394.920	1,224	0.323		
	Total	414.130	1,226			

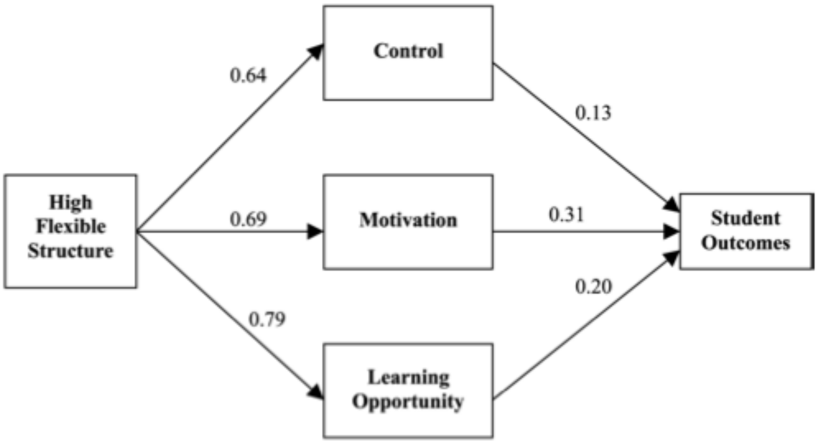


Figure 3.
3 Path analysis of relationship of teacher learning and student learning under high flexible structure

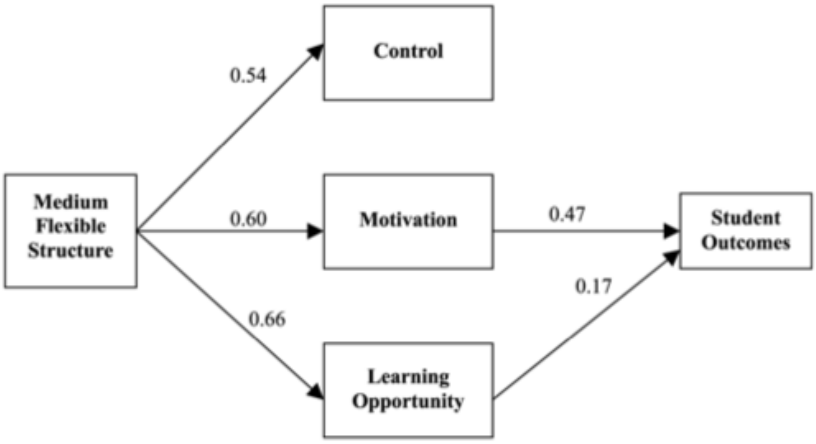


Figure 4.
Path analysis of relationship of teacher learning and student learning under medium flexible structure

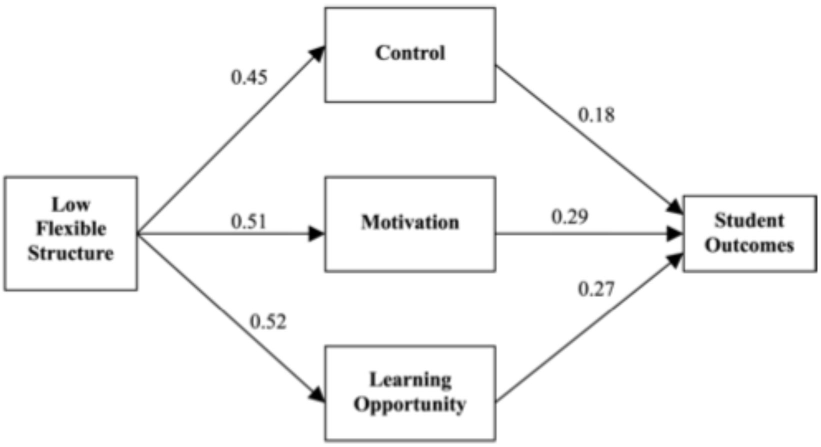


Figure 5.
Path analysis of relationship of teacher learning and student learning under low flexible structure

Table 1
Variable definitions

Teacher status	
UNION	Member of a teacher union $Y = 1$; $N = 0$
PERMANENT	Permanent status $Y = 1$; $N = 0$
TESEX	Teacher is male $Y = 1$; $N = 0$
Teacher human capital	
TEDUYRS	Teacher's education in years
TOTEXP	Teaching experience in years
EXPSQ	Experience squared
TRAINING	Pre-service Training $Y = 1$; $N = 0$
Teacher quality	
DIVISION	Index of teacher quality. It is the average division/grade she obtained in her various degree and board exams, after assigning a value of 3 to first, 2 to second and 1 to third division
NCLTAUT	Number of grades taught
SUBMATCH	Teaches subject of her specialization $Y = 1$; $N = 0$
REGEXAM	Teacher took most of her board exams as a Regular candidate? $Y = 1$; $N = 0$
Teacher pay	
GROSSPAY	Pay (rupees per month)
LNPAY	Log of pay
School quality	
JHS	Junior high school = 1; Secondary school = 0
MINACAD	Minutes of academic instruction per week
CLNUM	Class size
RESOURCE	Index of school resources. The index was constructed by giving a value of 1 for each of seventeen facilities such as availability of desks and chairs, blackboards, chalk, charts, playground, toilet, drinking water, musical instruments and educational equipment such as overhead projector, cassette recorder, computer, video cassette player, etc.
Child attributes	
ACHIEVE	Student's achievement score (total on numeracy and literacy tests)
CHAGE	Child's age (in months)
MALE	Child's gender MALE = 1; FEMALE = 0
CEDASP	Child's educational aspirations: index from 1 to 6 of the highest level to which child aspires, e.g. 1 = up to grade 8; 2 = up to grade 10; 4 = first degree, etc.
HSTUDY	Weekly hours of home study
TRTIME	Travel time to school (minutes)
VACWRK	Child works out of school hours
TAKESTU	Student has private home tuition
NUMSIB	Number of siblings
Child ability	
SRAVEN	Score on Raven's test of ability or intelligence
Parental attributes	
PARHELP	Parents help with studies at home $Y = 1$; $N = 0$
MEDYRS	Mother's education in years
MEDYRSQ	MEDYRS squared
WEALTH	Index of household wealth. The variable was constructed by assigning the following values to owned assets: Car = 50, scooter = 15, video = 15, fridge = 6, telephone = 5, TV = 3, tape recorder, gas cooker = 2 each and radio, bed(s), bicycle, and clock = 1 each
WEALTHSQ	WEALTH squared
BOOKHOM1	Less than or equal to 50 books in the house $Y = 1$; $N = 0$
BOOKHOM2	More than 50 books in the house $Y = 1$; $N = 0$
BOOKHOM3	More than 100 books in the house $Y = 1$; $N = 0$
LOWCASTE	Belongs to low caste $Y = 1$; $N = 0$
MUSLIM	Religion is Muslim $Y = 1$; $N = 0$

Table 3
Student achievement equation variables

		Government schools		Private schools	
		Mean	Sd	Mean	Sd
Child achievement					
ACHIEVE	Student's achievement score	19.00	8.38	33.79	10.5
Child ability					
SRAVEN	Score on Raven's ability test	26.87	10.10	36.03	10.6
Child attributes					
CHAGE	Child's age (in months)	163.91	14.58	164.31	11.1
MALE*	Proportion of male students	0.46	0.50	0.63	0.5
CEDASP	Child's educational aspirations	4.23	1.38	5.06	1.1
HSTUDY	Weekly hours of home study	19.69	10.16	24.51	10.7
TRTIME	Travel time to school (minutes)	17.48	11.73	17.76	11.93
VACWRK*	Child works out of school hours	0.18	0.38	0.09	0.29
TAKESTU*	Student has private home tuition	0.37	0.48	0.28	0.45
NUMSIB	Number of siblings	4.46	1.70	3.28	1.45
Parental attributes					
PARHELP*	Parents help with studies at home	0.56	0.50	0.63	0.48
MEDYRS	Mother's education in years/10	0.71	0.46	1.11	0.45
MEDYRSQ	MEDYRS squared	0.71	0.64	1.43	0.81
WEALTH	Index of household wealth/10	1.41	1.09	3.95	2.35
WEALTHSQ	WEALTH squared	3.18	5.24	21.09	21.5
BOOKHOM2*	More than 50 books in the house	0.27	0.44	0.26	0.44
BOOKHOM3*	More than 100 books in the house	0.20	0.40	0.44	0.50
LOWCASTE*	Belongs to low caste	0.19	0.40	0.04	0.20
MUSLIM*	Religion is Muslim	0.29	0.45	0.12	0.32
Teacher variables					
DIVISION	Index of teacher quality	1.77	0.20	2.05	0.21
LNPAY	Log of gross pay	7.80	0.13	7.12	0.65
School quality					
JHS*	Junior High School	0.29	0.46	0.51	0.50
MINACAD	Minutes of academic instruction per week	1161.47	146.14	1454.78	329.30
CLNUM	Class size of the sample class 8	44.11	16.49	41.03	8.23
PPMINACAD	Per pupil minutes of academic instruction per week (MINACAD / CLNUM)	31.63	18.72	37.04	11.27
RESOURCE	Index of school resources	6.87	2.79	11.96	3.23
Number of observations		542		360	

D14. Acevedo (2009)

Table 6
Marginal effect of a standard deviation increase in teacher characteristics on student achievement

	Pooled	African American	European American	Subsidized lunch	Regular lunch	Below-average performing	Above-average performing
Experience	−0.008	−0.011	–	–	–	–	–
Overall GPA	0.034***	0.084***	–	0.061***	0.000	0.054**	–
Math hours	0.281***	0.108***	–	–	−0.002	–	–
Math GPA	–	–	–	0.107***	–	–	–
Math education hours	0.385***	0.009	–	–	–	–	–
Math education GPA	–	–	–	–	–	–	–
N	1988	566	1151	794	914	510	1299

Estimates from fixed effects models, by student group. *Note*: ***$p < 0.01$; **$p < 0.05$. –, Marginal effect not displayed because effect is not jointly statistically significant.

D15. Salfi and Saeed (2007)

Table VII.
Relationship among school size, school culture and students' achievement

Variables	1	2	3
1. School size	–	− 0.497(**)	− 0.339(**)
2. School culture		–	0.075
3. Students' achievement			–

Notes: *$p < 0.05$; **$p < 0.01$

D16. Calcagno, Bailey, Jenkis, Kienzl and Leinbach (2008)

Table 3
Marginal effects of institutional variables on community college student outcomes

Variable	Model 1		Model 2		Model 3		Model 4	
	Pooled probit		Random effect probit		Pooled probit multiple institutions		Random effect linear model	
	dy/dx	S.E.	dy/dx	S.E.	dy/dx	S.E.	dy/dx	S.E.
1001–2500 FTE undergraduates	−0.157**	0.061	−0.122**	0.056	−0.176***	0.064	−0.209*	0.112
2501–5000 FTE undergraduates	−0.176***	0.063	−0.139**	0.057	−0.200***	0.064	−0.250**	0.114
More than 5000 FTE undergraduates	−0.153**	0.064	−0.150***	0.057	−0.180***	0.063	−0.123	0.110
Proportion part-time faculty	−0.220**	0.092	−0.155***	0.058	−0.237**	0.102	−0.307**	0.135
Certificate degree oriented	0.001	0.056	−0.054	0.046	−0.002	0.057	−0.052	0.104
Proportion FTE minority	−0.269**	0.123	−0.186**	0.087	−0.293**	0.14	0.076	0.194
Proportion FTE female	0.351	0.267	−0.011	0.257	−0.237	0.26	−0.605	0.544
Proportion FTE part-time	−0.237	0.224	−0.018	0.121	−0.093	0.258	−0.606**	0.274
Federal aid (Pell Grants)[a]	0.054	0.064	0.041	0.05	0.112	0.083	−0.160	0.120
In-state tuition[b]	−0.026	0.019	−0.004	0.017	−0.019	0.018	0.029	0.036
Instructional expenditures[a]	0.004	0.02	0.000	0.016	−0.007	0.02	−0.031	0.036
Academic support[a]	−0.119*	0.068	0.013	0.056	−0.125*	0.068	−0.097	0.117
Student services[a]	−0.057	0.066	−0.030	0.049	−0.018	0.052	0.037	0.122
Administrative expenditures[a]	0.024	0.034	−0.032	0.028	0.025	0.046	−0.027	0.061
College is located in urban area	−0.044	0.041	−0.054	0.039	−0.057	0.041	−0.093	0.066
College is located in rural area	0.043	0.066	0.059	0.081	0.016	0.08	−0.101	0.208
Individual-level characteristics[c]	Yes		Yes		Yes		Yes	
Unweighted observations	2196		2196		2117		2196	
Number of institutions	536		536		–		536	
Log-likelihood	−1310.20		−1331.55		−1266.44		–	
Pseudo-R^2	0.137		0.139		0.139		0.089	
Estimated rho			0.117				0.072	

Source: Authors' estimates based on NELS:88 and IPEDS, various years.
Notes: The dependent variable in Models 1–3 is attainment of any degree (certificate, associate's, or bachelor's) or transfer to a 4-year institution, while in Model 4 the dependent variable is the logarithm of cumulative number of credits earned. (***), (**), (*), indicate statistically significance at 1%, 5% and 10% level.
[a]In $1000s per FTE undergraduate.
[b]In $1000s.
[c]Models include individual-level controls for gender, race, SES, ability, and delay enrollment.

APPENDIX E – Literature Review Statistical Results for Family and Parent Sector

Figure/table numbers in this appendix are taken from the original work.

E1. Griffith (1997)

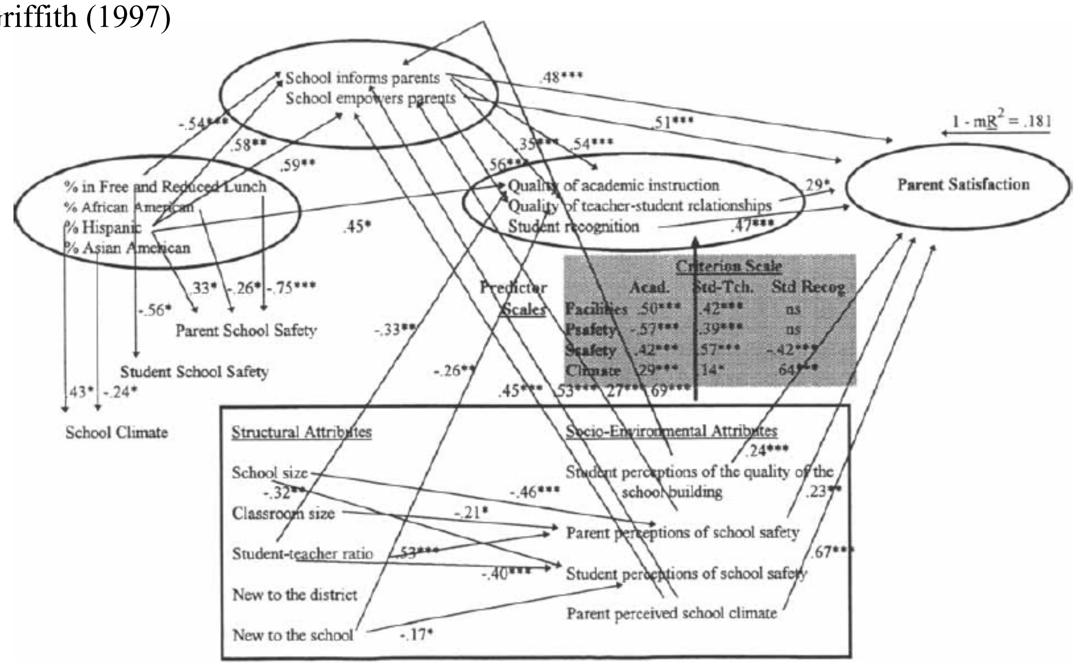


Figure 2. Path coefficients (standardized beta weights) depicting the relations of parental sociodemographic background, parent-school interactions, school social and structural characteristics, and classroom climate to parental satisfaction with education. Acad. = Academic Instruction; Std.-Tch. = Student-Teacher Relationships; Std.-Recog. = Student Recognition; Psafety = Parent School Safety; Ssafety = Student School Safety.
$^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

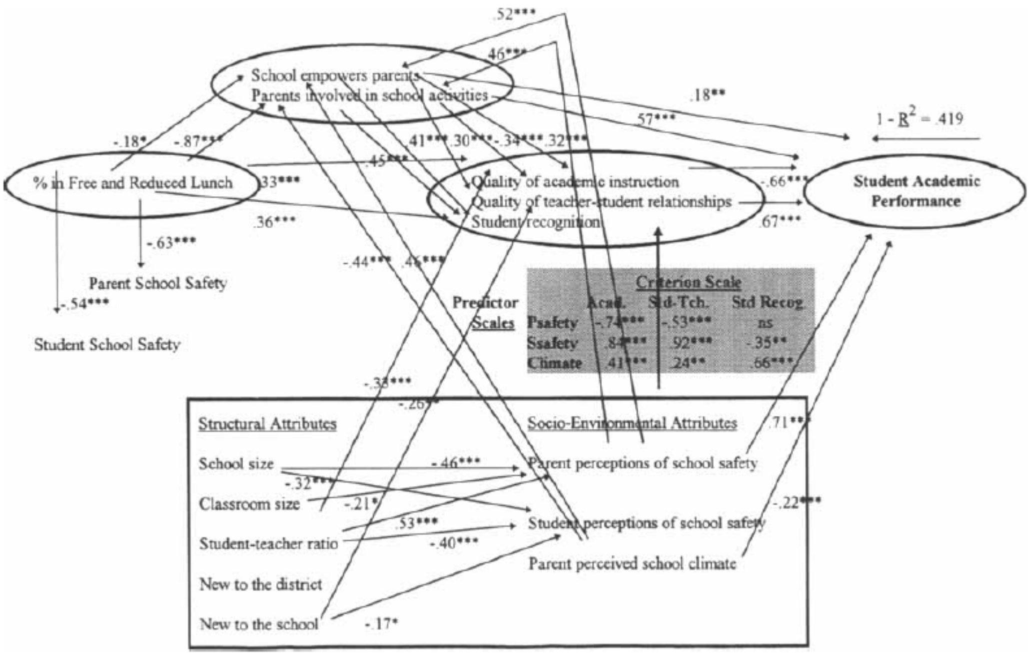


Figure 3. Path coefficients (standardized beta weights) depicting the relations of parental sociodemographic background, parent-school interactions, school social and structural characteristics, and classroom climate to student academic performance. Acad. = Academic Instruction; Std.-Tch. = Student-Teacher Relationships; Std.-Recog. = Student Recognition; Psafety = Parent School Safety; Ssafety = Student School Safety.
$^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 4

Relation of Sociodemographic and Socioenvironmental Characteristics to Parental Satisfaction and Student Academic Achievement

	Parental satisfaction		Student CRT	
Predictor variable	*r*	β	*r*	β
Family background				
African American[a]	-.50***	.128	*ns*[b]	
Asian American	-.01	-.008	*ns*	
Hispanic	-.39***	.151*	*ns*	
Non-White other	-.15	.058	*ns*	
% FARMS	-.54***	-.064	-.65***	-.537***
School structural characteristics				
School size	.01	.215***	-.36***	-.120
Class size	-.12	.065	.12	-.159*
Student-teacher ratio	-.11	-.097	.32***	.092
% new to the district	.18	.094*	.09	.050
% new to the school	-.03	-.106*	-.28***	.095
Parent-school interaction				
Parents informed	.76***	.226**	*ns*	
Parents empowered	.77***	.200**	.30***	-.101
Parents involved	*ns*[b]		.61***	-.141
School socioenvironmental characteristics				
School facilities	.44***	.134*	*ns*	
School safety (parent)	.51***	.420***	.69***	.390***
School climate (parent)	.82***	.342***	.12	.035
School safety (student)	.74***	-.059	.12	.066
Classroom climate				
Academic instruction	.44***	-.193*	-.12	-.062
Student-teacher relationships	.40**	.017	.11	.106
Student recognition	.06	.008	-.21*	-.095
Student satisfaction	.42**	.208*	-.07	-.047
Total R^2	.877 $F(20, 94) = 33.46$***		.669 $F(15, 98) = 13.15$***	

[a]Racial/ethnic identification was dichotomously coded so that values of 1 represented membership in the racial/ethnic group and values of 0 did not. Whites served as the reference group. [b]Nonsignificant for this criterion in first set of regression analyses but significant for the other criterion.
*$p < .05$. **$p < .01$. ***$p < .001$.

E2. Keith etal. (1998)

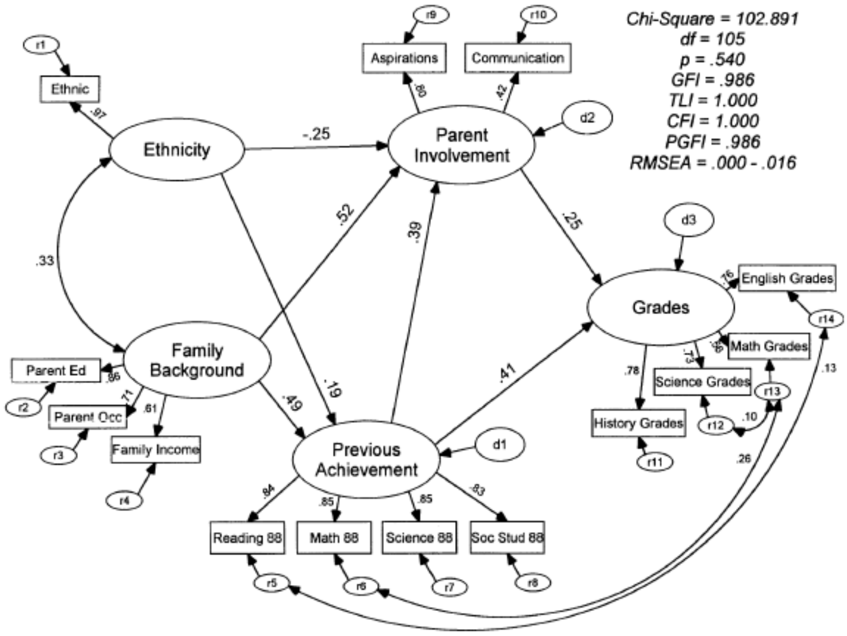


Figure 2. Validation analysis of the effects of eighth-grade parent involvement on high school grades. Parent involvement had a powerful effect on students' learning, as measured by grades.

Table 3
Direct, Indirect, and Total Effects on High School Grade Point Average

Variable	Direct Effect	Indirect Effect	Total Effect
1. Ethnicity	0	.036	.036
2. Family background	0	.378	.378
3. Previous achievement	.413	.095	.508
4. Parent involvement	.246	0	.246

Table 6
Direct and Total Effects on Student Grades, by Ethnic Group

Outcome & Influence	White	African American	Hispanic American	Asian American	Native American
To grades			Direct Effects		
Parent involvement	.44	.47	.56	.46	.61
	.22	.23	.25	.18	.43
Previous achievement	.08	.04	.05	.06	0
	.46	.25	.27	.45	
To parent involvement					
Previous achievement	.03	.02	.03	.02	0
	.39	.29	.37	.43	
Family background	.30	.34	.27	.20	1.09
	.48	.50	.47	.56	.79
To previous achievement					
Family background	3.90	4.46	3.26	3.27	6.78
	.51	.50	.43	.49	.43
To grades			Total Effects		
Previous achievement	.09	.05	.06	.07	0
	.55	.32	.37	.52	
Family Background	.49	.39	.35	.33	.67
	.38	.28	.28	.36	.34
To parent involvement					
Family background	.43	.44	.36	.28	1.09
	.68	.65	.63	.77	.79

Model Fit	White	African American	Hispanic American	Asian American	Native American
χ^2	41.292	48.000	43.067	123.211	55.036
df	57	57	59	59	62
p	.942	.796	.941	<.001	.722
GFI	.987	.986	.987	.962	.922
TLI	1.008	1.006	1.009	.970	1.025
CFI	1.000	1.000	1.000	.978	1.000
PGFI	.618	.617	.640	.624	.628
RMSEA, 90% confidence interval	.000–.006	.000–.019	.000–.006	.035–.058	.000–.049

Note. Unstandardized effects are listed first; standardized effects are listed underneath the undstandardized effects. All direct effects are significant (effect/standard error of effect >1.96). Total effects that are the same as direct effects (e.g., from parent involvement to grades) are not listed. Abbreviations are as noted in Table 2.

E3. Kohl, Lengua, and McMahon (2000)

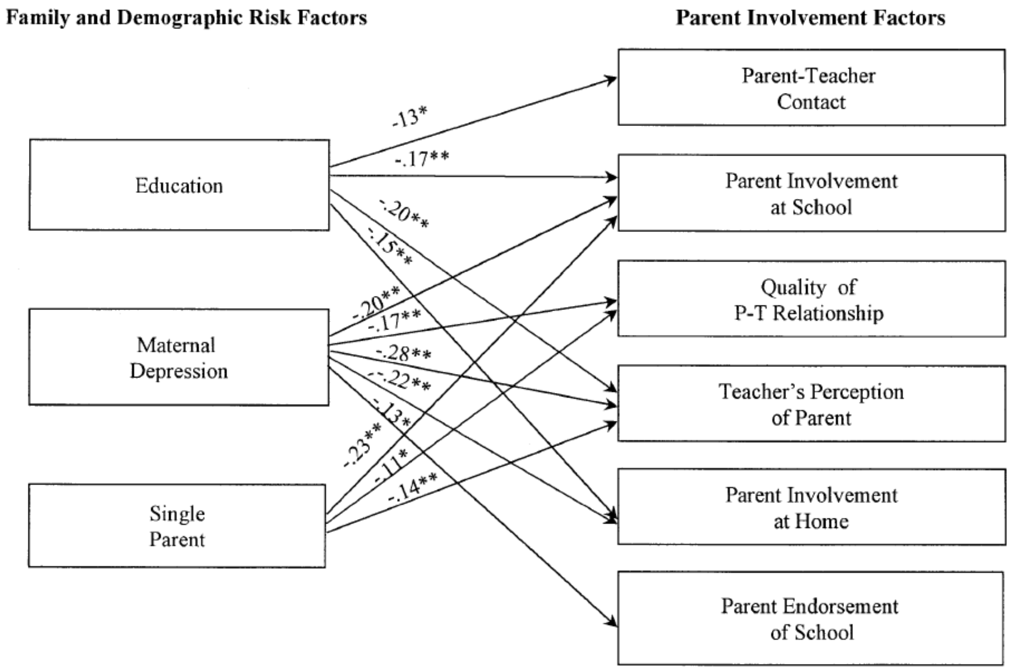


Figure 1. Model for whole sample illustrating differential pattern of prediction between family and demographic risk factors and parent involvement factors (n = 347). Standardized beta values and their significance levels are given; *$p < .05$, **$p < .01$.

E4. McBride, Sullian and Ho-Ho (2005)

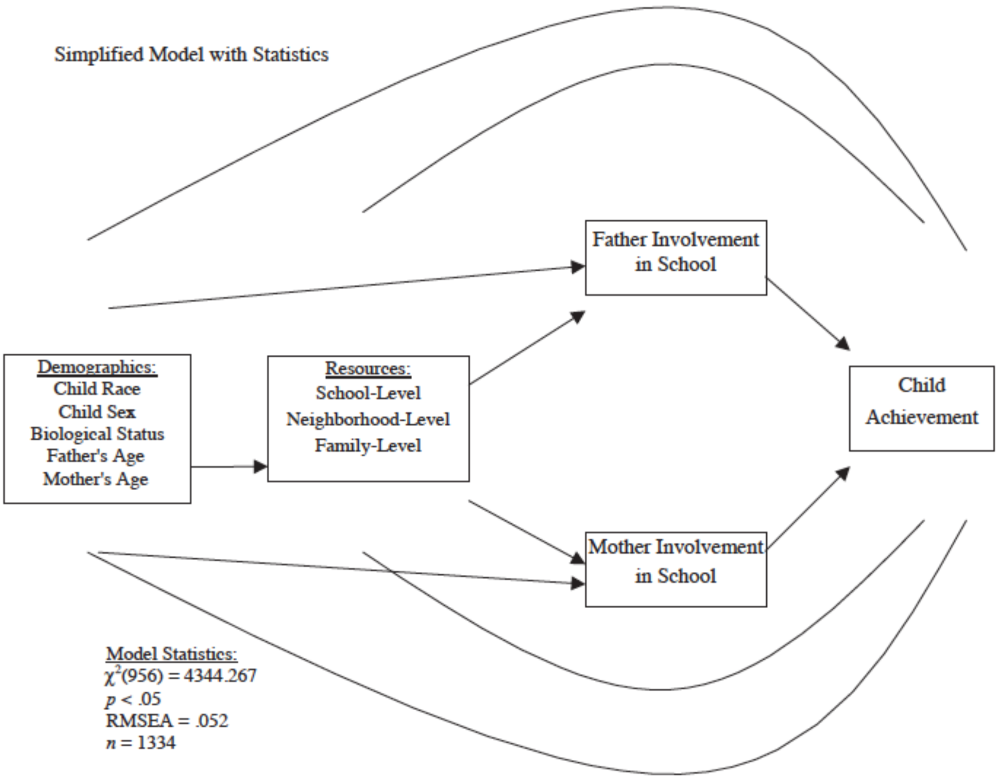


Fig. 1. Simplified model with statistics.

Table 2
Significant path coefficients in the model

Variable	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Child race[a]			−0.29	−0.37	−0.08	−0.30	+0.29	+0.36		+0.33				−0.12
2. Child sex[b]							−0.12	−0.14	−0.15					
3. Biological status[c]						−0.15		−0.14			−0.08			−0.11
4. Father's age										−0.23		−0.23		
5. Mother's age			+0.23	+0.21		+0.22						+0.17		
6. Teacher–student ratio								−0.41	−0.32	−0.42	−0.33	−0.28		+0.14
7. Computer use											−0.09			+0.08
8. Neighborhood quality								+0.11	+0.09	+0.14	+0.19			
9. Proportion home-owners									−0.13		−0.10	+0.10		
10. Resident from stranger								+0.09	+0.23	+0.12	+0.16			
11. Family income								+0.09	+0.16	+0.14	+0.19	+0.17	+0.09	+0.19
12. Barriers*								−0.48	−0.41	−0.50	−0.45	−0.29	−0.37	−0.16
13. Father communication*														
14. Mother communication*														
15. Father physical*														
16. Mother physical*														+0.18
17. Father talk*														+0.15
18. Mother talk*														+0.15
19. Child achievement*														

The value in the table indicates the path coefficient from the row variable to the column variable.
Values in the table are significant at $p < .05$. Asterisks (*) indicate variables constructed as latent factors.

[a] 0 = White; 1 = Black.
[b] 0 = Male; 1 = Female.
[c] 0 = Biological Father; 1 = Non-Biological Father.

Table 3
Intercorrelations among the variables in the model

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Child race[a]	1																		
2. Child sex[b]	−0.06	1																	
3. Biological status[c]	0.18	0.01	1																
4. Father's age	−0.04	0.03	−0.04	1															
5. Mother's age	−0.07	0.05	−0.02	0.81	1														
6. Teacher–student ratio	0.02	−0.06	−0.02	−0.06	−0.05	1													
7. Computer use	−0.03	−0.04	0.06	0.07	0.09	−0.06	1												
8. Neighborhood quality	−0.28	−0.01	−0.10	0.10	0.16	0.05	0.02	1											
9. Proportion home-owners	−0.35	−0.01	−0.13	0.17	0.23	−0.04	0.08	0.40	1										
10. Resident from stranger	−0.08	−0.03	−0.06	0.06	0.05	0.07	0.03	0.17	0.23	1									
11. Family income	−0.33	−0.01	−0.21	0.17	0.22	0.04	0.09	0.26	0.37	0.05	1								
12. Barriers	0.20	−0.12	0.06	−0.04	0.05	−0.04	−0.01	−0.15	−0.10	0.19	−0.11	1							
13. Father communication	0.24	−0.08	−0.11	−0.08	0.14	−0.08	0.05	0.11	−0.02	0.02	0.12	0.01	1						
14. Mother communication	−0.08	−0.09	−0.06	0.00	0.10	0.07	−0.01	0.06	−0.07	0.13	0.18	−0.12	0.49	1					
15. Father physical	0.20	−0.02	−0.05	−0.21	0.15	−0.11	0.01	0.14	−0.07	0.05	0.16	0.02	0.86	0.39	1				
16. Mother physical	−0.08	0.02	−0.10	−0.03	−0.02	0.01	−0.07	0.18	−0.04	0.05	0.20	−0.19	0.37	0.86	0.59	1			
17. Father talk	−0.05	−0.02	−0.02	−0.19	0.17	−0.20	0.08	0.08	0.11	−0.02	0.19	−0.14	0.34	0.18	0.37	0.20	1		
18. Mother talk	−0.16	−0.01	−0.01	0.02	−0.06	0.12	0.06	0.10	0.06	−0.02	0.11	−0.33	0.07	0.22	0.07	0.29	0.28	1	
19. Child achievement	−0.21	0.06	−0.16	−0.03	0.04	0.05	0.09	0.07	0.04	−0.09	0.29	−0.37	0.04	0.13	0.10	0.24	0.25	0.31	1

[a] 0 = White; 1 = Black.
[b] 0 = Male; 1 = Female.
[c] 0 = Biological Father; 1 = Non-Biological Father.

E5. Lasky (2000)

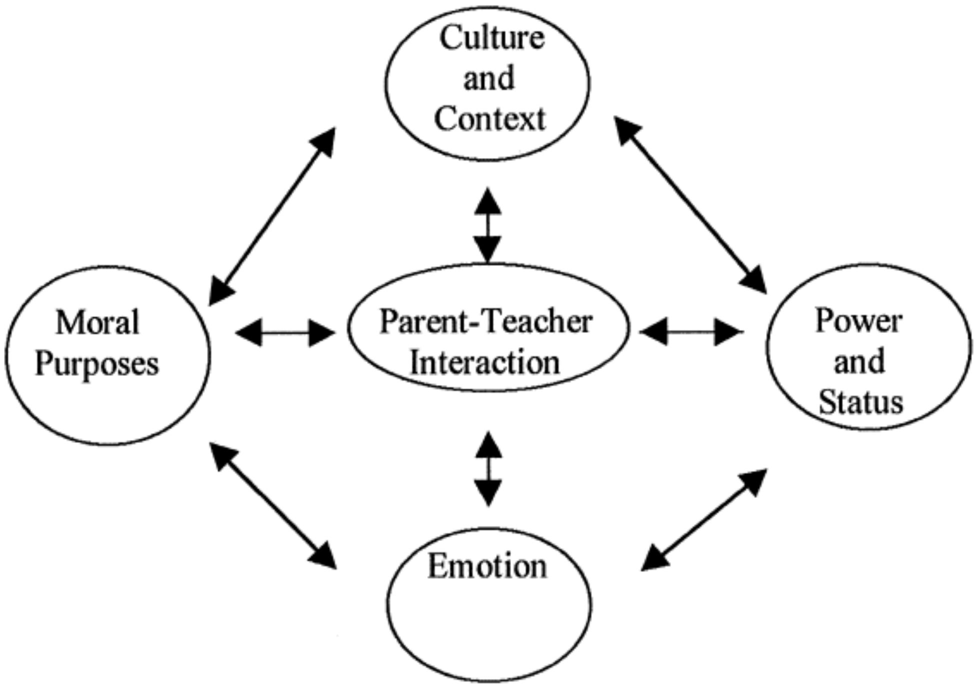


Fig. 1. A cross-correlational model for emotional influences on parent–teacher interactions.

E6. Seitsingeretal (2008)

Table 1
Exploratory and confirmatory factor analysis of teacher–parent-contact practices items

	Factor loading			Standardized path coefficient
	1	2	3	
Factor 1: Student performance and problems				
Student accomplishments	**.73**	.22	.14	.78
Student academic performance	**.73**	.26	.21	.77
Student behavior problems	**.70**	.20	.26	.75
Class activities	**.53**	**.49**	.21	.73
Make-up work for student returning from absences	**.46**	.32	.34	–
Factor 2: Information and activities to increase parent involvement				
Information on the programs and requirements in the grade levels that you teach	.24	**.72**	.25	.70
Suggestions to parents on how to help students with school work	**.47**	**.55**	.27	.79
Homework to do with students	**.46**	**.46**	.22	–
Information on talking to students about the importance of school	.29	**.44**	.37	.67
Using parents as school resources/volunteers	.19	**.43**	.37	.58
Factor 3: Information/referrals for health and social services needs				
Student referrals for health and social services	.25	.21	**.85**	.85
Information on the availability of health and social service programs	.20	.32	**.73**	.85

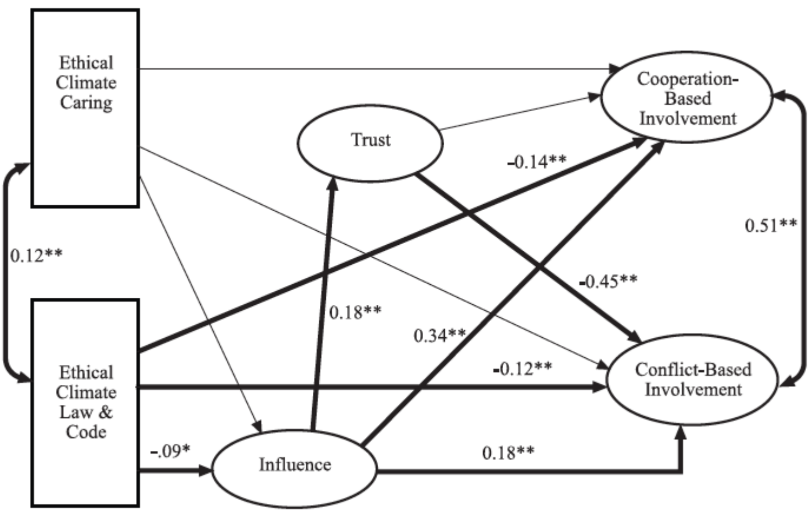
Note: $n = 808$.
SRMR = .05, CFI = .95.
Bold signifies factor loadings greater than .40.

Table 8
Partial correlation[a] matrices for teacher–parent-contact practices and student achievement by building type

Academic achievement	Teacher–Parent Contact Scale			
	Student performance and problems	Information and activities to increase parent involvement	Information/referrals for health and social services needs	Total
Elementary schools (n = 184)				
Academic performance[b]	.09	.02	.07	.08
Reading basic understanding	.03	.10	.07	.10
Reading analysis and interpretation	.02	.06	.05	.07
Writing conventions	−.05	.03	−.03	−.01
Writing effectiveness	−.06	.02	−.03	−.01
Mathematics skills	.04	.04	−.02	.05
Mathematics concepts	.02	−.03	−.06	.01
Mathematics problem solving	.02	−.05	−.03	−.01
Middle schools (n = 41)				
Academic performance	−.48***	−.38**	−.23	−.40**
Reading basic understanding	.15	−.10	.05	−.04
Reading analysis and interpretation	−.14	−.17	.07	−.09
Writing conventions	.20	.15	−.03	.17
Writing effectiveness	.26	.19	−.01	.25
Mathematics skills	.25	.34*	.02	.34*
Mathematics concepts	.09	.08	−.19	.09
Mathematics problem solving	.12	.20	−.12	.16
High schools (n = 43)				
Academic performance	−.1	−.1	−.01	−.04
Reading basic understanding	.35	−.31*	−.40**	−.42**
Reading analysis and interpretation	−.30	−.26	−.38*	−.38*
Writing conventions	−.13	−.32*	−.36*	−.29
Writing effectiveness	−.18	−.10	−.23	−.24
Mathematics skills	−.06	−.23	−.34*	−.24
Mathematics concepts	.09	−.13	−.24	−.12
Mathematics problem solving	.14	−.03	−.19	.06

Note: Responses on the Teacher–Parent Contact Scale range from 1 (*never*) to 7 (*daily*).
*$p<.05$. **$p<.01$. ***$p<.001$ All correlations are 2-tailed.
[a] Partial correlation, controlling for school-level poverty.
[b] Teacher rating of GPA; responses on a 5-point scale (1=*Mostly D's and below*, 5=*Mostly A's and B's*).

E7. Rosenblatt and Peled (2002)



Note: Thick arrows indicate significant relationships. *$p < 0.05$, **$p < 0.01$
χ^2 (132, N = 516) = 354.1; p < 0.000; GFI = 0.952; AGFI = 0.923; NFI = 0.947; RMSEA = 0.042

Figure 2. Associations among ethical climate, perceived influence, parental trust and parental involvement in schools (high socioeconomic status)

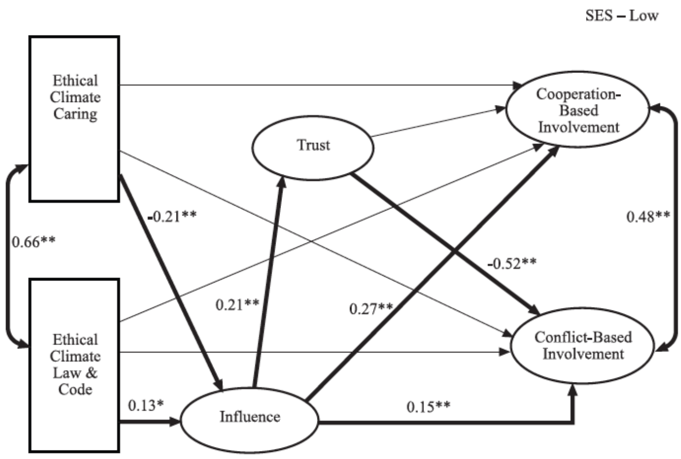


Figure 3. Associations among ethical climate, perceived influence, parental trust and parental involvement in schools (low socioeconomic status)

Note: Thick arrows indicate significant relationships. *$p < 0.05$, **$p < 0.01$
χ^2 (132, N = 420) = 354.1; $p < 0.000$; GFI = 0.952; AGFI = 0.923; NFI = 0.947; RMSEA = 0.042

E8. Hausman and Goldring (2000)

TABLE 3.
Regression of Parents' Reasons for Choice, Income Level, and Distance to School on Involvement at the School ($N = 836$)

	β	Sign. T
Predictor variable		
Income	.28	.00**
Distance from home to school	−.09	.02*
Reasons for choice		
Academic	.01	.73
Convenience	.05	.21
Discipline/safety	−.06	.14
Values	.29	.00**
R^2 = .185		
F = 22.67		
Sign. F = .00		

*$p < .01$.
**$p < .05$.

TABLE 4.
Regression of Parents' Reasons for Choice, Income Level, and Distance to School on Influence in School Decision Making ($N = 836$)

	β	Sign. T
Predictor variables		
Income	−.01	.81
Distance from home to school	−.02	.67
Reasons for choice		
Academic	.06	.19
Convenience	−.01	.85
Discipline/safety	−.03	.48
Values	.28	.00**
R^2 = .86		
F = 8.25		
Sign. F = .00		

*$p < .01$.
**$p < .05$.

E9. Bast and Walberg (2004)

Table 1
Summary of research on school choice

Nature of choice	Summary of findings	Sources
Public school choice	Parents and experts rate schools similarly	Hoxby (2001)
	Small public school districts that compete for students with neighboring districts achieve higher test score growth	Hoxby (2001); Hoxby (2002); Belfield and Levin (2001)
	Public schools that compete with private, charter, and voucher schools achieve higher test score growth	Teske and Schneider (2001); Belfield and Levin (2001)
Private schools	Parents choose schools based on academic achievement, not convenience	Coulson (1999)
	Catholic high schools achieve higher graduation, college enrollment, and college graduation rates than public schools	Alt and Peter (2003); Neal (1996); Grogger and Neal (2000); Witte (1996)
	Test score growth is greater in Catholic schools than in public schools	Coleman and Hoffer (1987); Chubb and Moe (1990); Patrinos and Ariasingam (1997); Peterson and Walberg (2002)
Charter schools	Parents and experts rate schools similarly; parents choose for academic reasons	Solmon (2003)
	Test score growth is greater (or no worse) in charter schools than in public schools	Finn, Manno and Vanourek (2001); Solmon, Paark and Garcia (2001); Mulholland (1999)
Voucher schools	Parents choose voucher schools based on academic achievement, not convenience	Moe (1995); Witte (2000)
	Test score growth is greater in voucher schools than in public schools, particularly for minority students	Gill, Timpane, Ross and Brewer (2001); Greene (2001); Green (2002); Howell, Wolf, Peterson and Campbell (2001); Peterson (2001); Rouse (2000)

E10. King, Huebner, Suldo and Valois (2007)

Table 2 Pearson correlation coefficients among demographic variables, school satisfaction, internalizing and externalizing behaviors, and social support variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. GE	–											
2. R	−0.06	–										
3. SES	0.05	−0.25*	–									
4. A	0.04	−0.17*	0.07	–								
5. GR	0.07	−0.15*	0.03	0.96*	–							
6. SS	0.12*	−0.15*	0.06	−0.14*	−0.13*	–						
7. IB	0.13*	0.07*	0.07	−0.02	−0.04	−0.25*	–					
8. EB	−0.06	0.07*	0.05	0.05	0.03	−0.35*	0.54*	–				
9. TSS	0.16*	−0.05	0.06	−0.22*	−0.21*	0.42*	−0.26*	−0.28*	–			
10. SP	−0.01	−0.05	0.03	−0.29*	−0.29*	0.31*	−0.34*	−0.34*	0.73*	–		
11. ST	0.06	−0.01	0.07	−0.32*	−0.32*	0.43*	−0.12*	−0.26*	0.73*	0.44*	–	
12. SC	0.15*	−0.05	0.02	−0.03	−0.02	0.28*	−0.19*	−0.12*	0.75*	0.34*	0.34*	–
13. SF	0.29*	0.01	0.04	0.01	0.03	0.22*	−0.09*	−0.10*	0.72*	0.32*	0.34*	0.51*

Note. 1. *GE*=Gender (Male=1, Female=2), 2. *R*=Race (Dichotomized into African American and "Other" Races=1, and Caucasian=2), 3. *SES*=Socioeconomic Status (Paid Lunch=1, Free or Reduced Lunch=2), 4. *A*=Age, 5. *GR*=Grade, 6. *SS*=School Satisfaction, 7. *IB*=Internalizing Behavior, 8. *EB*=Externalizing Behavior, 9. *TSS*=Total Social Support, 10. *SP*=Support From Parents, 11. *ST*=Support From Teachers, 12. *SC*=Support from Classmates, 13. SF=Support From a Close Friend

* $p<0.01$

E11. Barnard (2004)

Table 2
Correlations among key outcome and explanatory variables

Variable	1	2	3	4	5	6
1. Parent involvement at home	–					
2. Parent involvement at school	0.28***	–				
3. Teacher ratings of school involvement (1–6 grade)	0.04	0.24***	–			
4. Any preschool participation	0.04	0.05	0.14***	–		
5. Any follow-on participation	0.04	0.10**	0.17***	0.41***	–	
6. Extensive participation	0.05	0.12***	0.25***	0.60***	0.68***	–
7. Dropout	−0.03	−0.03	−0.23***	−0.06	−0.01	−0.07*
8. High school completion	0.03	0.02	0.27***	0.08**	0.03	0.08**
9. Highest grade attained	0.03	0.05	0.27***	0.09**	0.04	0.09**

APPENDIX F – Literature Review Statistical Results for School Sector

Figure/table numbers in this appendix are taken from the original work.

F1. Bedi and Edwards (2002)

Table 1
Variable definitions and descriptive statistics

Variable	Label	Mean	S.D.
Individual level variables			
TOTALINC	Monthly income in Lempiras	411.76	471.93
SCHOOL	Years of schooling	7.165	4.352
EXPER	Experience	11.44	6.436
MARRIED	Married = 1	0.288	0.453
MIGRANT	Migrant = 1	0.512	0.500
EAST	Resides in the East = 1	0.078	0.268
WEST	Resides in the West = 1	0.089	0.284
NORTH	Resides in the North = 1	0.370	0.482
SOUTH	Resides in the South = 1	0.104	0.305
CENTRAL	Resides in the Central area = 1	0.359	0.480
Municipal level variables			
PRO	Percentage of teachers with professional degrees	0.691	0.169
T_SCHOOL	Years of schooling—teacher	13.89	0.379
T_EXPER	Years of experience—teacher	13.30	2.168
ELECTRICITY	Percentage of schools with electricity	0.315	0.250
WATER	Percentage of schools with water	0.509	0.198
MGRADE	Percentage of multigrade schools	0.405	0.191
STTEACH	Student / teacher ratio	41.09	7.756
CLASSST	Class / student ratio	0.030	0.010
TABLEST	Table / student ratio	0.068	0.041
SCHFATH	Years of schooling—father	2.730	1.806
SCHMOTH	Years of schooling—mother	2.908	0.618
Observations		3691	

Table 2
Impact of school quality on earnings (S.E.)

	(1)	(2)	(3)	(4)	(5)	(6)
CONSTANT	3.962 (0.052)	3.993 (0.088)	3.746 (0.144)	3.746 (0.150)	3.792 (0.214)	3.456 (0.301)
Years of Schooling (SCHOOL)	0.138 (0.003)	0.122 (0.004)	0.147 (0.013)	0.147 (0.017)	0.117 (0.005)	0.168 (0.032)
Percentage of teachers with professional degrees	–	–	–	–	−0.114 (0.115)	−0.017 (0.220)
Percentage of schools with electricity	–	–	–	–	0.223 (0.110)	0.109 (0.135)
Student / teacher ratio *10	–	–	–	–	−0.042 (0.023)	0.003 (0.004)
Class / student ratio	–	–	–	–	1.086 (0.301)	1.485 (0.525)
SCHOOL*Percentage of teachers with professional degrees	–	–	−0.013 (0.013)	−0.013 (0.015)	–	−0.011 (0.028)
SCHOOL*Percentage of schools with electricity	–	–	0.017 (0.009)	0.017 (0.010)	–	0.012 (0.013)
SCHOOL*Student / teacher ratio *10	–	–	−0.008 (0.002)	−0.008 (0.003)	–	−0.010 (0.005)
SCHOOL*Table / student ratio	–	–	0.091 (0.039)	0.091 (0.039)	–	−0.058 (0.072)
R^2	0.362	0.387	0.394	0.394	0.394	0.396
Returns to education at $\overline{Q}$	–	–	0.117 (0.004)	0.117 (0.004)	0.117 (0.005)	0.117 (0.004)
Returns to education at $\overline{Q}+\sigma_Q$	–	–	0.129 (0.004)	0.129 (0.004)	0.117 (0.005)	0.124 (0.005)
Returns to school quality at $\overline{S}$ and $\overline{Q}$						
$(\partial Y/Y)\partial$ Percentage of teachers with professional degrees	–	–	−0.097 (0.096)	−0.097 (0.106)	−0.114 (0.115)	−0.099 (0.114)
$(\partial Y/Y)\partial$ Percentage of schools with electricity	–	–	0.124 (0.068)	0.124 (0.070)	0.223 (0.110)	0.194 (0.107)
$(\partial Y/Y)\partial$ Student / teacher ratio *10			−0.055 (0.020)	−0.055 (0.020)	−0.042 (0.023)	−0.044 (0.020)
$(\partial Y/Y)\partial$ Table / student ratio			0.651 (0.281)	0.651 (0.279)	1.086 (0.301)	1.073 (0.301)

Sample size—3691. Estimates in columns 2–6 include controls for experience, marriage, migratory status, region of residence and a selection correction term for migrant endogeneity. In addition, estimates in columns 3–6 include five variables that control for inter-municipal variation in wealth. Standard errors in columns 4–6 are corrected for heteroscedasticity and for intra-municipal error correlation. Returns to education and school quality are computed at the means of the schooling ($\overline{S}$) and school quality ($\overline{Q}$) variables.

F2. Marlow (2000)

Table 4
SUR estimations of education spending and fourth-grade performance (education spending: per pupil)

	Education spending	Reading	Math	Writing	Teacher–student ratio
Constant	3224.96[a]	−62.52[a]	−61.31[a]	−73.42[a]	−0.02
	4.85	3.86	2.86	3.72	0.70
Education spending		0.002[c]	−0.001	0.002	1.24×10^{-5}[a]
		1.60	0.84	1.41	6.88
Per capita income	0.03	−0.0001	0.0004[c]	−0.0003	-1.9×10^{-7}
	1.56	0.74	1.85	1.18	0.61
Population density	0.03	0.001	0.001	0.002	-3.8×10^{-6}[a]
	0.027	1.07	1.45	1.20	3.05
Student share of population	−11.30				
	0.01	0.01	0.01	0.01	0.01
State share of funding	103.66	−5.59	5.09	−4.58	-7.4×10^{-5}
	0.18	1.20	0.94	0.81	0.01
Federal share of funding	4783.16	−20.99	−30.73	−44.09	−0.07
	1.40	0.61	0.74	1.06	1.59
% Black		−0.12	−0.47[a]	−0.10	
	1.59	1.15	3.81	0.73	0.73
% Hispanic		−0.01	−0.13[a]	−0.03	
	0.73	0.36	3.78	0.85	0.85
% Asian		0.01	−0.20	−0.04	
	0.85	0.09	1.39	0.26	0.26
Median education		6.49[a]	6.97[a]	8.24[a]	0.002
		4.79	4.25	5.01	0.77
Herfindahl	545.92[a]	−4.13[b]	−1.45	−3.38[c]	0.01[c]
	2.65	2.46	0.71	1.66	1.81
R^2 adjusted	0.07	0.72	0.80	0.71	0.56
S.e.e.	375.73	2.94	3.45	3.57	0.01
N	54	54	53	54	54

[a] Significance at 0.01 level (two-tailed test).
[b] Significance at 0.05 level (two-tailed test).
[c] Significance at 0.10 level (two-tailed test).

F3. Tanner (2000)

School architecture and achievement

325

Analysis of patterns			
Multiple *R*	0.97250		
R square	0.94575		
Standard error	13.77360		
Analysis of variance	DF	SS	MS
Regression	6	3307.16289	551.19382
Residual	1	189.71211	181.71211

Notes: F = 2.90542; Significant F = 0.4212

Variables in equation	Beta weights	*T*	Significant *T*
Compatible with context	–0.12	–0.22	0.86
Outdoor rooms	0.20	0.26	0.83
Pathways	0.57	2.03	0.29
Positive outdoor spaces	0.62	0.87	0.54
Computers for students	0.82	1.93	0.30
Overall impression	–0.35	–0.57	0.67

Table III.
Analysis of patterns

F4. Silins and Mulford (2002)

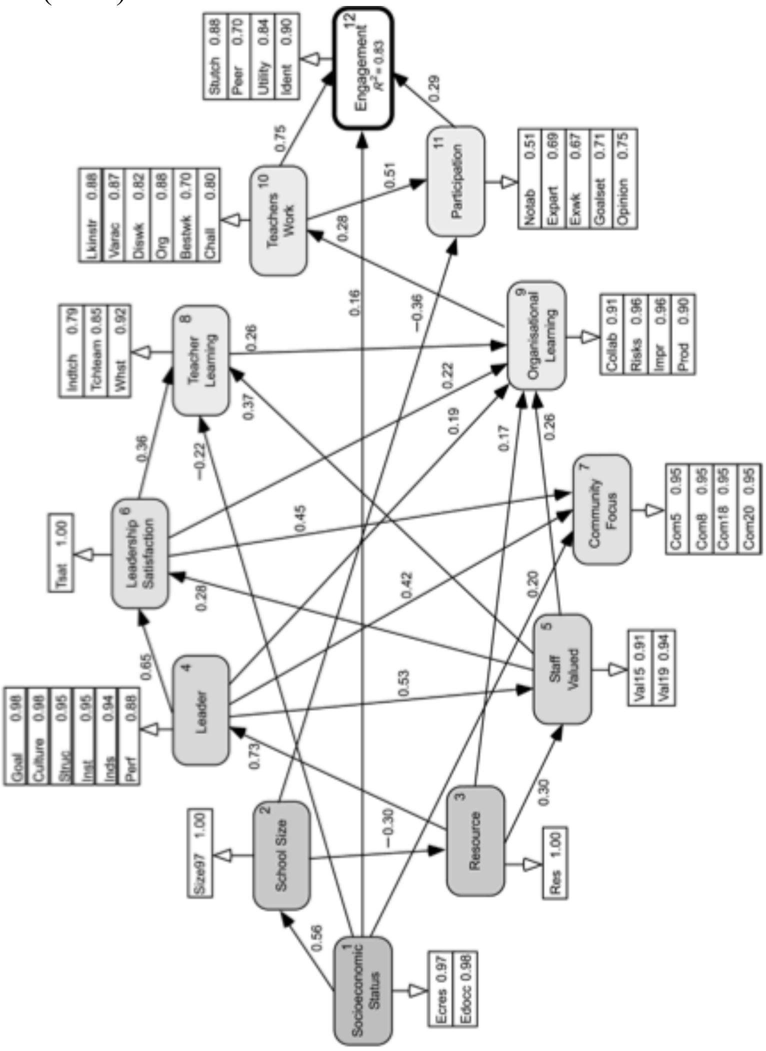


Figure 1.
Factors influencing system, teacher and student learning

F5. Uline and Moran (2008)

		2.	3.	4.	5.
1. Quality of school facilities	(0.93)	0.73**	0.52**	−0.23	0.25*
2. Resource support		(0.82)	0.62**	−0.23	0.31*
3. School climate index			(0.96)	−0.47**	0.61**
4. Free and reduced-priced meals					−0.85**
5. Student achievement					(0.96)

Notes: * $p < 0.05$; ** $p < 0.01$; Cronbach's alphas are reported on the diagonals

Table II.
Correlations between school facilities, climate, and student achievement

	Student achievement Beta	t	Sig.
Quality of facilities	−0.16	−01.34	0.19
School climate index	0.70	6.02	0.000**
			$R^2 = 0.39$
			Adjusted $R^2 = 0.37$
			SE = 0.794

Notes: $N = 80$; * $p < 0.05$; ** $p < 0.01$

Table III.
Multiple regression analysis of quality of facilities and school climate on student achievement

F6. Huang (2010)

Table 4
Coefficient estimates and variance components of the SES and school-level models (1790 students and 60 schools).

Model	SES (3)				School (4)			
Subject	English		Math		English		Math	
Coefficient estimates								
Intercept	25.86***		30.11***		23.70***		27.86***	
Student-level								
IQ	0.26***		0.30***		0.26***		0.30***	
Gender	3.61***		2.57***		3.60***		2.56***	
Attended kindergarten	0.11		0.33		0.15		0.41	
Age	2.35***		1.92**		2.28***		1.86**	
Months in school	0.18***		0.25***		0.18***		0.26***	
Grade repeater	−5.23***		−7.74***		−5.24***		−7.78***	
Father's education	0.19***		0.18**		0.20***		0.18**	
Mother's education	0.21***		0.18**		0.22***		0.18**	
Household index	0.35**		0.20		0.33**		0.23	
Expenditure/HH member (log)	0.93**		0.75*		0.92**		0.79*	
School level								
Electricity					2.91**		3.70**	
Avg teacher experience					−0.19**		−0.23**	
Avg student–teacher ratio					−0.01		0.02	
Enough textbooks					−0.25		−0.50	
Urbanicity					−0.09		−1.46	
Variance components								
Variance (percentage of total)								
School ($\tau_{00}/\tau_{00}+\sigma^2$)	2.0	4.0%	4.6	8.8%	1.4	2.7%	3.0	5.2%
Student ($\sigma^2/\tau_{00}+\sigma^2$)	49.4	96.0%	54.3	91.2%	49.4	97.3%	54.2	94.8%
Total	51.4		58.9		50.8		57.2	

* $p \le .05$.
** $p \le .01$.
*** $p \le .001$.

F7. Hoy (2012)

JEA
50,1

86

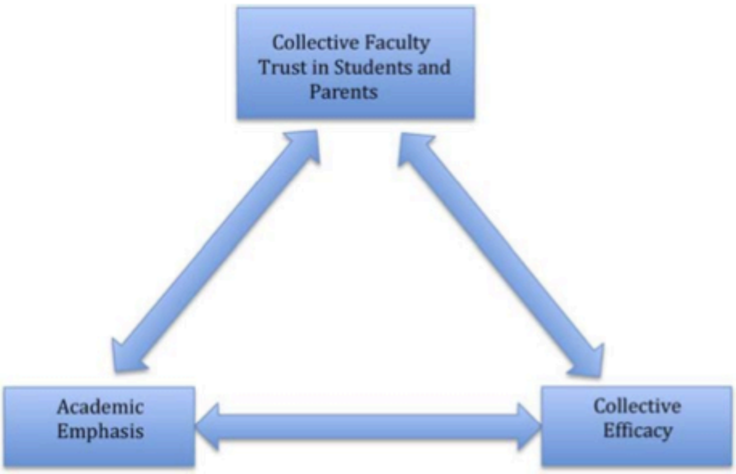
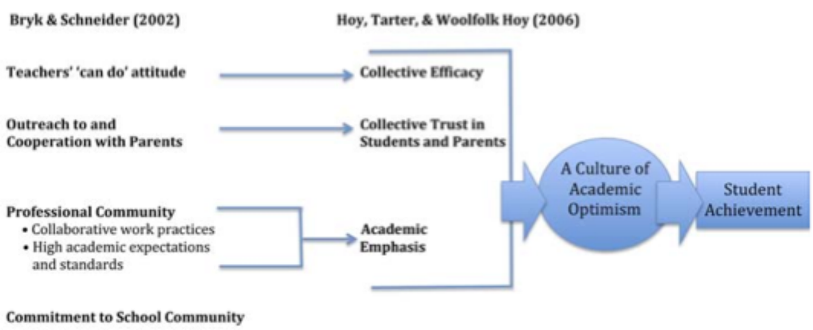


Figure 1.
Triadic reciprocal relations of elements of academic optimism

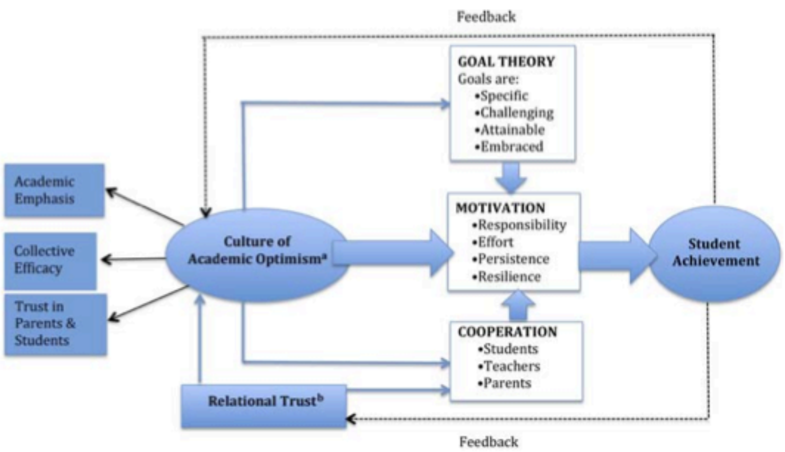
JEA
50,1

88



Source: © Hoy (2011)

Figure 2.
School conditions that promote student achievement



Notes: [a]Hoy *et al.* (2006); [b]Bryk and Schneider (2002)
Source: © Hoy (2010)

Figure 3.
A model of the dynamics of student achievement

F8. Jepsen (2005)

Table 4
Effects of teacher and student characteristics
Dependent variable is predicted classroom effect third grade cohort

	Mathematics			Reading		
	(1)	(2)	(3)	(4)	(5)	(6)
Class size	−0.004	−0.003	0.005	−0.009	−0.010	0.004
	(0.62)	(0.49)	(0.79)	(1.53)	(1.70)	(0.69)
Experience (years)	0.015	0.018	0.021	0.012	0.014	0.020
	(1.41)	(1.59)	(1.98)	(1.13)	(1.27)	(1.92)
Experience squared	−0.0003	−0.0004	−0.0004	−0.0005	−0.001	−0.001
	(0.98)	(1.08)	(1.31)	(1.51)	(1.66)	(2.14)
BA or less	0.001	0.008	0.007	−0.001	−0.026	−0.003
	(0.02)	(0.11)	(0.10)	(0.01)	(0.36)	(0.04)
More than BA (no MA)	−0.044	−0.061	−0.047	0.023	0.001	0.009
	(0.66)	(0.92)	(0.73)	(0.36)	(0.02)	(0.15)
Not fully certified	−0.161	−0.151	−0.144	−0.172	−0.136	−0.112
	(1.58)	(1.49)	(1.46)	(1.58)	(1.25)	(1.07)
Aide in class		0.063	0.032		−0.003	−0.060
		(0.76)	(0.40)		(0.04)	(0.75)
Use of computers		−0.034	−0.035		−0.066	−0.072
		(1.28)	(1.37)		(2.59)	(2.95)
Hours homework per week		0.018	0.040		0.012	0.025
		(0.88)	(2.03)		(0.60)	(1.31)
Teacher enthusiasm		−0.047	−0.038		0.026	0.027
		(1.97)	(1.64)		(1.17)	(1.23)
Adequacy of materials		0.147	0.152		0.098	0.107
		(2.09)	(2.25)		(1.44)	(1.64)
Different Math/Eng. teacher		−0.001	−0.016		0.146	0.100
		(0.01)	(0.18)		(1.68)	(1.20)
Lagged test scores			−0.007			−0.009
			(8.44)			(9.88)
Observations	1246	1246	1246	1397	1397	1397

Notes: Absolute value of *t*-statistic in parentheses. All specifications also contain school and year fixed effects.

F9. Demir (2009)

Table 2
Standardized regression coefficients for relations between family background characteristics, student characteristics, school quality indicators and academic achievement

Predictors	Academic achievement					
	Model I		Model II		Model III	
	β	t	β	t	β	t
Family background characteristics						
Father education	.143	3.573^{***}	.106	2.788^{**}	.089	2.372^{*}
Mother education	.000	−.002	.039	1.053	.048	1.314
Household size	.009	.238	.010	.288	.006	.188
Home ownership	.103	2.787^{**}	.105	3.004^{**}	.087	2.499^{*}
Household possessions	.098	2.473^{*}	.051	1.364	.035	.893
Student characteristics						
Grade 7			−.049	−1.211	−.029	−.734
Grade 8			−.013	−.312	−.001	−.024
Work status			−.024	−.640	−.029	−.789
Gender			−.179	-4.623^{***}	−.173	-4.563^{***}
Student's perception of treatment by teachers			.138	3.766^{***}	.133	3.716^{***}
Number of friends at school			.101	2.919^{**}	.097	2.859^{**}
Participation in extra-curricular activities			.014	.413	.037	1.072
Time spent on studies			.093	2.504^{*}	.075	2.059^{*}
Time spent on leisure activities			−.031	−.862	−.028	−.800
Level of homework completion			.059	1.596	.060	1.653
Getting help with studies outside school			−.084	-2.409^{*}	−.081	-2.356^{*}
Parents level of follow-up			.024	.702	.025	.724
Attendance level			−.076	-2.115^{*}	−.073	-2.067^{*}
School quality indicators						
Teacher degree level					−.132	-3.615^{***}
Teacher in-service training					−.118	-2.835^{**}
Teacher–student ratio					.144	3.704^{***}
Classize					−.035	−.989
School's facilities					−.054	−1.439
Multiple R	$.23^{***}$		$.45^{***}$		$.50^{***}$	
Adjusted $100R^2$	.048		.18		.22	
Effect size (R^2)	.054		.21		.25	
R^2 change	.054		.15		.043	

$N = 719$.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

F10. Huang (2009)

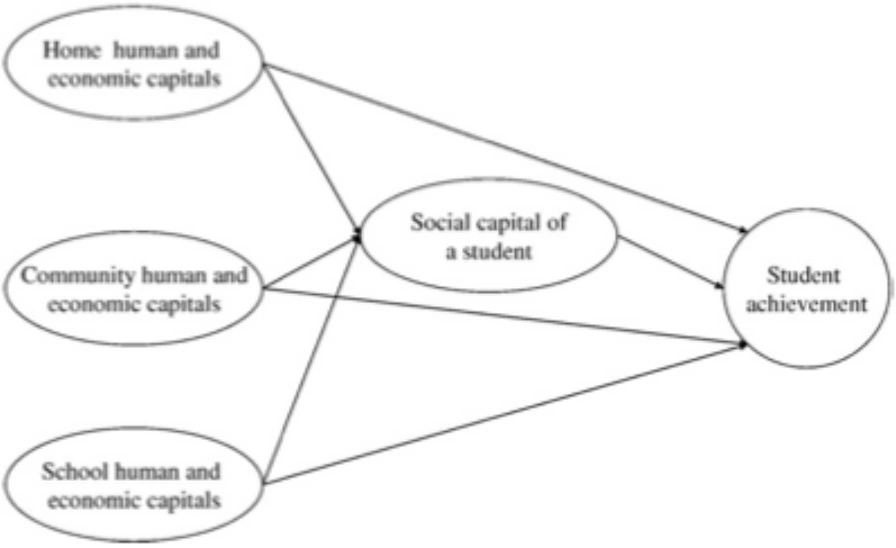


Fig. 1. Path diagram for a hypothesised model linking students' home, community and school backgrounds with social capital and student achievement.

Table 3
Standardised maximum likelihood regression weights of effects of home human and economic capital and student social capital variables on student achievement.

	Intermediating variables								Dependent variable	
	Good child–parent interaction		Good peer–teacher		Friends' help		Teachers' help		Achievement	
	A	B	A	B	A	B	A	B	A	B
Independent variables										
Home human capital	0.10	0.13	0.28	0.24	0.04	0.03	–	–	0.26	0.26
Home economic capital	0.23	0.24	−0.04	–	−0.09	0.04	–	–	−0.05	–
Student age		−0.29		0.40		0.22		0.18		−0.08
School size		0.02		–		−0.04		−0.06		−0.02
Community		−0.03		0.02		–		–		−0.05
Gender		0.26		–		0.66		0.12		0.34
R^2	0.07	0.22	0.08	0.22	0.01	0.47	0.00	0.04	0.30	0.34
Intermediating variables										
Good child–parent interaction									0.39	0.28
Good peer–teacher									0.12	0.21
Friends' help									0.11	−0.12
Teachers' help									−0.06	–

Note: –Indicates an effect not significant at 0.05 level. The correlation between independent variables is 0.29 as they are allowed to correlate in the model specification. Fit statistics for the models: A: χ^2/df: 29.73; RMR: 0.04; GFI: 0.96; AGFI: 0.94. B: χ^2/df: 37.08; RMR: 0.04; GFI: 0.94; AGFI: 0.92.

F11. Bedi (1997)

Table 1. Variable labels and descriptive statistics

Variable	Description	Mean	Std. dev.
TOTALINC	Total monthly income (Lempiras)	277.32	273.65
SCHOOL	Years of schooling	6.70	3.75
EXPERIENCE	Years of experience	8.30	5.40
SCHFATH	Years of schooling, father	2.63	3.81
SCHMOTH	Years of schooling, mother	2.94	3.49
MUNICIPAL LEVEL VARIABLES			
PRO	Teachers with professional teaching degree (% in municipality)	0.718	0.158
STTEACH	Student–teacher ratio	40.160	7.700
TABLEST	Desk–student ratio	0.070	0.037
ELECTRIC	Schools with electricity (% in municipality)	0.368	0.247
DIRTFLR	Dwelling has dirt floor (% in municipality)	0.256	0.173
BRIWALL	Dwelling has brick wall (% in municipality)	0.414	0.205
OWNER	Dwelling is owned (% in municipality)	0.042	0.079

N=1568

Table 4. Structural equation estimates: the effects of school quality and family background on earnings (standard errors)

Structural equation	LOGINC
SCHOOL	0.567 (0.044)
EXPERIENCE	0.614 (0.335)
EXPERIENCE^2	–0.262 (0.316)
SCHOOL QUALITY (Q*)	0.086 (0.019)
FAMILY BACKGROUND (F*)	0.081 (0.018)
Indicator relations:	Q*
PRO	1.0
STTEACH	–0.522 (0.104)
TABLEST	0.619 (0.109)
ELECTRIC	1.158 (0.101)
	B*
SCHFATH	1.0
SCHMOTH	1.124 (0.108)
Goodness-of-fit	
N	1568
Chi-Square (19)	48.51
Root Mean Square Residual	0.019
Goodness-of-fit index	0.994
Adjusted GFI	0.982

Table A1. Dependent variable-LOGINC OLS estimates: the effect of school quality and family background on earnings (standard errors)

CONSTANT	3.935 (0.067)	3.889 (0.158)	3.899 (0.157)	3.937 (0.170)
SCHOOL	0.125 (0.005)	0.121 (0.005)	0.113 (0.005)	0.113 (0.005)
EXPERIENCE	0.087 (0.010)	0.090 (0.010)	0.091 (0.010)	0.090 (0.010)
EXPERIENCE^2*10	−0.017 (0.004)	−0.017 (0.004)	−0.018 (0.004)	−0.018 (0.004)
PRO	.	−0.068 (0.142)	−0.099 (0.141)	−0.071 (0.143)
STTEACH	.	−0.003 (0.002)	−0.003 (0.002)	−0.004 (0.002)
TABLEST	.	2.125 (0.460)	2.162 (0.457)	1.942 (0.468)
ELECTRIC	.	0.214 (0.089)	0.185 (0.089)	0.106 (0.101)
SCHFATH	.	.	0.013 (0.004)	0.012 (0.004)
SCHMOTH	.	.	0.016 (0.005)	0.016 (0.005)
DIRTFLR	.	.	.	−0.049 (0.105)
BRIWALL	.	.	.	0.114 (0.105)
OWNER	.	.	.	0.375 (0.212)
F	216.80	100.79	82.41	62.32
R^2	0.294	0.311	0.322	0.325

F12. Kythreotis, Pashiardis and Kyriakides (2010)

The influence of school leadership styles

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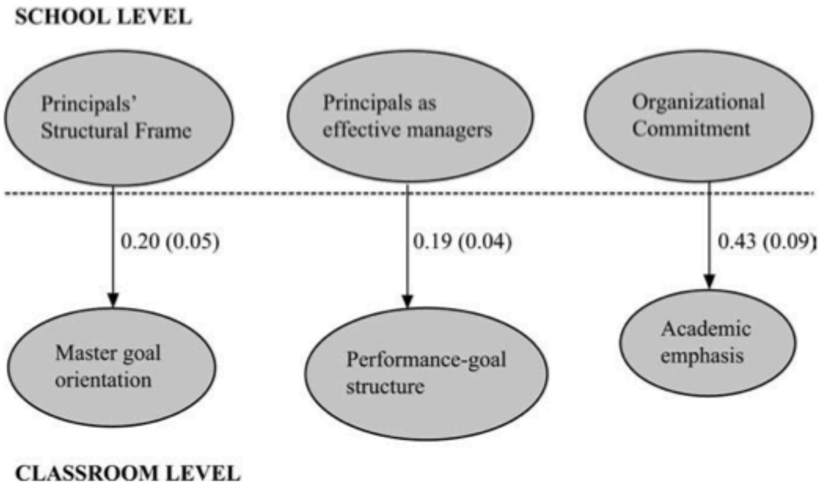


Figure 3.
Parameter estimates and standard errors for the structural multilevel model

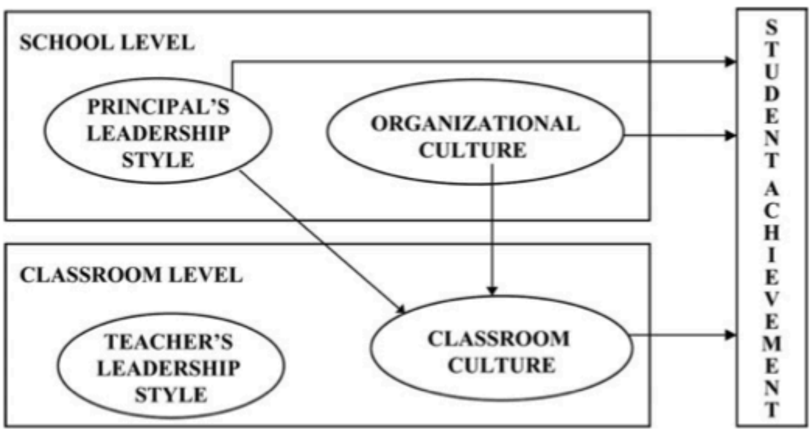


Figure 4.
The final model of the relationships among leadership, culture and student achievement

APPENDIX G – Literature Review Statistical Results for Academic Achievement

Figure/table numbers in this appendix are taken from the original work.

G1. Bruyn, Dekovic and Meijnen (2003)

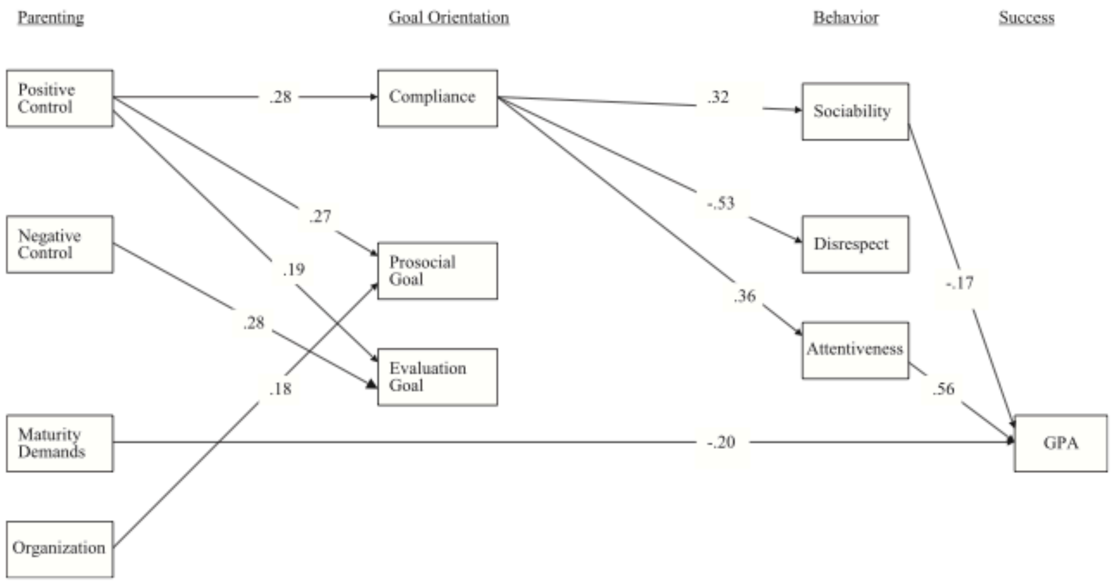


Fig. 3. Multiple regression model for girls.

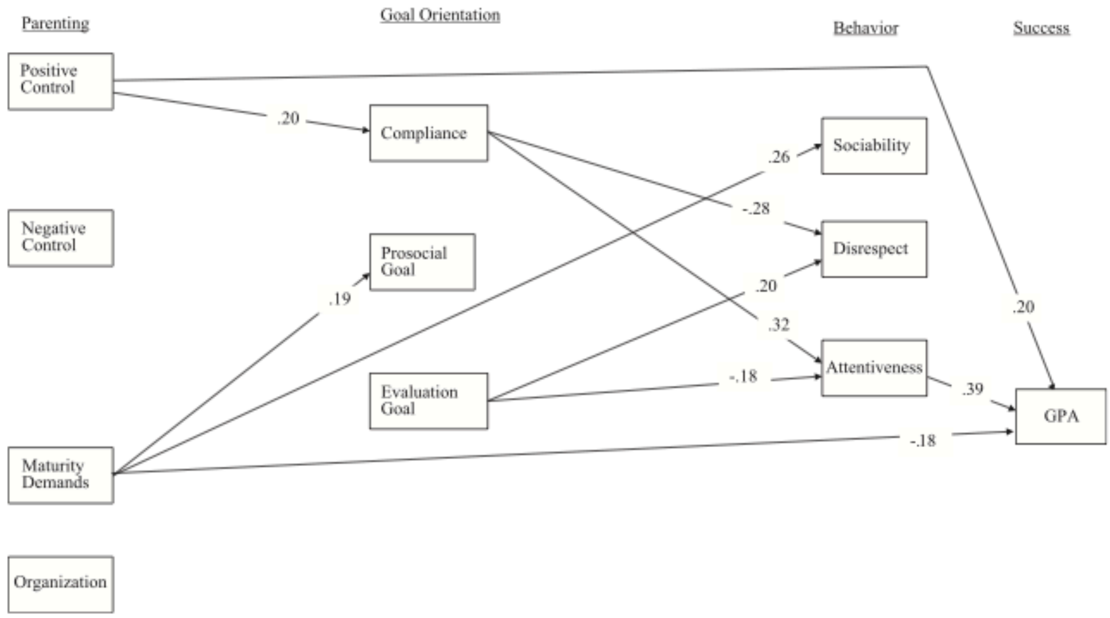


Fig. 2. Multiple regression model for boys.

G2. Ryabov and Hook (2007)

Table 6

HLM Regression coefficients of school composition, immigrant generational status and its interactions with average SES and percentage of minority students in school

		GPA Models		AHPVT Models	
		1	2	1	2
Part A. Interaction effects of generational status and average SES					
School-level factors					
Average SES		3.37	2.91	113.45**	111.73***
Percentage of minority students		0.11	0.09	−5.95	−6.65
Immigrant generation status					
Generation 1.0		0.16*	0.14*	−8.85***	−8.64*
Children of immigrants (Gen 1.5, 2.0, and 2.5)		−0.03	−0.03	0.88	1.00
Interactions of immigrant generation status and school factors					
Generation 1.0	Average SES	2.63	4.89*	−50.94	−89.88
Children of immigrants	Average SES	−5.06*	−3.57*	−51.37	−51.16
Part B. Interaction effects of generational status and percentage of minority students					
School-level factors					
Average SES		−0.49	2.52	98.81**	92.49**
Percentage of minority students		0.00	0.14	−7.30*	−7.94*
Immigrant generation status					
Generation 1.0		0.28***	0.22**	−9.12***	−8.74***
Children of immigrants (Gen 1.5, 2.0, and 2.5)		−0.02	−0.04	0.59	0.72
Interactions of immigrant generation status and school factors					
Generation 1.0	Percentage of minority students	−0.60**	−0.94**	6.59	6.22
Children of immigrants	Percentage of minority students	0.21	0.21	5.06	4.56

Note: Dependent variables are GPA and AHPVT. Regression coefficients of the control variables are not shown for the sake of the space. Model 1 controls for individual-level factors, except for family social capital (parents' educational expectations, parents' supervision, parents' limit setting), and Model 2 controls for all individual-level factors.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

G3. Martin (2008)

Table 3

Pre- and post-treatment and control group means and SDs and weighted external comparison data

	Treatment		Control		Comparison[a]
	Pre	Post	Pre	Post	
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Adaptive					
Self-efficacy	82 (11)	84 (11)	87 (11)	88 (09)	81 (14)
Valuing	81 (10)	84 (09)	88 (08)	85 (09)	79 (14)
Mastery orientation	84 (14)	87 (13)	86 (13)	87 (09)	82 (13)
Planning	59 (16)	69 (13)	67 (16)	72 (14)	59 (18)
Task management	70 (16)	76 (11)	77 (13)	78 (11)	67 (18)
Persistence	69 (12)	74 (11)	77 (13)	74 (11)	69 (15)
Impeding/maladaptive					
Anxiety	62 (17)	54 (19)	62 (18)	62 (15)	59 (18)
Failure avoidance	46 (19)	40 (20)	43 (14)	42 (13)	47 (19)
Uncertain control	54 (20)	45 (14)	44 (17)	43 (17)	50 (18)
Maladaptive					
Self-handicapping	36 (14)	33 (10)	31 (16)	32 (14)	42 (19)
Disengagement	36 (18)	33 (17)	28 (15)	27 (11)	37 (18)

[a] Weighted external comparison is weighted sample of $n = 3381$ Australian high school boys.

G4. Steinmayr and Spinath (2009)

Table 6
Hierarchical regression of school performance in math on prior math achievement, measured numeric intelligence and different motivational constructs

		Beta	*t*	*p*	*R*	R^2	ΔR^2	$\Delta F(df)$	Δp
Model 1	Prior math achievement	.72	18.64	.00	.72	.52	.52	347.51 (1, 327)	.00
Model 2	Prior math achievement	.70	16.55	.00					
	Numeric intelligence	*.06*	*1.48*	*.14*					
Model 3a	Prior math achievement	.53	10.56	.00					
	Numeric intelligence	*.03*	*.61*	*.54*					
	Ability self-perception math	.28	5.48	.00	.75	.56	.04	27.94 (1, 325)	.00
Model 3b	Prior math achievement	.57	12.17	.00					
	Numeric intelligence	*.02*	*.42*	*.68*					
	Values math	.26	5.56	.00	.75	.57	.05	30.91 (1, 325)	.00
Model 3c	Prior math Achievement	.70	16.18	.00					
	Numeric intelligence	*.06*	*1.50*	*.13*					
	Hope for Success	*−.01*	*−.32*	*.75*					
Model 3d	Prior math achievement	.69	16.23	.00					
	Numeric intelligence	*.05*	*1.26*	*.21*					
	Fear of failure	*−.06*	*−1.37*	*.17*					
Model 3e	Prior math achievement	.68	15.72	.00					
	Numeric intelligence	*.06*	*1.50*	*.14*					
	Need for achievement (PRF)	.09	2.14	.03	.73	.53	.01	4.60 (1, 325)	.03
Model 3f	Prior math achievement	.68	16.25	.00					
	Numeric intelligence	*.07*	*1.70*	*.10*					
	Learning goals	.09	2.43	.02	.73	.53	.01	5.90 (1, 325)	.02
Model 3g	Prior math achievement	.70	16.48	.00					
	Numeric intelligence	*.06*	*1.45*	*.15*					
	Performance-approach goals	*.01*	*.19*	*.85*					
Model 3h	Prior math achievement	.70	16.50	.00					
	Numeric intelligence	*.06*	*1.52*	*.15*					
	Performance-avoidance Goals	*−.04*	*−.92*	*.36*					
Model 3i	Prior math achievement	.70	16.45	.00					
	Numeric intelligence	*.06*	*1.51*	*.13*					
	Work-avoidance goals	*−.02*	*−.38*	*.70*					

Notes: *N* = 328. Variables printed in italics were not included in the prediction.

APPENDIX H – Literature Review Statistical Results for Parent Satisfaction

Figure/table numbers in this appendix are taken from the original work.

H1. Griffith (1996)

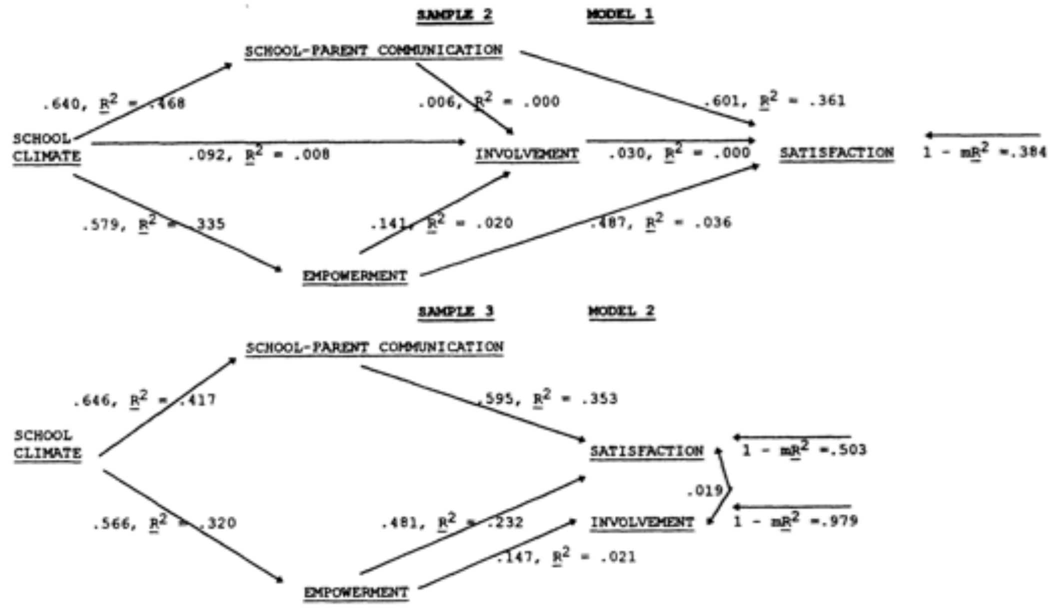


Fig. 1. Path analytic model describing relations among school climate, school–parent communication, parent empowerment, parent involvement, and parent satisfaction. Each regression analysis controlled for parent expectations for child's education and student Chapter 1 status. All path coefficients (standardized beta weights) are significant at $p < .001$.

Parent Involvement/Satisfaction with Public Education **1565**

Table VI. Simple Correlations between Parent Involvement and Parent Satisfaction for Schools Having Low and High Climate, Informing, Empowering, and Involving Parents[a]

Simple correlation between involved and satisfy for schools with:	Sample 3		
	Low	High	Diff. *b/n rs*: *Z*
M school climate	−.01 (N = 5,354)	.06** (N = 5,063)	3.68**
M school informed	−.00 (N = 5,326)	.06** (N = 5,091)	3.16**
M school empowered	−.02 (N = 5,326)	.06** (N = 5,091)	4.21**
M school involved	.00 (N = 5,356)	.04* (N = 5,061)	2.03*

[a]The median split on each scale determined the "low" and "high" categories.
*$p < .01$, two-tailed test.
**$p < .001$, two-tailed test.

H2. Friedman, Bobrowski and Geraci (2006)

African-American ($N = 3{,}186$)	Asian ($N = 1{,}069$)	Caucasian ($N = 19{,}295$)	Hispanic ($N = 4{,}055$)
Safe environment	Safe environment	Safe environment	Safe environment
School budget	Facilities and equipment	Teacher effectiveness	Teacher effectiveness
Teacher effectiveness	School budget	Facilities and equipment	Facilities and equipment
Parental involvement	Computer technology	School budget	School budget
Curriculum	Teacher communication	Principal	Principal
Training	Training	Curriculum	Curriculum
Teacher communication	Principal	Parental involvement	Parental involvement
	Teacher effectiveness	School communication	School communication
		Teacher communication	Teacher communication

Table V. Rank order of influence of school dimensions on school satisfaction for each ethnic group

H3. Friedman, Bobrowski and Geraci (2007)

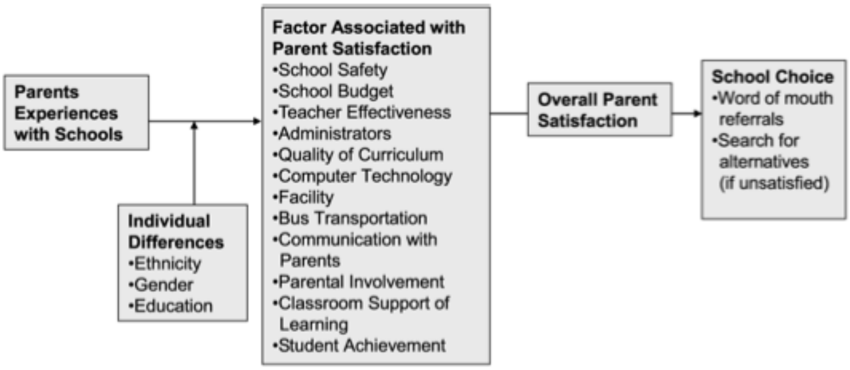


Figure 1. A conceptual model of parent school satisfaction

	Communication and involvement	Factor Resources	Leadership and budget
Teacher communication	0.83	0.11	0.06
School communication	0.81	0.16	0.14
Parent involvement opportunities	0.76	0.23	0.19
Teacher effectiveness	0.69	0.26	0.09
Principal effectiveness	0.51	0.12	0.22
Computer technology	0.09	0.76	0.04
Training opportunities	0.21	0.70	0.28
School facilities	0.24	0.68	0.15
Curriculum	0.27	0.59	0.33
Superintendent	0.16	0.16	0.90
Board of Education	0.18	0.20	0.90
Budget process and value	0.20	0.39	0.50

Note: [a]Principal component analysis extraction method with a varimax rotation method with Kaiser normalization was used

Table III. Rotated factor loadings[a] for three factor solution assessing parent school satisfaction with their children's school

H4. Gibbons and Silva (2011)

Table 5
Correlations in prediction using set of controls excluding school characteristics (upper right) and correlations of unobservables (lower left) from models of attitudinal variables.

	Child attitudes			Parent attitudes		
	Unhappy at School	Bored in lessons	Dislikes teachers	Low school quality rating	Not satisfied with progress	Teachers not interested
Unhappy at school	–	0.882	0.877	0.636	0.829	0.748
Bored in lessons	0.200	–	0.900	0.626	0.737	0.717
Dislikes teachers	0.265	0.246	–	0.682	0.742	0.743
Low school quality rating	0.107	0.069	0.077	–	0.760	0.718
Not satisfied with progress	0.120	0.081	0.089	0.316	–	0.861
Teachers not interested	0.114	0.077	0.100	0.326	0.290	–

Note: Table reports Pearson correlation coefficients. Upper right panel reports correlations of predictions using pupil, family and Census information (Panels A, C and D of Appendix table* A1), standardised pupil value-added and KS2 point scores. Lower left panel reports correlations of residuals from specifications including the full set of control variables, standardised school value-added, school KS2 (intake quality), pupil value-added and KS2 point scores (Column 4 of Tables 2 and 3). All correlation coefficients are significant at the 5% level or better.

H5. Skallerud (2011)

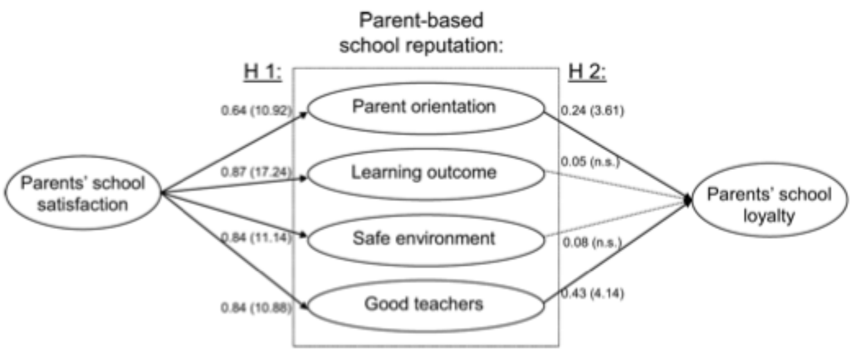


Figure 1.
Structural model of parent-based school reputation, its antecedent and consequence

Table IV.
Structural parameter estimates

Dimension	Parents' school satisfaction Estimate (γ)	t-value	Parents' school loyalty intentions Estimate (β)	t-value
Parent orientation	0.64	10.92	0.24	3.61
Learning quality	0.87	17.24	0.05	NS
Safe environment	0.84	11.14	0.08	NS
Good teachers	0.84	10.88	0.43	4.14

Notes: $\chi^2 = 216.24$ (df $= 81$, $p = 0.00$), RMSEA $= 0.066$, NNFI $= 0.98$, CFI $= 0.99$

H6. Fantuzzo, Perry and Childs (2006)

Table 3
Means for PSEE factors as a function of demographic characteristics

Variable	PSEE factor					
	Teacher		Classroom		School	
	M	S.D.	*M*	S.D.	*M*	S.D.
Caregiver education level[a]						
Greater than high school	48.2	9.7	47.8	9.9	47.7	10.5
High school diploma or GED	48.9	8.8	48.9	9.4	49.2	8.5
Less than high school	48.6	10.4	50.3	10.3	50.3	10.8
Parent marital status[b]						
Married	49.8_a	9.0	48.4	10.7	48.8	10.0
Single	47.6_b	10.1	49.0	9.2	48.5	10.1
Separated/divorced/widowed	48.8	8.6	49.0	9.8	50.1	9.0
Parent employment status[c]						
Presently employed full-time	46.7_b	9.9	46.7_b	10.2	46.4_b	10.4
Presently employed part-time	49.3_a	9.8	49.0_a	9.9	49.7_a	10.0
Not presently employed	49.7_a	8.9	50.4_a	9.5	50.4_a	9.2
Child gender[d]						
Male	48.3	9.4	48.8	9.5	48.7	10.0
Female	48.6	9.7	48.5	10.0	48.4	10.1
Race/ethnicity[e]						
African American	48.1	9.6	48.6	9.6	48.5	10.5
White	50.4	8.5	50.0	9.3	49.8	8.8
Other	47.6	10.3	47.7	11.4	48.6	9.4

Note. Reported means of profiles are expressed as *T* scores ($M = 50$, S.D. = 10), based on area conversion of precision-weighted factor scores (in standard *z*-score form). Means under the same variable heading (e.g. marital status) and in the same column that do not share letters (a, b) differ at $p < 0.05$ in the Tukey honestly significant difference comparison. If there are no subscript letters (a, b), there were no significant differences.

[a] $N = 642$.
[b] $N = 641$.
[c] $N = 628$.
[d] $N = 599$.
[e] $N = 639$.

H7. Raty and Kasanen (2006)

Table 1. Means of parental satisfaction in the three phases of the study

Aspect of satisfaction	1st grade	3rd grade	5th grade
Instruction	4.28^{a}	4.09^{b}	4.02^{b}
Assessment	4.31^{a}	4.23^{ab}	4.15^{b}
Fairness	4.28^{a}	4.19^{ab}	4.12^{b}
School success	4.60^{a}	4.34^{b}	4.32^{b}
Influence	3.79	3.75	3.69
Cooperation	3.91	3.91	3.85
Individuality	3.73	3.66	3.67
Dealing with problems	3.82^{a}	3.70^{ab}	3.62^{b}
Teacher	–	4.18	4.13
Overall	4.09^{a}	3.98^{b}	3.93^{b}

Note: Means with different superscripts are significantly different according to the Bonferroni test ($p<0.05$).

APPENDIX I – MIT ROAD MAPS SYSTEM PRINCIPLES

1. **“The feedback loop is the basic structural element of systems.”**
   “Feedback loops are the building blocks of systems that are linked together to build more complex systems. The more complex systems are assemblies of interacting feedback loops.”

2. **“Levels and Rates are fundamental to loop substructure.”**
   “A feedback loop consists of two distinct types of variables, the levels (also called stocks or states) and the rates (also called flows or actions). These two variables are both necessary to represent the structure in a feedback loop. The loop dynamics cannot be represented without their inclusion.”

3. **“Levels and Rates are not distinguished by units of measure.”**
   “Units do not determine whether a variable is a level or a rate. The units of measure of a variable do not distinguish between a level and a rate. The modeler must recognize the difference between a variable created by integration and one that is a policy statement in the system. Here, and in all models, the units of a rate are the units of its associated level over time. A good rule of thumb for distinguishing levels from rates is to imagine what would happen if action were halted. Rates will cease when action stops, but levels will continue to exist.”

4. **“Levels are accumulations (integrations).”**
   “Levels accumulate the results of rates (actions) in the system. Levels change smoothly but not instantaneously— there are no discontinuities, no jumps.”

5. **“Levels are changed only by the Rates.”**
   “Only rates can change levels. A level variable's current value is computed using only its previous value and the change due to the rates acting on the level. The earlier value of the level is carried forward from the previous period. It is altered by rates that flow in and out of the level over the intervening time period. The present value of a level is not directly dependent on the present or previous values of any other levels.

   A level variable is computed by the change, due to rate variables, that alters the previous value of the level. The earlier value of the level is carried forward from the previous period and is altered by rates that flow in and out of the level over the intervening time period.”

6. **“Levels exist in conservative subsystems.”**
   “A conserved quantity has the property that it is never created or destroyed (within its system); it is only moved around.”

7. **“Rates depend only on Levels and Constants.”**
   “Rates depend only on levels and constants. The value of a rate variable depends only on present values of level variables and constants. No rate variable depends directly on any other rate variable. The rate equations (or policy statements) of a system are of simple algebraic form; they do not involve time or the solution interval; they are not dependent on their own past values.”

8. **"Decisions are always within feedback loops."**
"No matter what the nature of the decision process— human, subconscious, biological, chemical, mechanical, electrical, etc.— it is always imbedded within at least one feedback loop."

9. **"Every equation must have dimensional equality."**
"In any equation, every term must be measured in the same dimensions. "One cannot add apples and oranges." This is true within converters, and it is true within level and rate equations. Dimensional inequality between terms indicates a faulty equation formulation."

10. **"First-order loops exhibit exponential behavior."**
"The first-order feedback loop always exhibits an exponential time shape."

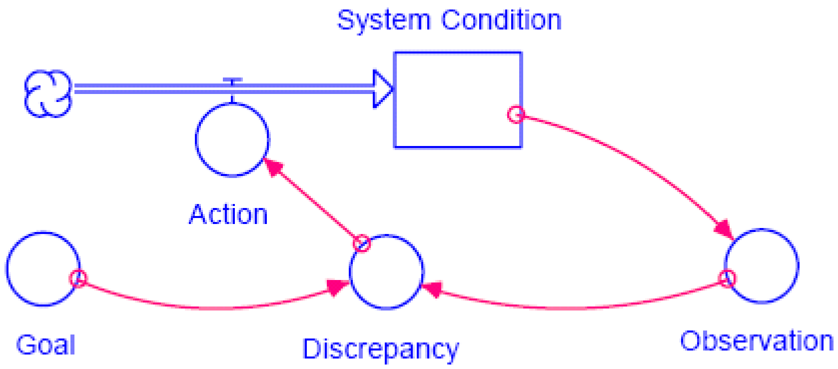
11. **"Levels completely describe the system condition."**
"Levels completely describe the state of system. The values of all other variables (the rate variables) can be computed from these values and the system equations alone. There must be a level for each quantity needed to describe the condition of the system, and the value of each level must be specified at the start of a simulation. Because the system condition is computed at every step of the simulation and depends on the previous values, it must be known at the start of simulation. Thus the initial values must be determined. Before the start of a simulation, a set of initial conditions must be specified for all the levels."

12. **"Variables have the same units within conservative subsystems."**
"Recall from System Principle #6 that levels exist in conservative subsystems— the contents of tocks are neither created nor destroyed, just moved between levels via flows. Levels connected within a conservative subsystem have the same units of measure."

13. **"Solution interval DT is in all level equations and no others."**
"The DT (also called the solution interval, period of measurement, delta time, or time step) is the time period in which the level is changed by the rate. The DT is essential to the level equation."

14. **"Simple, second-order negative loops exhibit sinusoidal oscillation."**
"All of the systems in *Generic Structures in Oscillating Systems I* are secondorder negative loops, and they all oscillate. The oscillation is independent of the values of parameters; it is due to having the same qualitative structure. Any secondorder, negative loop with no minor loops oscillates as a sustained sinusoid."

15. "Goal, observation, discrepancy, and action create a system substructure."



A policy or rate equation recognizes a local goal toward which that decision point strives, compares the goal with the apparent system condition to detect a discrepancy, and uses the discrepancy to guide action.

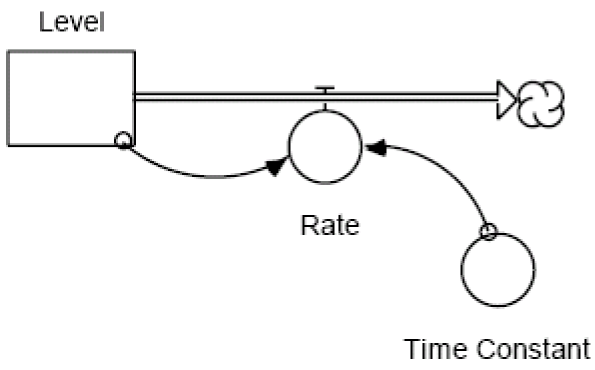
16. "Level variables and Rate variables must alternate."
"Converters are algebraically part of the rates to which they are connected. Any path through the structure of a system encounters alternating level and rate variables. Recall System Principles #5 and #7: Levels depend only on rates and Rates depend only on levels (and constants), respectively. Thus for any loop in a system, if we start at a level variable, the next variable we reach cannot be another level; the next variable must be a rate. Likewise, if we move through any loop starting from a rate variable, the next variable cannot be another rate (or even a constant, they are not influenced by any variable); the next variable must now be a level. This could be the same level, or it could be a new one. Try tracing out a loop in your own solution to the modeling exercise, and see for yourself!"

17. "Higher-order, positive-feedback loops usually show exponential behavior."
"Positive feedback loops of nth order usually exhibit simple exponential growth (ignoring possible initial transients)."

18. "Conversion coefficients are identifiable within real systems."
"Conversion coefficients should always have a clear, real meaning. They are not inserted just to balance equations. The conversion factor thus has a real physical meaning and balances the equations dimensionally."

19. "Conversion coefficients should be identifiable within real systems."
"Conversion coefficients should have numerical values that can be logically deduced from observation. They are not the result of only statistical analysis."

20. "Time constant of a first-order loop relates a level to a rate."
"The exponential time constant of a first-order loop is the reciprocal of the multiplier that defines the rate in terms of the level. It relates a level to the rate that affects it."



$$\text{Rate} = \frac{\text{Level}}{\text{Time Constant}}$$

"The Rate is equal to the Level divided by the Time Constant, or to the Level multiplied by the reciprocal of the Time Constant (the fraction 1/Time Constant)."

21. "Rates are not instantaneously measurable."
"No rate of flow can be measured instantaneously. A rate is a change over time. Without an observation over a time interval, a rate cannot be measured. The rate is determined as the change in the value of the level over time. There is no way to measure the instantaneous value of a rate. No rate can, in principle, control another rate without an intervening level variable (as rates cannot be measured instantaneously and must be averaged by using a level for integration). Two rates may be directly connected in some models as a short cut, but the occasion is rare and should be avoided by inexperienced modelers. Good modeling practice does not set a flow equal to another flow."

22. "Every system has a closed boundary."
"In creating a model of a real system, any interaction which is essential to the behavior mode being investigated must be included inside the system boundary. If our model is to generate the same behavior as the real system, then the system structure that is responsible for that behavior must be included inside the model. The behavior and its generator are endogenous to the closed system. In defining the model boundary, a modeler selects all the components necessary to create the behavior mode under investigation."

23. "Information links connect levels to rates."
"Information links, or connectors link levels to the control of rates. Through information links, values of level variables go to the rate equations, determining the rates of flow."

24. "Decisions (rates) are based only on available information."
"Decisions are made based on the policy statements in the rate equations. The rate equations in a system dynamics model are policy statements that determine how "decisions" are made."

25. "Auxiliary variables lie only in the information links."
"An auxiliary variable, or converter, is a subdivision of a rate equation. It allows a model to be disaggregated into easier to understand equation statements."

26. **“Mathematical simulation models belong to the broad class of abstract models.”**
“A model is a substitute for an object or a system. Some models are physical, such as a toy airplane or an architectural scale model. We are familiar with these. Some models are abstract. These abstract models include mental images, literary descriptions, behavior rules for games, and legal codes.

Mathematical simulation models also belong to the broad class of abstract models. Because computer modeling has become so widespread in recent years, it is important to understand the assumptions and applications of various modeling techniques.”

27. **“Model validity is a relative matter.”**
“The usefulness of a mathematical simulation model should be judged in comparison with the mental image or other abstract model that would be used instead. No model is a perfect representation of a real object. A model is successful if it opens the road to improving the accuracy with which we can represent reality.”

SOURCE: http://ocw.mit.edu/courses/sloan-school-of-management/15-988-system-dynamics-self-study-fall-1998-spring-1999/readings/

APPENDIX J – SYSTEM DYNAMICS MODEL CORRECTNESS CHECKLIST

SYSTEM DYNAMICS IN EDUCATION PROJECT SLOAN SCHOOL OF MANAGEMENT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

By: Danny Lai and Rebekah Wahba

"Perfect models are rare in Systems Dynamics because the correctness of model is relative to its purpose and varies widely, depending on the modeler, users, and modeling conventions. Below are some pointers one should use when building and simulating models. They include some accepted modeling standards, and also tips to check if your model works."

1. **"Units check** – Vensim and some other programs (Stella, iThink etc.) have built-in units feature that will check all equations for consistency in units. (That is to make sure the left and right side of all equations have the same units.) This feature is a valuable tool that can be used to check that valid dimensions, constants and equations are used. One must check models for dimensional consistency before simulating either using the software feature or manually."

2. **"Naming variables** – A general element naming convention has been proposed by Ventana, the makers of Vensim. The first letter of Stock names should be capitalized; CONSTANTS should be in all capitals, and names of all other variables, including flows are all lower case. Use names that clearly explain what a model element represents. In general, the word "rate" is reserved for flows. For example, do not confuse birth fraction, with birth rate."

3. **"No constants embedded in equations** – It is often tempting to simplify equations by using numeric constants embedded in equations. One must not do so! A good model will show all constants explicitly as individual elements. One must be able to recognize all model elements at a glance. Name the constant and use the constant name in the equation. This allows constants to be recognized and changed easily in future simulations, without changing any equations in the model."

4. **"Do not mention parameter values in the documentation** – The documentation complements the equations and should merely describe what the equations mean, and contain special notes. Frequently, constants are changed and sensitivity analysis is performed on models, and parameter values are changed in the equations (in the case of constants). If parameter values are mentioned in the documentation, they will have to be changed every time the equation is changed. This can be tedious and confusing as a reader will see two different numbers if the documentation is not updated, (See #3). Not mentioning parameter values in the documentation keeps it robust and avoids potential confusion."

5. **“Choose appropriately small time steps** – Choose the time step to be about one-eighth the value of the smallest time constant in the model (the time constant is the reciprocal of a growth or decay fraction). Doing so will increase the frequency at which the software solves the model equations, improving the approximations of continuous time and avoiding some mathematical errors.”

6. **“Stock values can be changed only by flows** – The only model elements with direct connections to stocks are flows. No constants or auxiliary variables should directly enter the stock equation, except for the initial values of the stock, (See #11).”

7. **“Every flow should be connected to a stock** – A flow only increases or decreases a stock; it cannot be used as a source of information in a model as it cannot be measured, (See #8). A flow unattached to a stock serves no purpose in the model, as it does not affect anything.”

8. **“Flows should not be linked to auxiliary variables or to other flows** – Flows are instantaneous and cannot be measured in real-time. In fact, flows can only be measured by calculating the change in stock value per time unit. Furthermore, it takes time for information to move from one flow to another. So a flow theoretically cannot give another flow a value equal to itself in the same time period. Besides, as flows cannot be measured, clearly one flow cannot pass information to another flow. Therefore, one must not use a flow to provide information to an auxiliary variable. If two flows are defined by the same structure, then one should use the same structure and equation to define both flows (and be a little redundant) instead of simply connecting the two flows.”

9. **“Stocks should not be linked to stocks** – A stock is the integral of a flow, (See #6). To show information transfer between two stocks, connect the first stock to the flow of the second stock. Be sure to check the units.”

10. **“Using IF THEN ELSE, MIN/MAX and other logic statements** – Almost no real-life situations behave according to IF THEN ELSE or MIN/MAX statements. Change is almost always gradual and not sudden like such functions suggest. One must use table functions to avoid discontinuities introduced by such statements.”

11. **“Use of Initial Values** – When initial values are used in a model, they should be clearly specified and connected to the model. The newest versions of most of the popular modelling software enforce this practice. There are occasions though, where the software does not allow for these connections, another way to explicitly connect the initial values (e.g. Word) should be used. This modelling convention makes it considerably easier to change initial conditions while running simulations.”

12. **“Curving connectors** – This issue deals with aesthetics. The connectors that link one variable to another should be curved as a model with curved connectors looks nicer, and the feedback loops are easier to trace.”

10. CURRICULUM VITAE

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MURAT DiNÇER

EXPERIENCE

February 1999 – June 1999 *Eyüboğlu College, İSTANBUL*

Student Teacher - Trainee

- Following lectures from four different physics teachers for completely one term
- Teaching physics for eight hours
- Participation to lab activities for IBDP students
- Participation to evaluate lab activities for IBDP students

September 1999 – August 2008 *TED İstanbul College, İSTANBUL*

Physics Teacher

- Teaching physics in secondary and high school
- Being responsible for computer assisted instruction and for science curriculum
- Creating constructivist web-based science lessons
- Designing virtual physics courses (mentioned also in Ministry of Education web page)
- GLOBE Coordinator
- Participating in science projects for various Science Fairs and TÜBİTAK

August 2008 – January 2009 *Mehmetçik Dershanesi, KARS*

Military Service

- Teaching physics in 'Mehmetçik Dershanesi' for the students who study University Entrance Exam

June 2009 – August 2011 *Acarkent Doğa College, İSTANBUL*

Vice Principal and IBDP Teacher (Physics and Business & Management)

- Vice Principal (responsible for students and implementation of IBDP)
- Teaching physics and Business&Management in high school
- The creation and design of High School Physics Laboratory recommended by IB
- The design of school library in terms of IBDP Physics and B&M course resources
- The preparation of course outline, sylallbus, educational materials, assessment and calendar for IBDP Physics and Business & Management Courses
- The attendance to IBDP Physics workshop in Dubai, UAE
- The attendance to the IBDP Business & Management workshop in Barcelona, Spain
- The planning of the International Young Scientists Olympics

August 2011 – August 2014 Acarkent Doğa College, İSTANBUL

School Principal and Coordinator of Acıbadem District Doğa High Schools (Acıbadem, Çamlıca and Üsküdar Doğa High Schools)

- Teaching Business and Management Course for IB students
- Principal as team leader (Responsible for approximately 250 students and 35 teachers' management, creating flexible organization structure and the horizontal information linkages, human resource management, recruitment and teacher in-service training programs, marketing, student registration, academic curriculum development, implemantation of IB Diploma Programme, Cambridge IGCSE programs, possessing responsibility and the accountability of school budget)
- Responsible for coordinating other three Doğa campuses high schools

August 2014 – present ACS Doha International School, QATAR

IBDP Teacher

- Teaching Business and Management and Physics Courses for IB SL and HL students

EDUCATION

1992 – 1999 *Boğaziçi University, İSTANBUL*

- Graduated from Teaching Physics, Department of Education
- Working in "Promete Education Consultancy Office, İstanbul" when I was senior.

2000 – 2003 *Yıldız Teknik University, İSTANBUL*

- M.A. Master degree in "Curriculum Development and Teaching" from Institute of Social Sciences

2003 – 2015 *Yeditepe University, İSTANBUL*

- Phd in Management of Business Administration, Institute of Social Sciences

DISSERTATION

The effect of the application of a constructivist learning environment on student achievement, prevention of misconceptions, knowledge recall and students' subjective learning experiences when applied to 7th grade students studying the science topic of 'forces.' *(M.A. Thesis Advisor: Prof. Dr. Münire ERDEN)*

A study on the Dynamics of parent satisfaction and student academic achievement at schools using system dynamics modeling (*Ph.D Thesis Advisor: Assoc. Prof. Dr. M. Atilla ÖNER*)

COMPUTER PROGRAMS

Microsoft Word, Excel, Powerpoint, Adobe Fireworks, Flash, Dreamweaver, Freehand, Pascal.

HOBIES

Reading books especially in the field of education and management, going to the cinema and theatre, playing pc games, following the new technologies, swimming, tennis, travelling and world cuisines

AREA OF INTERESTS

Management, Leadership, Organizational Culture and Change, Quantitative Analysis for Management, Strategic Management, System Dynamics Modeling, Total Quality Management, Higher Education, Curriculum Design and Development, K-12, Teacher Training, Instructional Technolog, Research, Constructivist Approach, web-based instruction, Integration of Education and Management Philosophy

CERTIFICATES

- August 15, 1999. "*Communication",* Prof. Dr İpek GÜRKAYNAK", organized by TED İstanbul College, Princess Hotel, İSTANBUL
- August 17, 1999. "*I solve problem",* Doç. Dr. S.ÖĞÜTÜLMÜŞ organized by TED İstanbul College, Princess Hotel, İSTANBUL
- 12.01.2000 - 11.03.2000 "Civil Protection and First Aid Course" organized by İstanbul Governorship, Şişli Etfal Hospital, İSTANBUL
- January 15, 2000. "*Communication",* Prof. Dr. Üstün DÖKMEN, TED İstanbul College, İSTANBUL
- 4-5 March 2000. "*Effective and Interactive Teaching Methods",* Prof. Dr. İpek GÜRKAYNAK, Mutlu ÖZTÜRK and Tufan ERHÜRMAN. TED İstanbul College, İSTANBUL
- April 1, 2000. "*Class Management*" Doç. Dr. Deniz ALBAYRAK. TED Istanbul College, İSTANBUL
- 7-8 April 2000. "*The new approaches to science education",* Dr. Mehmet SANCAR, organized by TED Headquarter, Kervansaray Hotel, BURSA
- April 16, 2000. "*Adolescence and Student's problems",* Prof. Dr. Ayşe YALIN. TED İstanbul College, İSTANBUL
- April 29, 2000. "*Very Active Students and ADHD",* Doç. Dr. Yankı YAZGAN. TED İstanbul College, İSTANBUL
- 26-30 June 2000. "*Global Learning and Observation to benefit the Environment*" organized by MEB, Sinop Öğretmen Lisesi- SİNOP
- 24-28 July 2000. "*Preparing and presenting a web based course*" organized by Macromedia, Bahçeşehir University, İSTANBUL
- 24-28 July 2000. "*Certificate of Macromedia Dreamweaver*" Bahçeşehir University, İSTANBUL
- 4-8 February 2001. "*Project based teaching",* Prof. Dr. Özcan DEMİREL, organized by TED Headquarter, Merit Limra Hotel, ANTALYA
- 28-30 November 2001. "1st *International Educational Technology Fair*" Sakarya University, SAKARYA
- December, 2001. *Certificates by General and School Principle* to thanks about "Web based Physics Course"
- 3-5 May 2001. "Education Conference under the light of Technology", Middle East Technical University (ODTÜ), ANKARA

- 20-22 May 2002. “Education Conference under the light of Technology”, Middle East Technical University (ODTÜ), ANKARA

- February 27, 2003. “*Macroscope 2003 Seminars*” organized by Macromedia, İSTANBUL
- 21-23 May 2003. “Education Conference under the light of Technology”, Middle East Technical University (ODTÜ), ANKARA

- June 14, 2003. Educational Administration at the twentifirst century, Yeditepe University, İSTANBUL

- October, 2005 – January, 2006. NLP (Neuro Linguistic Programming) Training, TED İstanbul College, İSTANBUL

- 1-3 October 2009. ‘International Baccalaureate Diploma Programme Teacher Training Physics Workshop’ Uptown High School, Dubai, UAE

- October 30 – November 1, 2009. ‘International Baccalaureate Diploma Programme Teacher Training Business & Management Workshop’ Barceló Hotel Sants, Barcelona, SPAIN

PRESENTATIONS

Topic: Creating web-based physics courses in secondary schools

Places:

May 3-5, 2001. Middle East Technical University (ODTÜ), ANKARA

November 28-30, 2001. Sakarya University, SAKARYA

Topic: The Evaluation of TIMSS 99 results from the constructivist approach in education

Places:

September 16-18, 2002. “5th National Science and Mathematics Education Conference, Middle East Technical University (ODTÜ), ANKARA

October 19, 2002. “6th Annual Teachers’ Conference”, MEF Schools, İSTANBUL

Topic: The effect of the application of a constructivist learning environment on student achievement, prevention of misconceptions, knowledge recall and students’ subjective learning experiences when applied to 7th grade students studying the science topic of ‘forces.’

Places:

May 21-23, 2003. “Education Conference under the light of Technology”, Middle East Technical University (ODTÜ), ANKARA

October 18, 2003. “7th Autumn Teachers Conference”, Koç Schools, İSTANBUL

Topic: Why Constructivist Learning?

Place:

January 17, 2004. "Good Samples in Education" Conference, Sabancı University, İSTANBUL

Topic: Project Studies in TED İstanbul College

Place:

October 16, 2004. "8th Autumn Teachers Conference", Robert College, İSTANBUL

(Note: presented together with the deparment members)

Topic: The integration of constructivist approach with computer assisted education in physics

Places:

August 2004- Participating in "E-learning Awards 2004" Project supported by Eurepean Committe (Among 1024 projects all over the world, it is selected in top 100 projects- among selected 100 projects, only one project from Turkey)

January 15-16, 2005. "Good Samples in Education" Conference, Sabancı University, İSTANBUL

March 5, 2005. "1st Science and Mathematics Teacher Conference", İstek Belde Schools, İSTANBUL

SCIENCE FAIRS

- May 10, 2002. 2nd Science Fair, Doğuş Schools, İSTANBUL
- April 22, 2002. 6th Science Fair, Koç Schools, İSTANBUL
- May 1, 2004. 5th Science Fair, Eyüboğlu College, İSTANBUL
- April 30, 2005. 6th Science Fair, Eyüboğlu College, İSTANBUL
- December 3, 2005. Invention Fair, İstanbul Technical University, İST
- 6-9 May 2008. 17th Science Projects, MEF Schools, İSTANBUL
- March 29, 2008. 1st Science Fair, Haliç University, İSTANBUL
- April, 2008. TÜBİTAK, İstanbul

PHYSICS PROJECT

The calculation of thermal expansion coefficients of metals at higher temperatures by using the laws of reflection *(2008 Haliç University Science Fair, the best project in the field of physics, 2008 TÜBİTAK the finalist of İstanbul Asian Side, 2008 MEF 17. Science Fair Projects, accepted as one of the best 10 physics projects from Turkey)*

PERSONAL INFORMATION

Nationality: TC (Turkish Republic)
Birth Date: 21.04.1975
Birth Place: Köln / Germany
Marital Status: Married, having one daughter

REFERENCES

Sema Kan ÖZKAYA – Acarkent Doğa College IB Advisor (currently), IB Authorization team leader and CIS Accreditation team member (currently), Private Eyüboğlu Schools General Manager (former)

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