

Using TRIZ to Resolve Educational Delivery Conflicts Inherent to Expelled Students in Pennsylvania

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Abstract

Public education in the U.S. is now facing increasing competition from private educational initiatives especially in the virtual domain. In Pennsylvania public education is partially funded by the State, based upon student enrollment and attendance. The increasing numbers of two groups of students, those who are homebound and those who are homeschooled, are adversely affecting the monetary resources available to districts. Homebound students fall into two subsets. The larger is composed of students who have been expelled for disciplinary reasons or inappropriate social behavior and are not permitted to be in school. Districts must provide them with a free education until the age of 17. The second subset consists of students that are homebound due to medical reasons. Districts find educating homebound students to be inordinately expensive. The home-schooled group consists of students whose parents are instructing their students at home. School districts do not receive state aid for home-schooled students. These students are being attracted in large numbers to cyber charter schools that provide educational curricula on the Internet. For each enrolled student, the school district must pay the cyber charter school approximately 75-80% of the home district's per pupil cost of educating a student or lose a portion of its state funding because the State mandates that districts subsidize the cyber charter schools for the expenses of educating these students.

A group of 20 doctoral students in educational leadership at East Stroudsburg University of Pennsylvania were introduced to TRIZ and the use of a new Contradiction Matrix for Business and Management. These students together with the authors have rewritten the 31 features of the matrix in the language of educators in order to modify this matrix to create a version appropriate for educational problems.

The doctoral students have addressed some technical contradictions (trade-offs) associated with home-schooled students, in particular the homebound population of students expelled from the public school system for severe behavioral problems, such as drug use or carrying weapons.

This paper will report the 31 features written in educational terms and their relationships to the business and management features. This paper will also discuss potential solution concepts generated by the doctoral students in education, using the Contradiction Matrix for Business and Management modified to be used to resolve education related technical conflicts including an extension of the cyber school concept for a second student population.

1.0 General Introduction

A wide array of public and private alternatives now exists for families with school-aged children. In the private domain options include traditional independent residential and day schools, institutions supported by religious groups, and a recent addition, private cyber charter schools that use e-learning as the instructional delivery model. Some states and regions support parental choice by providing taxpayer-generated stipends called vouchers that can be utilized to underwrite all or a portion of the tuition. A second category of alternatives, which falls under the public domain, includes magnet schools, that have a specifically designed mission, such as the arts or technology, and charter schools that are funded by taxpayer generated monies, free from most state mandates, and meant to be tuition free. A new version of the charter school, the cyber charter school, has surfaced recently and allows students to receive their education while at home delivered through the internet from a site that might be miles away and not in anyway associated with the district.

School districts across Pennsylvania are seeking technology-enhanced solutions to various educational challenges. For example, in the 2001-2002 school year, Monroe County school districts spent over \$200,000 to ensure barely adequate training for their “homebound” students. Based upon projections, these numbers will drastically increase in coming years. A second group of students, the homeschooled, for example, drain funds from the districts when they enroll in cyber charter schools, as most of the funds allocation per student travels to the charter school. A second problem is the need to enhance the educational training experience for all students by offering web-based learning alternatives for students within the Commonwealth. Ultimately, district owned and operated cyber-schools would ensure educational excellence for all students receiving cyber education, while returning funds and resources to local districts to be used by all students. This paper reports the work of the authors, and Dr. Faith Waters' graduate studies class of twenty doctoral students. The paper includes “educational equivalents” for the 31 features of a Contradiction Matrix for Business and Management developed by Mann (1), and results for resolving contradictions associated with “homebound” students using the Contradiction Matrix for Business and Management.

2.0 Students Who Are Taught at Home

Homebound students fall into several populations or categories. Home-schooled students represent an important class. These are students whose parents have made the decision to keep them out of the public school system. The parents are required to provide an education consistent with the public school standards and curricula. The parents are making a tradeoff between the quality of education and exposing their children to an environment that does not meet their expectations for respect for authority, religious curricula, moral issues such as sex, drugs, and inappropriate behavior, and the safety of their children. The parents of students want control of the environment, and the schools want control over a consistent curriculum. Another class of homebound students is those who are confined to their homes for medical reasons. These students may have short or long term schooling at home.

A final class of homebound students is students who have been expelled from the public school system due to severe behavior problems. This paper addresses this class of homebound student specifically.

3.0 Ideal Final Result

An ideal solution is that all schools will be able to meet the needs of all students. This includes the general student population as well as the homebound population.

4.0 Methods

Dr. Faith Waters, Department Chair, Professional and Secondary Education, and a group of twenty doctoral students were introduced to TRIZ and the use of TRIZ principles to find a solution to the problems associated with homebound students. In particular, the group focused on the population of homebound students who had been expelled from the public schools. The group

decided to use the Contradiction Matrix for Business and Management developed by Darrell Mann and reported at TRIZCon 2002, the 4th Annual Conference of the Altshuller Institute for TRIZ Studies, in St. Louis, April 30 – May 2, 2002. (1) The group was also encouraged to concentrate on the ideal final result and the optimal use of resources.

The Contradiction Matrix for Business and Management contains 31 parameters. A portion of this matrix is reproduced in Table 1 below. The new Matrix is intended to function in much the same way as the classical Matrix; the user is encouraged to think about what they are trying to improve and then what is stopping them from making the improvement. The win-win matrix contains 31 business features. The win-win matrix is symmetrical, that is, the trade-offs between any two features do not depend on which is improving or worsening.

Table 1. CreaTRIZ 2.2 Win-Win Matrix Features 1 to 5

	win-win Matrix	R&D Spec/Quality/Capability	R&D Cost	R&D Time	R&D Risk	R&D Interfaces
		1	2	3	4	5
1	R&D Spec/Quality/Capability		2, 4, 15, 38	21, 38, 35, 23, 15	3, 9, 24, 23, 36, 11	3, 13, 24, 33, 38
2	R&D Cost	2, 4, 15, 38		26, 34, 1	27, 9, 34	13, 26, 35, 1
3	R&D Time	21, 38, 35, 23, 15	26, 34, 1		1, 29, 10, 11	15, 25, 35, 1
4	R&D Risk	3, 9, 24, 23, 36, 11	27, 9, 34	1, 29, 10, 11		6, 29, 15, 14, 17
5	R&D Interfaces	3, 13, 24, 33, 38	13, 26, 35, 1	15, 25, 35, 1	6, 29, 15, 14, 17	

5.0 Results and Discussions

5.1 Educational Equivalents for the Business Features

The team immediately recognized the need to identify some ‘educational equivalents’ to the parameters developed for business applications. The team decided to create equivalents for Kindergarten through 12th grade and an additional set of equivalents for higher education (Colleges and Universities). These equivalents are reported below in the tables 2 and 3. Table 2 suggests educational equivalents for the 31 features of the Contradiction Matrix for Business and Management for public education grades K–12. For example, feature number 16 is labeled Product Reliability (or Support Specification, Support Quality, and Support Means) for business and management. The K–12 educational equivalents are Remediation, Quality of Education, Quality of Supervision, and Student Test Scores.

Table 2: K – 12 Educational Equivalents of the 31 Features - Contradiction Matrix for Business

No.	Business & Management	K-12 Education Equivalent
1	R&D Spec/Quality/Capability	Student Achievement; Teacher & Curriculum Quality; Instructional Practices
2	R&D Cost	Curriculum Development; Professional Development; Research
3	R&D Time	Professional Development; Collaboration; Summers
4	R&D Risk	Non-accredited School & Degree; Teacher Retention
5	R&D Interfaces	State Mandated Standards; Student Teaching
6	Production Spec/Quality/Means	Curriculum Development; Standards; Federal & State Mandates
7	Production Cost	Per Pupil Cost; Strategic Plan Costs; School Facilities and Infrastructures
8	Production Time	Differing Ability Levels; Efficiency in Use of Instructional Time; Scheduling
9	Production Risk	Student Failure & Drop-out Rates; State Take-over (Empowerment); Public Dissatisfaction
10	Production Interfaces	Stakeholders; Educators; Dept. of Education; PTA; PTO
11	Supply Spec/Quality/Means	Budgets; Bid Lists
12	Supply Cost	Salaries; Remediation; Materials; Technology
13	Supply Time	Instruction; Staff Hiring & Removal; Order Completion
14	Supply Risk	Student & Non-certified Teachers; Budgets; Substitute Teachers
15	Supply Interfaces	Budget Constraints; Line and Staff Relationships; Administration; Staff; School Board Priorities
16	Product Reliability Support Spec/Quality/Means	Remediation; Quality of Education & Supervision; Student Test Scores
17	Support Cost	Salaries (Administration; Aides; Counseling; Special Education); Remedial Programs; Support Staff
18	Support Time	Filling Unfilled and Understaffed Positions; Professional Development; Scheduling
19	Support Risk	Insufficient Staffing Pool; Special Education Programs; Retention of Qualified Personnel
20	Support Interfaces	Collective Bargaining Agreements; Department of Education; School Boards; Community Officials; Organizational Memberships; Teachers; Parents; Schools
21	Revenue/Demand/Feedback	Graduation Rates; School Placed under State Management; Department of Education; Employment Rates; Empowerment; College Acceptance; Parents
22	Amount of Information	Assessment Data; Educational Research; Special Education Data; Curricula
23	Communication Flow	Report Cards; Among (Administration; Teachers; Staff; Students; Parents; Community; State; Federal)
24	System Affected Harmful Effect	Societal Dysfunctions; Inadequate Funding; Alcohol; Drugs; Poor Test Scores; Poor Instructional Facilities; Poor Programs; Drop-out Rates; Budgets Voted Down
25	System Generated Harmful Effect	Disrespect; High Drop-out Rates; Exposure to Drugs; Violence; Sexual Behavior; Poor Test Scores; Exposure to Unsafe Environments

26	Convenience	School Calendar; Parental Involvement; School Holidays; Busing; Motivation; Community Support
27	Adaptability/Versatility	Schedules; Alternative Routes; Split Sessions; Time; Block Scheduling; Emergency Certification
28	System Complexity	School Funding; Alternative Education/Choice; Special Education; Private; Public; Charter; Homebound; Cyber; State & Federal Funding Regulations; Remediation
29	Control Complexity	State Department of Education; Educational Regulations; State Boards; School Boards; Special Interest Educational Groups
30	Tension/Stress	State & Federal High Stakes Testing; Teacher & Staff Morale; Community Expectations; Societal Dysfunctions
31	Stability	Personnel Retention; Disaffected Children; Enrollment; Attendance; Mobility Rates; Special Education; Foster Children

Table 3 suggests educational equivalents for the 31 features of the Contradiction Matrix for Business and Management for higher education (Colleges and Universities, Post-graduate Studies, etc.) For example, the higher educational equivalents for Feature 16 Product Reliability or Support Spec/Quality/Means are Quality of Education, Graduate Employment Statistics, Certification Exams, Graduate School Enrollment, and GRE.

Table 3: Higher Educational Equivalents of the 31 Features - Contradiction Matrix for Business

No.	Business & Management	Higher Education Equivalent
1	R&D Spec/Quality/Capability	Degree/Diploma/Certificate/Honors; General Educational & Graduate Requirements; Professional Standards
2	R&D Cost	Accreditation; Professional Development
3	R&D Time	Scholarly Activities; Research Grants
4	R&D Risk	Tenure; Competition; Attrition; Promotion
5	R&D Interfaces	Collaboration; Partnerships; Research Facilities
6	Production Spec/Quality/Means	Licensing & Certification Requirements; Accreditation Requirements; School Facilities & Infrastructures
7	Production Cost	Faculty & Staff Salaries; Financial Aid; Graduate Student Assistantships; Tuition; Stipends
8	Production Time	50 Week Instruction; Continuing Education; Weekend & Evening Instruction
9	Production Risk	Declining Enrollment; Declining Funding Sources; Increased Competition from Online Venues; Endowments
10	Production Interfaces	Board of Trustees; Accreditation Bodies; State Boards; Alumni Groups
11	Supply Spec/Quality/Means	Curricula; Government Regulations; Books & Supplies; IT; LAN's; Technology
12	Supply Cost	Faculty & Staff Salaries; Recruitment & Retention; Cost of Supplies; Libraries; Medical
13	Supply Time	Purchasing; Faculty and Administrative Search Committees; Order Completion
14	Supply Risk	Faculty Grants; Budgets Constraints; Faculty Grievances
15	Supply Interfaces	Government & Industry Grants; Faculty; Administration; Staff; Publishers

16	Product Reliability Support Spec/Quality/Means	Quality of Education; Graduate Employment Statistics; Certification Exams; Graduate School Enrollment; GRE's
17	Support Cost	Salaries; Facilities & Grounds; Remedial Programs; Administration; Counseling; Psychological Services
18	Support Time	Unfilled Administration/Faculty/Staff Positions; Adjunct Professors
19	Support Risk	Retention of Qualified Personnel; Special Education & Remedial Programs; Administrators Resign & Retire
20	Support Interfaces	Board of Trustees; Faculty Governance Committees; External Interfaces; Program Boards; Faculty; Staff; Administration
21	Revenue/Demand/Feedback	Students; Legislators; Parents; Alumni; Faculty; Community; Industry
22	Amount of Information	Curricula; Accreditation Processes; Tenure & Promotion Processes; Institutional Research
23	Communication Flow	Among (Administration; Faculty; Staff; Students; Parents; Community; Alumni; State; Federal); Recruitment; Institutional Review Board
24	System Affected Harmful Effect	Legislative Mandates; Alcohol; Drugs; Unsafe Environment; Censorship; Balancing Freedom & State Policies
25	System Generated Harmful Effect	Exposure to Alcohol & Other Drugs; Violence; Sexual Harassment
26	Convenience	Course Availability; Calendar; Evening & Weekend Instruction
27	Adaptability/Versatility	Multiple Instructional Delivery Systems; Articulation Agreements
28	System Complexity	Private/Public/Virtual Universities; Trade & Technical Schools; Community Colleges; Affirmative Action; Sororities & Fraternities; Sports & Extracurricular Activities
29	Control Complexity	Multiple Constituencies; State Boards; Interdepartmental Competition; Alumni; State & Federal Government; Funding Sources
30	Tension/Stress	Academic Freedom; Accreditation; Collective Bargaining; Tenure & Promotion; State Exams & Expectations; Community Expectations; Assessment; Reductions in Force
31	Stability	Funding; Enrollment; Retention; Facilities; Endowments; Grants

6.2 Contradictions Associated with the Expelled Homebound Student

We considered some of the contradictions inherent to the problem of the homebound students who were expelled from the traditional public school environment for behavior or discipline reasons. These students receive the least adequate schooling and are the largest financial drain on the school districts. On the other hand, their parents are the least resistant to changes to their children's programming, as they feel a need to be compliant based on the expulsion dilemma and desiring favorable consideration for future readmittance. Teachers often feel threatened by these students in the public school venue. In some districts, teachers refuse to go to the homebound students' homes fearing for their safety. The law states that these students must be educated, yet no one wants to do it. It is very expensive to educate them off-site, and the increasing numbers of expelled students are diverting large sums of money from budget-distressed schools. These students are often oppositional and need structured support to develop morally and emotionally. However, few

curricula have been developed to meet this need and are rarely if ever included in a homebound program, as the limited instructional time is devoted to basic skills. These students frequently return to the general student population, but there will be dim hope for modification of their previous behavior if there is no consistent intervention while they are homebound. These homebound students are assessed from time to time to determine progress and ensure compliance. However, almost always the teacher or teachers who work with them are not certified in the subjects the students must complete. They must then rely on worksheets and texts to deliver the content. Several contradictions related to this issue are summarized in Table 4 below.

Table 4. Contradiction Worksheet

7.0 TRIZ Solutions for Four Contradictions

The first contradiction in Table 3 is the trade off between Feature 17, Support Cost (Salaries,

	Factor List	Improve	Worsen
1	R&D Spec/Quality/Capability/Means		
2	R&D Cost		
3	R&D Time		
4	R&D Risk		
5	R&D Interfaces		
6	Production Spec/Quality/Means		
7	Production Cost		
8	Production Time		
9	Production Risk		
10	Production Interfaces		
11	Supply Spec/Quality/Means		
12	Supply Cost		*
13	Supply Time		
14	Supply Risk		
15	Supply Interfaces		
16	Product Reliability	*	
17	Support Spec/Quality/Means		
18	Support Cost	*	*
19	Support Time		*
20	Support Risk		
21	Support Interfaces		
22	Revenue/Demand/Feedback from		
23	Amount of Information		
24	Communication Flow		
25	System Affected Harmful Effects		
26	System Generated Harmful Effects		
27	Convenience		
28	Adaptability/Versatility		
29	System Complexity		
30	Control Complexity		
31	Tension/Stress		*
32	Stability		

CONTRADICTIONS

16 vs. 12

16 vs. 17

16 vs. 18

17 vs. 30

IDEAL FINAL RESULT

All schools will be able to meet the needs of all students.

#3 2, 25

#4 22, 25

#1 35, 24

#2 35, 24, 10, 2

Remedial Programs, Support Staff) and Feature 30, Tension and Stress (State and Federal High Stakes Testing, Teacher and Staff Morale, Community Expectations, Societal Dysfunctions).

School districts attempt to lower costs by cutting budgets (thus costs are improving from their point of view.) As stated above, special teachers instruct homebound students at home. This requires costs associated with the remedial programs, teacher certification, and teacher salaries. Without generous salaries and meaningful resources for these programs, the teachers' morale is adversely affected because they do not want to enter the hostile environments that exist in some of these students' homes. Further, they recognize that they are not certified to teach most of the subjects and feel insecure about the accuracy of the content and the quality of the instructional delivery. Therefore, a trade-off exists between costs and tension and stress.

7.1 First Contradiction

For the first contradiction, the Contradiction Matrix directs us to look at Principles 35 (Parameter Change), 24 (Intermediary), 10 (Prior Action), and 2 (Take Out). We considered examples from two TRIZ Journal articles; namely, '40 Inventive (Business) Principles' (2) and '40 Inventive Principles with Social Examples' (3). Mann, *et al.*, have suggested that the same 40 Principles used for technical problem solving, may be used for resolution of business problems. The team now proposes that these same 40 Principles may be used to resolve contradictions and generate solution concepts for educational problems.

For Principle 35 (Parameter Change) Part a., Change an object's physical state (e.g. to a gas, liquid, or solid), the suggestion is made to use virtual prototyping. Part b., Change the concentration or consistency, suggests changing the team structure. Part c., Change the degree of flexibility, suggests software with options for 'beginner' to 'expert' usage. Part d., Change the temperature, suggests getting the customer or team fired up or 'hot' about the product.

These ideas prompted us to consider a "Virtual Educational Component" for every school. The "Virtual Educational Component" would utilize the existing teaching staff but in a different way. The "Virtual" curricula would support teaching levels from remedial to accelerated beginning to expert and the ability to deliver instruction at a variety of appropriate levels. The "Virtual Educational Component" would provide a high level of educational quality for the homebound students, and also eliminate or reduce the tension and stress of teachers having to go to the students' homes. The existing teaching staff may be enthusiastic about developing the "Virtual Educational Component," an innovative way to deliver instruction, as they perceive it to be a resource support for their traditional instruction as well.

In Principle 24 (Intermediary) Part a., Use an intermediary carrier article or intermediary process, the idea of introducing a "Virtual Educational Component" as an interface between the teaching staff and the homebound students emerges.

In Principle 10 Prior or Preliminary Action, Part a., Perform, before it is needed, the required change of an object (either fully or partially), changing the delivery system for learning is consistent with the development of a "Virtual" curricula.

For Principle 2 Take Out Part a., Separate an interfering part or property from an object, or single out the only necessary part (or property) of an object, suggests that it is the educational product that needs to be delivered to the homebound student, and this may be done without the teacher physically present. Thus the real teacher can be replaced with a virtual teacher. This principle also suggests separating the disruption of the behavior problems from the learning process.

7.2 Second Contradiction

The second contradiction associated with homebound students is the tradeoff between a quality education for the homebound students and the cost of providing this education. In Table 3, this contradiction is represented by Feature 16, Product Reliability or Support Spec/Quality/Means (Quality of Education & Supervision; Test Scores) and Feature 12, Supply Costs (Salaries; Remediation; Materials; Technology). The contradiction matrix directs us to Principles 35 and 24. These have been discussed above.

7.3 Third Contradiction

The third contradiction is the tradeoff between quality of education and support costs. These are related to Features 16 and 17. The contradiction matrix directs us to consider Principles 2 (Take Out), and 25 (Self-service). We have discussed Principle 2 above. The Principle 25 Self-service, Part a., Make an event serve itself by performing auxiliary helpful functions, suggests that the customer of the educational system (homebound student) could take flexible advantage of the “Virtual Education Component” in a manner that is adapted to their own circumstances, learning styles, time of day needs, etc. Benefits of asynchronous delivery match the needs of this population. The “virtual” curricula may also be developed to address the moral and emotional challenges of the homebound student, to develop their character while they are learning.

7.4 Fourth Contradiction

The fourth and final contradiction is the tradeoff between quality of education and support time, Features 16 and 18 respectively. Feature 16 has been discussed. Feature 18 Support Time has educational Equivalents: Filling Unfilled and Understaffed Positions; Professional Development; Scheduling. The Contradiction matrix directs us to Principle 22 (Blessing in Disguise) and Principle 25 (Self-service). The latter has been addressed above. Principle 22 Blessing in Disguise, Part b., Eliminate the primary harmful action by adding it to another harmful action to resolve the problem, suggests eliminating fear of change by introducing fear of competition. The establishment of a “Virtual Education Component” to the traditional educational system deals effectively with the challenges of the homebound student but also threatens and challenges teachers and staff. However this may be preferable to the recent challenges of the private cyber charter school initiatives in Pennsylvania that represents an even greater competitive threat as well as the threat of loss of resources as the budget must accommodate increasing costs for homebound students.

8.0 General Notes on Application of the Business Matrix

This paper records some pioneering applications of the new Business Contradiction Matrix. Continued efforts should be directed toward validating it as a useful addition to the creative process in resolving educational issues. This case plus a variety of others taken from a range of other industry sectors - from legal, to finance to business model design to organization structure re-definition - have highlighted a number of points that appear to be applicable generally:

- 1) Different industries appear to generate very distinct terms and expressions to describe different aspects of their business (e.g. 'teacher release', 'SAT scores' in this paper). No generic set of parameters seems capable of mapping even a small proportion of the different terms and expressions used. In many senses, this should be viewed as a benefit rather than a problem - especially since one of the main aims of the Matrix is to facilitate the transfer of 'good' solutions from one sector to others. On the other hand, however, users of the Matrix should be able to focus on their problem rather than the mechanics of the tool. This is a definition of another contradiction; one that, like in other sectors, the team involved in the work described here solved by preparing the tables of generic-to-specific translations before sitting down to actually use the Matrix in earnest (i.e. Inventive Principle 10 - Preliminary Action - was employed).

- 2) In the opinion of the authors, technical situations and 'people' unpredictability are often distinguished by the presence of significantly higher degrees of uncertainty in the latter. The Matrix

has been constructed in a manner that tries to 'manage' this uncertainty. With the technical contradiction matrix of classical TRIZ, there is often a debate over whether A or B represents the 'right' contradiction to a given problem situation. The new Matrix has been constructed in a manner that encourages users to examine A and B.

3) The nebulous nature of people-type problem situations also makes it likely that solutions will be generated from a wider range of Inventive Principles than would be expected in technical situations. It also means that there is often considerable benefit in inserting an additional step into the 'generate solutions' part of the problem solving process; a step that examines the possibilities of combining the solutions derived from the different Inventive Principle suggestions. Individual Inventive Principles, in other words, offer useful solution generating triggers, but unlike what often happens in technical situations, the ultimately best business solutions will emerge through combination rather than selection of the ideas generated.

9.0 Other Educational Trade-off Examples for Future Work

The doctoral students identified other unresolved, complex problems with the following contradictions facing administrators, teachers, and staff in Kindergarten through 12th grade levels in public schools in the US today. We shall continue to test the ability of the win-win Matrix modified with educational equivalents to find solutions for these contradictions.

9.1 Teacher Release Time

Full time teachers have contractual release time for professional development that takes them out of the classroom. In some cases as many as twelve to fifteen full-time teachers may be absent at one time. Full-time teachers while in the classroom provide excellent quality of instruction. Substitute teachers replace full time teachers when they are absent; however, the quality of instruction suffers, non-productive, repetitive work is the norm, and general chaos often occurs. There is a technical contradiction between Teacher Release and Quality of Education. In addition, there are associated physical contradictions, the full-time teachers must be present and absent, and the substitute teachers are present but should be absent.

9.2 Teachers and Community Morale

Teacher morale is an issue in “empowered or distressed” schools’ (Schools whose governance and daily administration has been taken over by the State or its designee because of poor test scores). There is enormous pressure to manage the district’s financial resources tightly and to curb spending in order to stay within the budget.

Teachers and the community complain that it is not possible to teach more students with less teacher aid, support, etc. and share concern over the investment of significance resources in public relations devoted to justifying the takeover process.

9.3 Standardized Test Scores

Teachers are expected to improve their classes’ Pennsylvania State Standardized Assessment (PSSA) scores each year. Co-incidentally, societal pressures, such as divorce, child abuse, drug and alcohol use, plus new mandates regarding special education, limited English proficiency populations and curricular content to be added provide competing challenges. This situation results in several technical contradictions; namely, Product Quality vs. Communication Flow, Product Quality vs. Support Interface, and Product Quality vs. Supply Interface.

9.4 Time Resources

Administrators require more time to discuss curricula and instructional issues with teachers. Teachers have no time available during “contract” hours, and are unwilling to stay overtime. A physical contradiction exists, that is, time is needed, but there is no time.

9.5 Teamwork

Administrators desire more teamwork between administrators and teachers regarding student disciplinary issues. Teachers expect that administrators will deal with student behavior problems such as smoking, dress-code violations, and inappropriate behavior in hallways, etc. in order to allow them to focus on instruction. A technical contradiction between Support Interface and Feedback exists.

9.6 Cyber Charter Schools

School districts are partially funded by the state based on student enrollment and attendance. Home-schooled students do not contribute to enrollment or to attendance, and have recently begun receiving state-mandated funding from the school districts to attend approved charter schools, including cyber-schools, thereby diverting funds from the local school districts. Because of this funding process, independent cyber-schools are beginning to surface across the state.

A number of problems arise due to this action. Schools must deal with multi-layered communication, and state aid is being diverted from the school districts thereby impacting the education of the traditional students. The State pays 35% to 50% of Yearly Per Pupil Costs but is withholding approximately 75-80% of those funds for homeschooled students. The school districts need to cut staff, but cannot cut staff due to contracts, and the number of students with severe behavioral problems who are expelled is increasing, yet the pool of eager, qualified teachers to work with them is decreasing and the funds available to pay for homebound instruction is shrinking.

10.0 Conclusions

The team has endeavored to use TRIZ principles to resolve contradictions associated with public school education in the US. In school districts in Pennsylvania, homebound students, in particular, students that have been expelled from the public school environment, represent significant challenges for these budget-distressed school districts.

A solution for resolving four contradictions associated with these homebound students has been identified. The introduction of a “Virtual Educational Component” in conjunction with the traditional educational venues effectively resolves the identified contradictions. In addition, the solution also addresses an associated challenge regarding the emergence of “cyber charter schools” in Pennsylvania. These schools further challenge the already budget distressed school districts.

The TRIZ experience at East Stroudsburg University of Pennsylvania has enabled the administration to react quickly to a 2 million dollar grant opportunity from the United States federal government. East Stroudsburg University of Pennsylvania in collaboration with Right Reason Technologies have submitted a proposal for a “Virtual Education Academy – A Cyberschool Alternative” with the mission of “Assuring Student Achievement so that No Student is Left Behind.”

References

1. Darrell Mann (2002) ‘Systematic Win-Win Problem Solving in a Business Environment’, Conference Proceedings, TRIZcon 2002, St. Louis.
2. Mann, D., Domb, E., ‘40 Inventive (Business) Principles with Examples’, The TRIZ Journal, www.triz-journal.com, September 1999.
3. Terninko, J., ‘Inventive Principles with Social Examples’, The TRIZ Journal, www.triz-journal.com, June 2001.