

Using TRIZ to resolve conflicts between Public Educational Institutions and private Cyber-Charter School Initiatives in Pennsylvania

Dana G. Marsh / Heidelberg Digital L.L.C.

Darrell Mann / Systematic Innovation, UK

Abstract

Public education in the U.S. is now facing competition from private educational initiatives in the virtual domain. In Pennsylvania, public education at the high school level is funded by the state, based upon enrollment and attendance. However, many parents are choosing to home-school their children rather than send them to public schools. The school districts do not receive state aid for this class of students. To make matters worse, Cyber-Charter Schools that provide educational curricula on the Internet are attracting the home-schooled students. In addition, the school districts lose some of their state funding because they must pay the Cyber-Charter Schools for the expenses of these students.

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

The doctoral students have addressed the technical contradiction faced by the parents of the home-schooled students, that is, the tradeoff between the quality of education at the public schools, versus the system generated harmful effects (exposure to drugs, violence, etc.) at public schools.

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 a few of the 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

1.0 General Introduction

School districts across Pennsylvania are seeking technology-enhanced solutions to various educational challenges. This year, Monroe County school districts, alone, are spending over \$200,000 to ensure adequate training for their “homebound” students. Based upon projections, these numbers will drastically increase in coming years. Additionally, school districts hope to enhance the complete training experience for all students by offering web-based learning alternatives for students within the Commonwealth. Ultimately, district owned and operated cyber schools will ensure educational excellence for all students receiving cyber education, while funds will return to local districts to be used by all students. This paper reports the work of the authors, and Dr. Faith Waters and her 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 Technical and Physical Contradictions – Educational Examples

The following are typical examples of contradictions facing administrators, teachers, and staff in K – 12 grade levels in public schools in the USA today.

2.1 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 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, busy work is the norm, and general chaos occurs. There is a technical contradiction between Teacher Release and Quality of Education. In addition, there are physical contradictions associated with the full time teachers must be present and absent, and the substitute teachers should be present and absent.

2.2 Teachers and Community Morale

Teacher morale is an issue in empowered schools. School districts invest significant resources in public relations; however, teachers and the community complain that it is not possible to teach more students with less teacher aid support, etc.

2.3 Standard Achievement Test Scores

Teachers are expected to improve their classes SAT scores each year. Co-incidentally, classrooms are becoming more diverse racially, ethnically, by income class, etc. This situation results in several technical contradictions; namely, Product Quality vs. Communication Flow, Product Quality vs. Support Interface, and Product Quality vs. Supply Interface.

2.4 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, Time is needed, but there is no time.

2.5 Teamwork

Administrators desire more teamwork between administrators and teachers. Teachers expect that administrators will deal with student behavior problems such as smoking, dress-code violations, and inappropriate behavior in hallways, etc. A technical contradiction between Support Interface and Feedback exists.

2.6 Cyber-Charter Schools

School districts are funded by the state based on student enrollment and attendance. Homebound students do not contribute to enrollment or to attendance, and are recently receiving funding from the school districts, by State mandates, thereby diverting funds from the school districts.

A number of problems arise due to this action. Schools must deal with multi-layered communication, state aid is being diverted from the school districts thereby impacting the education of the traditional students, the State pays 35% of Yearly Per Pupil Costs but is withholding 100% for homebound students, the school districts need to cut staff, but cannot cut staff due to contracts, and these actions may be good for expelled and homebound students but is not good for all students.

3.0 Homebound Students

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 safety of their children, and the quality of education. The parents of students want safety, and the schools want control over a consistent curriculum.

Another class of homebound students is represented by students who have been expelled from the public school system due to behavior or discipline problems. This paper deals with this class of homebound student.

4.0 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.

5.0 Results and Discussion

Dr. Faith Waters, Department Head, 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 we 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 Contradiction Matrix for Business and Management contains 31 parameters (see tables 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.

5.1 Educational Equivalents for the Business Features

We immediately recognized the need to identify some 'educational equivalents' to the parameters identified and used for business applications. The team decided to create equivalents for Kindergarten to 12th grade, and an additional set of equivalents for higher education (Colleges and Universities). These equivalents are reported below in the tables.

Table 1 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, or Support Means for business and management.

The K – 12 educational equivalents are Quality of Education, Quality of Supervision, and Student SAT scores.

Table 2 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.) The higher educational equivalents for Feature 16 Product Reliability or Support Spec/Quality/Means are Quality of Education and graduate employment statistics.

5.2 Contradictions Associated with the Homebound Student

We considered some of the contradictions inherent in 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 public school initiatives (they have to be compliant). Teachers are most threatened by these students in the public school venue. In some districts, teachers refuse to go to the students' homes. Students are required to be educated by law, 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 oppositional and need support to develop morally. However no curriculum has been developed to meet this need. These students will eventually return to the general student population, but there will be no modification to their previous behavior while they are homebound.

These homebound students are assessed from time to time to ensure compliance. However, the teacher or teachers who work with them may not be certified in the subjects they must take. Several contradictions exist for this situation. Four of the contradictions are summarized in Table 3 below.

5.3 TRIZ Solutions for Four Contradictions

The first contradiction in Table 3 is the trade off between Feature 17, Support Cost (Remedial Programs, Salaries, Counseling) and Feature 30, Tension and Stress (Teacher Morale, Community Expectations). As stated above, the expelled homebound students are serviced by special teachers who go to the students' homes. This requires costs associated with the remedial programs, teacher certification, and teacher salaries. The teachers' morale is adversely affected because they do not want to enter the hostile environments that exist for some of these student's homes and because they recognize that they are not certified to teach some of the subjects. Thus the costs versus and tension and stress.

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. We now propose 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 to change 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 '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 beginning to expert. 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 convinced to be enthusiastic about developing the “Virtual Educational Component”.

In Principle 24 (Intermediary) Part a., Use and 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.

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. From Table 3, this is represented by Feature 16, Product Reliability or Support Spec/Quality/Means (Quality of Education) and Feature 12, Supply Costs (supplies and salaries). The contradiction matrix directs us to Principles 35 and 24. These have been discussed above.

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, styles, etc.

The fourth and final contradiction is the tradeoff between quality of education and support time, Features 16 and 18 respectively. 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 to eliminate 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 the teachers and staff. However it also responds to the recent challenge of the private Cyber-Charter School initiatives in Pennsylvania that represents an even greater competitive threat.

6.0 Conclusions

We have 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”.

Table 1: K – 12 Educational Equivalents of the 31 Features - Contradiction Matrix for Business

Number	Business & Management	K-12 Education Equivalent
1	R&D Spec/Quality/Means	Teacher and Curriculum Quality; Teacher and Student Achievement and Research
2	R&D Cost	Staff and Curriculum Development; Research
3	R&D Time	Time on Task; Collaboration, ACT 80 days Development
4	R&D Risk	Teacher retention; Non-accredited school/degree
5	R&D Interfaces	Student Teaching; State Mandated Standards
6	Production Spec/Quality/Means	School facilities and infrastructures; Curriculum Development
7	Production Cost	School taxes/bond funds; Per Pupil Cost
8	Production Time	Efficiency in use of instructional time
9	Production Risk	Public dissatisfaction; Student failure/drop-out rates
10	Production Interfaces	Stakeholders; Dept. of Education; Educators, PTA, PTO
11	Supply Spec/Quality/Means	Books/supplies; Technology; Curriculum
12	Supply Cost	Supplies; Salaries; Technology
13	Supply Time	Order Completion; Staff Hiring & Removal; Instruction
14	Supply Risk	Budgets; Substitute, Student & Non-accredited Teachers
15	Supply Interfaces	Admin Staff; Budget Constraints; School Board Priorities
16	Support Spec/Quality/Means	Quality of Education & Supervision; Student SAT Scores
17	Support Cost	Salaries (Admin, Aids, etc.; Service; Counseling; Special Ed.; Remedial Programs
18	Support Time	Scheduling; In-service – Staff Development; Filling Unfilled and Understaffed Positions
19	Support Risk	Administrators Resign/Retire; Special Ed. Programs; Retention of Qualified Personnel
20	Support Interfaces	Dept. of Ed.; School Boards; Community Officials; Organizational Memberships
21	Revenue/Demand/Feedback	Parents; School placed under State Management; Dept. of Ed.
22	Amount of Information	Curricula; Assessment Data; Educational Research
23	Communication Flow	Between Admin/teachers/staff/students/parents/community
24	System Affected Harmful Effect	Drugs; Poor Test Scores; Poor Instructional Facilities; Poor Programs; Drop-out Rates; Budgets Voted Down
25	System Generated Harmful Effect	Exposure to Drugs, violence, etc.; High Drop-out rates; Poor Test Scores; Exposure to Unsafe Environments
26	Convenience	School Holidays; Bussing; School Calendar; Decay of Work Ethic/Motivation/Community Support
27	Adaptability/Versatility	Hours; Split Sessions; Time Issues; Block Scheduling; Emergency Certification; Alternative Routes
28	System Complexity	Private/Public/Charger/Homebound; Cyber; State Funding Regulations
29	Control Complexity	State Board of Regents; State Dept. of Ed.; School Boards; Special Interest Groups; Educational Regulations
30	Tension/Stress	State Exams & Expectations; Community Expectations; Teacher and Staff Morale
31	Stability	Enrollment/Attendance; Personnel Retention; Mobility Rates; Special Education; Foster Children

Table 2: Higher Educational Equivalents of the 31 Features - Contradiction Matrix for Business

Number	Business & Management	Higher Education Equivalent
1	R&D Spec/Quality/Means	Degree/Diploma/Certificate/Honors
2	R&D Cost	Tuition/Financial Aid
3	R&D Time	Years to Degree/B.S./M.S./Ph.D.
4	R&D Risk	Attrition/Competition
5	R&D Interfaces	Cooperative Learning/Partnerships
6	Production Spec/Quality/Means	School Facilities, and Infrastructures
7	Production Cost	Faculty & Staff Salaries/Grad Student Assistantships
8	Production Time	50 Week Instruction/Weekend and Evening Instruction
9	Production Risk	Declining Enrollment
10	Production Interfaces	State Boards/Board of Trustees/Accreditation Bodies
11	Supply Spec/Quality/Means	Books & Supplies/Curricula/IT/LAN's/Technology
12	Supply Cost	Cost of Supplies/Faculty/Staff
13	Supply Time	Order Completion/Purchasing
14	Supply Risk	Faculty Grants/Budgets Constrained
15	Supply Interfaces	Admin/Staff/Government & Industry Grants/Faculty
16	Product Reliability Support Spec/Quality/Means	Quality of Education/Graduate Employment Statistics
17	Support Cost	Salaries (Admin, Aids, Remedial Programs; Counseling; Psychological Services/Facilities & Grounds
18	Support Time	Unfilled Admin/Faculty/Staff Positions
19	Support Risk	Administrators Resign/Retire; Special Education & Remedial Programs; Retention of Qualified Personnel
20	Support Interfaces	Board of Trustees/External Interfaces/Program Boards
21	Revenue/Demand/Feedback	Students/Alumni/Legislators
22	Amount of Information	Curricula/Institutional Research
23	Communication Flow	Between Admin/faculty/staff/students/parents/community
24	System Affected Harmful Effect	Drugs/Unsafe Environment/Censorship/Balancing Freedom and State Policies/Legislative Mandates
25	System Generated Harmful Effect	Exposure to Drugs, Violence, etc.
26	Convenience	Calendar/Course Availability/Evening Instruction
27	Adaptability/Versatility	Multiple Instructional Delivery Systems
28	System Complexity	Private/Public/Virtual Universities/Trade & Technical Schools
29	Control Complexity	State Board of Regents/Multiple Constituencies
30	Tension/Stress	State Exams & Expectations/Community Expectations/ Assessment/Accreditation
31	Stability	Enrollment/Retention/Facilities/Endowments/Grants

Table 3. Contradictions

	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		

CONTRADICTION
 Homebound students are required to meet standards - (Quality of Education)
 Teachers assigned to teach them are not certified for some of the required subjects - (Supply Cost, Support Risk, Support Time, Tension & Stress)

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

#3 2, 25

#4 22, 25

#5

35, 24, 10, 2 #1

35, 24 #2

References

1. Darrell Mann (2002) 'Systematic Win-Win Problem Solving in a Business Environment', Conference Proceedings, TRIZcon 2002, St. Louis.
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