LAPM PROJECT REPORT
for Six Sigma K12 - Online Exam
By Terry Rosen

Project Background and Description

Industry certifications are nationally recognized as valuable in secondary education. They provide a step forward for recent high school graduates in entering the workforce in a higher state preparedness. Most business courses and sequences in our nation do not yet include management training information in Quality Improvement. Six Sigma K12 will provide a certification route for students in business courses.

Many student centered opportunities for exploring business principles involve students in after school and extended activities, (FBLA and DECA are examples). Six Sigma K12 will provide curriculum and testing to encourage students to learn about principles of improvement and project management to prepare them for the Six Sigma K12 Yellow Belt certification. This process will include:

1. Project based exercises that will build a portfolio of work created by the student to illustrate their depth of knowledge of the subject matter.
2. Computer based, modular, self-guided lessons that can also be used in class.
3. A free, repeatable, Yellow Belt exam with which to demonstrate mastery.

The goal of this project is to define a scope and sequence of content required by industry to show mastery of the Yellow Belt level of Six Sigma study. Next, exam questions will be developed. These exam questions will take various forms. The goal of this project is to develop the first iteration of a high quality examination of students' knowledge of Six Sigma at the level of Yellow Belt.

Why do this project?

Continuous Improvement as a field of study has value in every type of business. Yet study of the topics and lessons of QI are often relegated to a master's level of college study. An increasing number of businesses are finding that they have opportunities for saving money or producing products faster and better. Training high school students in these principles provides students with profound relevance to their studies, and encourages companies to consider younger people in their companies who will be more involved in the spirit of improvement.

Access to training in Six Sigma, and other industry level methods can be expensive. Exams and curriculum costs can be prohibitive. Developing a system of free curriculum and examination works to provide opportunities to students and schools that typically lack these opportunities. Further, the learnings from Six Sigma K12 are applicable in ANY business organization, so students unsure about their future goals can gain skills they will value no matter what path(s) they choose to take later in life.

Creating a valid assessment tool helps students gage their preparedness for the ASQ exam, perhaps the most prestigious in the industry. As our system develops, it will be shown that our exam, (future version), meets or exceeds the industry expectation. This first version of the exam demonstrates a significant first step toward a developing vision of younger people learning about quality sooner, and the personal value they will gain from the knowledge in their immediates futures.

Objectives

The objectives of this project are:

1. Examined the industry standard content for Yellow Belt.
2. Created evaluation methods for exam questions.
3. Completed a practice exam that can be taken remotely online.
4. The exam can be used as a partial assessment of the learning of Six Sigma in preparation of taking the exam for Yellow Belt.
5. This exam creates the path to now assess readiness for the ASQ yellow belt exam. We will begin studying this level of preparedness in the immediate future.
6. The exercise of creating this exam has helped us define and narrow the methods to be used in expanding the exam, and the curricula used to study it. Now we can better iterate lessons and training materials for the improvement of delivery online, perhaps with world-wide access.

Deliverables

Deliverables include:

a. A functioning, high quality, online, Six Sigma Yellow Belt exam. (via Google form)
b. A list of topics to be covered and measured
c. Prototype of fifty questions demonstrates concept - now labeled ‘Practice Exam’
d. Question Bank demonstrates suitability for future automated randomness for test security. (Not included on the current exam).

Team Members

Project Manager - Terry Rosen, CQE, CSSGB
Team Members -

Students: 3 students beginning their yellow belt studies (self selected)

Precious Gascott - LSSYB
Shawn Sigala - LSSYB, SSYB
Davyn Cassias - LSSYB, SSYB, SSGB, SSBB, (Amile certifications)
Joaquin Ortega - Meeting to discuss translation of exam questions into Spanish

Staff:

Micah Williams, CTE Coordinator - (prior industry background)
Ethan Emery, Assistant Principal - currently involved in district improvement
Sylvia Rocha, head secretary - beginning SSYB study
Colleen Grierson - Discussed possible use in middle school classes
Alex Sabin - Continuing discussions on applicability of student training to other certifications at state level incl. PMI steps, and Scrum

Other:

Tatsu Rosen - Exam QA
Chris Danillo - CTE Business Partner
Daniel Talero, SSYB - Business Partner
Ambyr Hardy - Suitability for indigenous peoples
Paul Sellards - Coding and infrastructure for advanced testing security
Tamara Kirch - Grant writing and non-profit administrative infrastructure
Michael Bautista - teacher of construction trades at Boulder TEC
Construction contractor
Lealon Sherrod - Artist for Promotions mailer for high school marketing roll out
Jacob Neuchterlein - Owner Elementum 3D
Bill Castle - Mentoring on completion of the project(s)
Clarke
Elie Zweibel - Attorney, on privacy matters in use of student content on website consultation re. Opportunities for grant funding
Aly Stasek - Web developer for the exam and SSK12
Clifford Norman - Mentoring on procedures for accurate calculation of control chart limits using industry standard methods.
USBank - options and details for banking for both TRC LLC and SSK12.
Glenn Harrison -

Stakeholders:

Terry Rosen
SSD Global Solutions
Staff and students at DC-21 High School
Students everywhere

Initial Meetings

Due to the asynchronous nature of meetings during Covid, we had great difficulty coordinating Meets with more than a few team members. This was compounded by communication with student members during the Summer. Many meetings were multi-functional. This review will include only those topics specifically affecting or guiding creation of the exam.

The initial meetings included, but were not limited to:

- Summary of the Six Sigma K12 mission and values
- Discussion of the relationship between our prototype test and the existing exams at QIMacros and Amile
- Low level review of the structure and method of the exams at QIMacros and Amile
- Review of our goal to provide access to the test and curricular free of charge

- Discussion of marketing and other business functions of Six Sigma K12 as they relate directly or indirectly to the exam itself
- Web Dev group meetings focused on the website generally, and included preliminary discussions on test security and verification of exams in the future.
- The issue of providing the test in other languages, and accessibility concepts
- The importance and value of being able to take the test on a smartphone
- Description of process of relating questions to topics in the Colorado business education standards

Agile methods were used to quickly develop test questions. PDCA was implemented to improve or replace some questions.

RAID-Assessment

- Funding sources unknown - possible kick off with crowd-sourcing. Prototype step likely completed with volunteer hours. This issue did not play a role at this stage of development as all time was volunteered.
- The decision was quickly made that smartphone use was important even at this preliminary stage. Not including this functionality might drastically reduce access to content for many students without quality access to the internet.
- Test content and questions should be aligned with both ASQ Yellow Belt and Colorado State business education standards. Coordinating this has proven challenging, but unnecessary. This step is more properly left for a later stage.
- It was also decided that it is too soon to be concerned about official opinions about our exam. This will be put off for roughly a year as our internal exam reaches maturity.

Initial Planning

- Full Topic List - gleaned from ASQ, QIMacros, and Amile sources.
- Estimated project timeline - assumed 50 questions
- Planned sprints for 10 to 15 questions per week. (This was substantially delayed for various reasons outlined above).
- Work breakdown structure was thorough, and led directly to the Gantt chart.
- Gantt chart was planned for six weeks, (optimistic), and for 12 weeks, (less optimistic). Actual length was very close to 12 weeks, or 2 weeks into the start of the new school year.

Execute

Various challenges needed to be managed. While the environmental or functional effect of Covid was anticipated, Summer Break actually posed bigger issues.

1. Contacting staff and students during the break proved to be the single most challenging aspect. Anyone with whom I contacted via email might not respond for up to two weeks.
2. Students were generally busy with jobs, and had little time to reply.
3. Some student technology was just non-functional in a real sense. This included my main student resource. Between us a text message has never been received in either direction, even as tested while standing in the same room.
4. Students do not check their emails over the Summer.
5. Teachers/staff, also, do not check their emails much, over the Summer.
6. Many meetings were held one on one, (via Meet). This did have good outcomes, but involved more time than planned for. It also reduced the synergy hoped for. More inclusive meetings are planned for as we enter the school year.
7. One student member had graduated and moved to Illinois. She was finally reached in the final weeks of this project. She is one of the testers, and is passionate about being included in the continuing development. Her ideas are incredibly well thought out and useful. She suggested that she visit with our class via Meet to share her experiences with Six Sigma so far, including her personal experience with the exams. She also saw immediately the value of students seeing students that were successful with Six Sigma.
8. We attempted to co-develop the questions with their related state business standards. We quickly realized that this halted our progress. I realized it meant learning two things at once, and reassigned the standards to a later stage of development.
9. The three students certified as yellow belts gave great advice about changes to questions and perspectives on handling future issues of test security. This advice led to agreement that Google Forms should be used, and more sophisticated platforms could be developed after the test questions were functional.
10. Discussion is still ongoing concerning the 100% passing requirement. My students are aware of the value as they have experienced this grading system in my class. But adults find it a bit stringent, and they don’t yet realize the validity of the rationale.
11. Careful thought has been applied to developing questions that cannot be easily answered by looking them up on the internet. This, too, is an ongoing concern.

Control

Assessment

Development of this exam represents various improvements over the other exams in play. Communicating this requires detailed examinations of sources/references for question content and for rationale in the method of the asking. Once these factors are known, the next steps to be taken will include:

- Relating the question content to Colorado state standards
- Developing effective and efficient lessons for communicating the required content

Moving Forward

Many ideas were had during this project. As in any suggestion system, they have been recorded, but are as yet unimplemented. An important early feature of the next stage of development will be a synergistic group review of the ideas, and an assessment of plausibility in their development and inclusion in further iterations.

Main Roadblocks to Progress

Communications issues over the Summer, though anticipated, were more substantial than expected. If work on this sort of project will utilize students and teachers, over Summer months, a much more formal scheduling would be required to ensure even partial group attendance.
A solution more likely to succeed would be the inclusion of these tasks ‘in class’, including meetings with SMEs ‘during class’. So, next step development will begin with crafting methods of inclusion into our business curriculum. Generally speaking, this will not be very difficult, but may be time consuming.

The other, very obvious impediment to successful team meetings was Covid. While online meetings did occur, and were productive, it’s difficult to compare them with the efficacy of meeting with all members in person. For the time being, we are in an environment with in-person capability as far as students and staff. It’s unclear if any outside SMEs or advisors could meet in person. Even meeting with staff from other schools might be a difficult thing to accomplish.

New Goals

As we proceeded to develop the exam, the realization came that students passing state-recognition certifications would create a revenue stream for their districts. Each district collects certifications received during the year and submits them to the state. If they are recognized by the state, then the state will remunerate the districts ostensibly to help offset the costs of delivering the training.

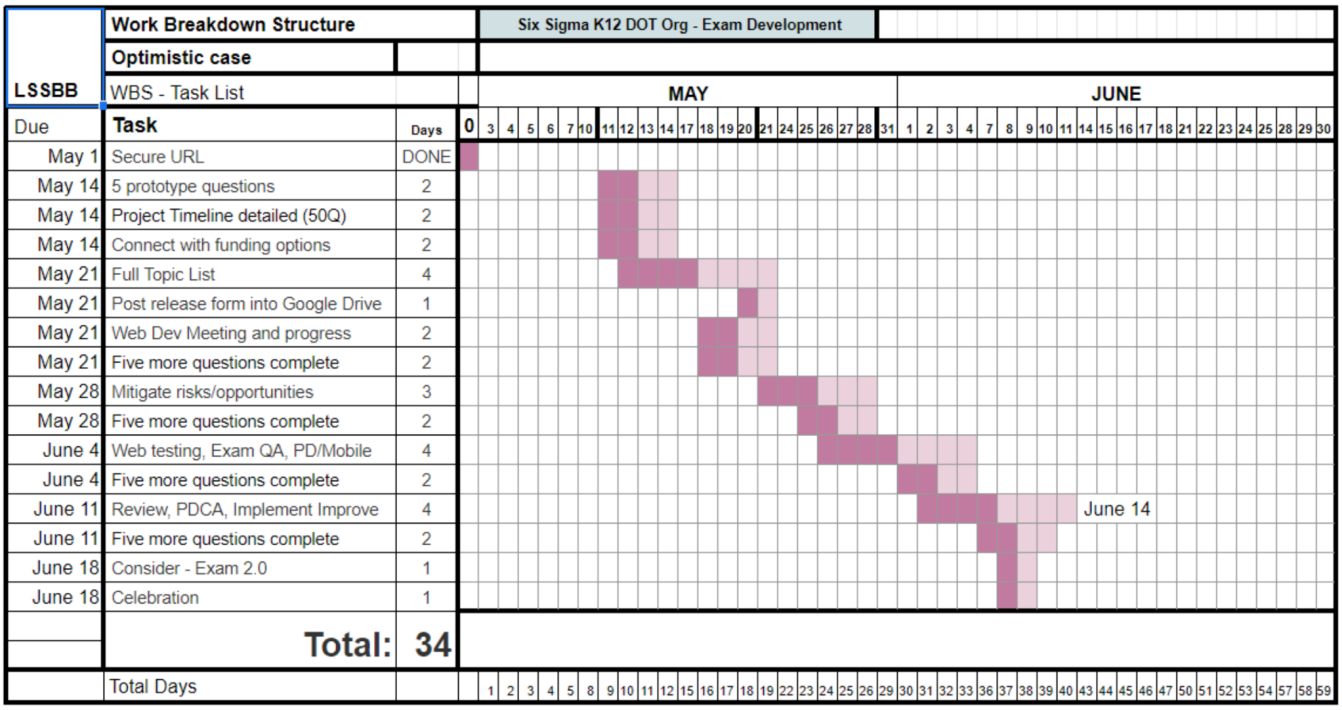
The Six Sigma K12 goal is to facilitate 2000 certifications by the end of June 2023. The question arises, by what method will we claim to have facilitated any individual certification? The majority of suggestions proffered to support this measure also have obvious effect on the ease with which a student has access to the learning. No student is required to use solely our materials, and no teacher is required to use our materials at all. But the state will gather data on which certifications were obtained in the state.

The exam, in current and future forms, may be a focal measure for participation in our specific content. As we near the middle of 2022 we hope to shift into a more formal acceptance of our own exams value. By mid 2023 we plan to be offering our own exam for certification, tailored to secondary schools, and to be recognized as meeting the ASQ standards for content. At that point, we hope that the exam will itself mark the measure of our success in imbuing quality science into public schools within Denver Public schools, the state of Colorado, and beyond.

Deliverables - Begins next page

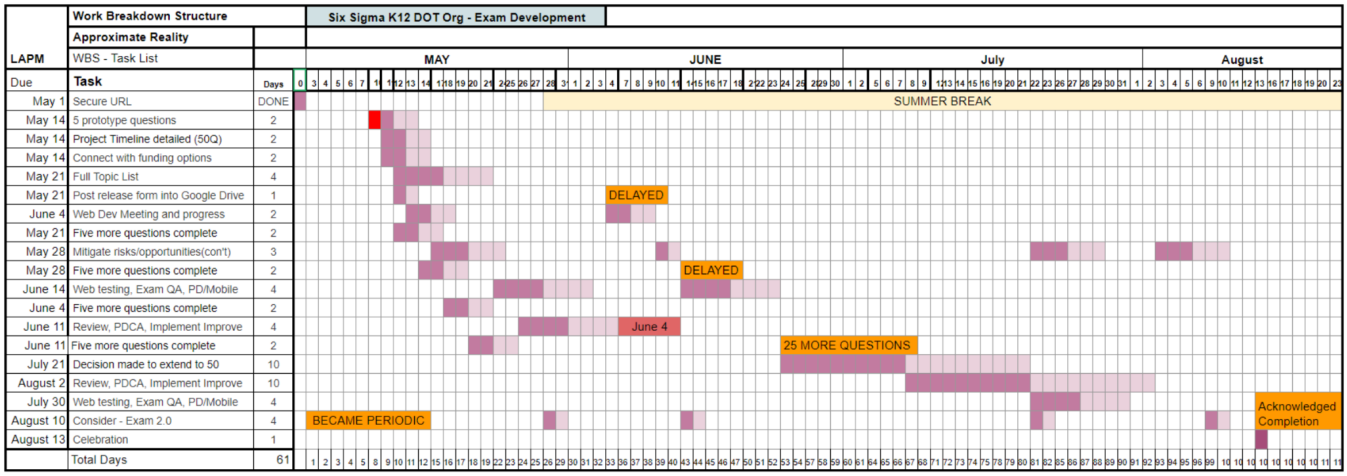
Deliverables

Gantt Chart - Optimistic Estimate



LSSBB	Work Breakdown Structure Optimistic case WBS - Task List		Six Sigma K12 DOT Org - Exam Development
Due	**Task**	Days	
May 1	Secure URL	DONE	
May 14	5 prototype questions	2	
May 14	Project Timeline detailed (50Q)	2	
May 14	Connect with funding options	2	
May 21	Full Topic List	4	
May 21	Post release form into Google Drive	1	
May 21	Web Dev Meeting and progress	2	
May 21	Five more questions complete	2	
May 28	Mitigate risks/opportunities	3	
May 28	Five more questions complete	2	
June 4	Web testing, Exam QA, PD/Mobile	4	
June 4	Five more questions complete	2	
June 11	Review, PDCA, Implement Improve	4	
June 11	Five more questions complete	2	
June 18	Consider - Exam 2.0	1	
June 18	Celebration	1	
	Total:	**34**	
	Total Days		

Gantt Chart - Approximate Reality



LAPM	Work Breakdown Structure Approximate Reality WBS - Task List		Six Sigma K12 DOT Org - Exam Development
Due	**Task**	Days	
May 1	Secure URL	DONE	
May 14	5 prototype questions	2	
May 14	Project Timeline detailed (50Q)	2	
May 14	Connect with funding options	2	
May 21	Full Topic List	4	
May 21	Post release form into Google Drive	1	
June 4	Web Dev Meeting and progress	2	
May 21	Five more questions complete	2	
May 28	Mitigate risks/opportunities(con't)	3	
May 28	Five more questions complete	2	
June 14	Web testing, Exam QA, PD/Mobile	4	
June 4	Five more questions complete	2	
June 11	Review, PDCA, Implement Improve	4	
June 11	Five more questions complete	2	
July 21	Decision made to extend to 50	10	
August 2	Review, PDCA, Implement Improve	10	
July 30	Web testing, Exam QA, PD/Mobile	4	
August 10	Consider - Exam 2.0	4	
August 13	Celebration	1	
	Total Days	61	

Web address for exam

https://docs.google.com/forms/d/e/1FAIpQLSeNyfbDAGvcujHZ4KQyAjLBBLhoTdmdgAaOLlg_c7tSbYAHiQ/viewform?vc=0&c=0&w=1&flr=0

Exam planning going forward

These discussions involved primarily Terry Rosen, and three certified yellow belt students.

PCDA exam improvement is proceeding. Some potential to replace certain questions with some that target the QIMacros testing. The test is functional in its current state, but will be revised up to web launch.

Discussed consideration for adding more questions. ASQ has 75 scored questions, and 10 unscored. The QIMacros exam has 140 questions. However, the QIMacros exam goes well beyond the ASQ BoK.

Discussed the process of shifting from a yellow belt practice exam, to a yellow belt actual exam.

The actual exam will be similar, but will have questions that are created live coded to the tester's name and date. Questions and responses will be coded at random to avoid the possibility of cheating via currently available cheating websites. A question bank will need to be created for other questions. A bank of 4 to 6 questions, per question, will need to be created.

Discussed timeline for creating green belt practice exam. That has been shelved until Six Sigma K12 has proven viable, and will be reconsidered in approximately 12 to 18 months, (~6/22 to 12/22).

Students will continue to be involved as deeply as possible in the creation of all content, including test questions. Final quality assurance to be overseen by a qualified adult.

Links to Colorado Business Standards

Colorado Secondary Business Administration Program - Skills and Competencies
http://coloradostateplan.com/wp-content/uploads/2020/04/Entrepreneurship-SS.pdf
Business and Marketing Scope and Sequence (CTE in Colorado) - [from Colorado State Plan]
http://coloradostateplan.com/business-and-marketing/

Career Certification information and references

HB16-1289 - List of Qualifying Programs (as of 10/17)
https://www.colorado.gov/pacific/sites/default/files/10-2017_HB16-1289_Approved_Programs_update.pdf
Colorado Talent Pipeline Report
https://www.colorado.gov/pacific/sites/default/files/2019_Talent_Pipeline_Report_Print.pdf
Career Development Incentive Program Approved Programs List (2020-2021)
https://public.tableau.com/app/profile/dhe.state/viz/CareerDevelopmentIncentiveProgramApprovedProgramsList2020-2021/2019CDIPList
Career Development Incentive Program - Fact Sheet (2019-2020)
https://www.cde.state.co.us/postsecondary/2019-20-fact-sheet-extended
Industry Credential District Participation.xls
Industry Credential District Participation.xlsx

Deliverables - (con't on next page)

Meetings with Minutes - (almost all meetings were conducted via Google Meet)

Meeting Minutes re. Six Sigma K12 Exam Development
From 4/30/21 to 9/19/21

Meeting - 4/30
- Attendees - Terry Rosen, Precious Gascott, Shawn Sigala, Davyn Cassias
- Topic - Introduction and review of the topic, opening discussions

Meeting - 5/13
- Attendees - Terry Rosen, Precious Gascott
- Topic - First five questions for exam prototyping
  - What options are available within Google Forms as an exam?
  - By what method can my students add questions and answers to the exam?
  - How do we access the scores?
  - Approximately how long will it take students to develop 15 questions each?
  - Students should create the videos for each topic to best connect with students.

Meeting - 5/16
- Attendees - Terry Rosen, Patricia Baca
- Topic - Possible funding sources for SSK12

Meeting - 5/21
- Attendees - Terry Rosen, Precious Gascott, Shawn Sigala
- Topic - Completing the list of concepts distilled from QIMacros and AMile
  - Adjusting for practicality
  - Selection of which 25 questions should be the stage 2 goal?

Meeting - 5/21
- Attendees - Terry Rosen, Precious Gascott, Shawn Sigala, Davyn Casias
- Topic - Informed that a student release form for use of student video in lesson creation has been uploaded.

Meeting - 5/21
- Attendees - Terry Rosen, Aly Stasek
- Topic - Initial meeting re. developing the online testing interface.
  - Agreed Google form is a good stage 1 plan.
  - Stage 2 will be handled by Aly once 100 questions have been created.

Meeting - 5/23
- Attendees - Terry Rosen, Shawn Sigala
- Topic - Next five questions for exam prototyping
  - Some adjustment to answers provided
  - First attempt to have students create and add the questions and answers
  - Task proved quite challenging - began rethinking this step

Meeting - 5/28
- Attendees - Terry Rosen, Davyn Casias
- Topic - Discussion of SWOT and Risk analysis
  - Brainstormed all
  - Outlined methods for mitigating known risks

Meeting - 5/30

- Attendees - Terry Rosen, Davyn Casias
- Topic - Next five questions for exam prototyping
  - Discussed control chart questions in depth
  - Discussed existing lesson suitability for those questions
  - Discussed conversation with Cliff Norman re. misuse of standard deviation
  - Began discussion of diving in deeper on that subject

Meeting - 6/4

- Attendees - Terry Rosen, Davyn Casias
- Topic - Prototype test with 15 questions
  - Proof of concept is established
  - Some spelling errors corrected
  - Correction process established
  - Testing options adjusted - scores not immediately released to user
  - Mobile test delayed

Meeting - 6/21

- Attendees - Terry Rosen, Davyn Casias
- Topic - 25 questions completed
  - Discussed completing 50 instead
  - Examined topic list for remaining questions
  - Agreed some risk involved in the timing due to required graphics
  - Decision made to move ahead on 50 questions
  - Review of requirements in time and effort to reach 100 questions
  - Review technology steps toward automated question generation

Meeting - 7/2

- Attendees - Terry Rosen, Precious Gascott
- Topic - Review, PDCA and improvement of 25 Q's
  - Discussed increasing difficulty in communication during Summer
  - First official test of interface via mobile device.
  - Mobile use is a complete success (25 Q's)

Meeting - 7/21 - Email update - no meeting

- Recipients - Terry Rosen, Precious Gascott, Shawn Sigala, Davyn Cassias
- Topic - Moving ahead with 25 more questions

Meeting - 7/22

- Attendees - Terry Rosen, Michael Bautista
- Topic - Introduction to the topic with specifics and potentials
  - Invitation to join the team
  - Discussed payroll and taxes
  - Arranged next meeting

Meetings with Minutes - (con't on next page)

Meetings with Minutes - (con't)

Meeting - 7/24
- Attendees - Terry Rosen, Michael Bautista
- Topic - Discussion of particulars in forming the businesses
  - Terry Rosen Consultant LLC, and Six Sigma K12 non-profit
  - Discussed pros and cons for LLC and non-profit
  - Discussed the value of the concept in general
    - Particular value in construction trades and
    - State remuneration for certifications

Meeting - 7/30
- Attendees - Terry Rosen, Precious Gascott
- Topic - Next five questions for exam prototyping, PDCA, and updating
  - Follow up testing on web and mobile

Meeting - 8/2
- Attendees - Terry Rosen, tester from outside the group (x2)
- Topic - Beta testing mobile functionality - images may load too slowly

Planned meetings postponed
- Postponed due to student work schedules and other factors

Meeting - 8/9 - Email update - no meeting
- Recipients - Terry Rosen, Precious Gascott, Shawn Sigala, Davyn Cassias
- Topic - 50 Questions complete, review needed
  - Last four questions requirement improvement
  - Clearer questions and better quality graphics

Meeting - 8/13 - Email update - no meeting
- Recipients - Terry Rosen, Precious Gascott, Shawn Sigala, Davyn Cassias
- Topic - Informal celebration of Alpha level completion
  - Planning on next steps
  - In person celebration TBA

Deliverables - (con't on next page)

GETSMART - Conversion from TIMWOODS or DOWNTIME

G.E.T. S.M.A.R.T.

TO REDUCE WASTE

G 

Glitch - Defect, scrap, rework
Parts not made to spec, breakage in the field
Spelling, grammar, math errors, no internet

E 

Excess Processing - Too good, extra steps
Time spent going beyond customer spec
Busy work, more quiz questions without value

T 

Transportation - Moving stuff around
Moving supply to or from storage, moving it again
Driving to school when students are staying home

S 

Surplus - Product made without a buyer
Too many widgets, more storage, transportation
Increases all other forms of waste

M 

Motion - People moving around
Needless movement of people, non value added
Crossing campus to retrieve a printout

A 

Abilities - Untapped worker skills
Qualifications, improvement opportunities, ideas
People not challenged at their level, joy in learning

R 

Reserve Supply - Excess raw materials
Excess inventory for production, increases costs
Buying unneeded supplies to maintain the budget

T 

Time - Waiting, anyone or anything
A product spends 99% of its time waiting
Teachers wait for work, students wait for grades

Six Sigma Yellow Belt practice Test

Topic List

5S
Management of responsibility
DMAIC
Muda - Waste
Voice of the... - (Business, customer, employee, supplier, product)
Lean
Six Sigma - rationale
GETSMART - (TIMWOODS)
PDCA
Control Charts
Work Breakdown Structure - Value Stream
Pareto
Value added
Standard Deviation
SIPOC
5 Whys
Kaizen, Imai
Suggestion System
SCRUM
SWOT
Fishbone diagrams
Root Cause Analysis
Box Plot
Poka Yoke
Performance Appraisal
Gantt
Critical to Quality
Six Sigma Projects
Agile
Toyota Production System
Kanban
4-50 Rule
Scatter Plot
Process champion (sponsor)