HOW STUDENTS LEARN THROUGH LEAN SIMULATION
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INTRODUCTION
Lean thinking is a systematic approach to eliminating waste through continuous improvement for the flow of product at the customer demand. Lean simulation allows students to achieve lean thinking faster and more efficiently through applied learning technology. Lean means having an individual mindset and specific set of principles for the creation a system free of waste and defects. The goal of this research project is to examine the effects of how well high school students comprehend lean philosophy, and what is required to improve this thought process. Countless students believe lean is just another term for cutting corners, however, it is much more. Some of the world’s best organizations incorporate these principles. Data was gathered through laboratory and classroom observations of approximately one hundred high school students from 5 different high schools. This study is a preliminary step by evaluating high school teacher thoughts about this simulation. As a result, it is hypothesized that high school students 16-19 years of age, are able to retain lean thinking principles through simulation.

MATERIALS AND METHODS
One-Hundred High School students between the ages of 16-19 from 5 different High Schools located in Northern Indiana participated in an Airplane simulation.

SHORT-TERM SIMULATION TRIALS
- Students were placed in teams of 4-6.
- Each team received a set of paper airplanes from the professor.
- Students were instructed to design and build paper airplanes within a certain amount of time.
- Students were encouraged to submit the best paper airplane.

RESULTS OF EXERCISE MEASURED:
- Percentage of quality passes
- Profit/Loss
- What types of waste were there

LESSON PLAN

Traditional Manufacturing Simulation Activity
Procedure:
1. Divide into teams
2. Develop Goals
   “sell paper airplanes to public”
3. Each team defines objectives to accomplish goals.
4. Students are assigned specific jobs.
5. Students work on their assigned position.

SIMULATION

One student as he has his responsibility of being the folder for his team

Professor Laux as he explains to the High School students how the simulation is going to articulate

Students at the beginning of the simulation

Students at the beginning of the simulation

Analysis
As a result, through lean simulation it is seen that the High school students were able to adapt at a better rate. After the first round students had improved participation, by raising their hand for more paper.

Education
This graph shows improvement, after simulation activity

Simulation
To study the response of students and how well they adapt to cutting waste under certain metrics.

Learning through simulation and teamwork
Marked improvement in participation and enthusiasm

SURVEY RESPONSES
Surveys were distributed to all high school teachers who had students participate in the simulation activity. The following are a representation of the survey questions and their responses:
Q: How do you think your students have benefited from this simulation?
A: Good connection to what really happens in the real world.
A: I think that students have a better idea of how manufacturing works.
Q: Do you think this simulation changed their way of thinking lean?
A: Yes, I believe that many students would have thought that the assembly line method would have been better.
Q: Would you use this simulation test again and why?
A: The simulation was neat and hands on. I would like to present this to my classes and learn about the concepts.
A: In a class that covers the different manufacturing forms, yes definitely. It is a simple way of demonstrating how lean manufacturing works and it’s benefits
Q: How do you think students enjoy hands on simulation opposed to learning a software simulation?
A: If a student can hold something in their hands, they will be able to make a connection to something that they already know.
A: This hands on activity for the time allotted. Normally the software simulation take a long time to set up and the students do not get a chance to do a lot with it. (only click a few buttons to see the outcomes because a lot needs to be pre-done.)

LONG-TERM GOALS

Expand to intermediate 7th and 8th grade students:

• Students will be able to apply lean concept “flow” to manufacturing simulation
• Discriminate non value and value added activities
• Assess the impact of applying lean concepts to the simulation related to quality and production cost.
• Increase survey participation

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