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## TEACHING BRIEF

# Teaching Teachers about Supply Chain Management to Influence Students' Career and Education Choices

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## ABSTRACT

Since teachers are influential in high school students' career choices, enabling high school teachers to introduce educational and career opportunities in supply chain management is a viable strategy for reaching high school students about these opportunities. This article presents a pilot program of supply chain workshops to educate high school and middle school teachers and guidance counselors about the opportunities in supply chain management and logistics and to enable them to integrate supply chain concepts into their teaching. These workshops incorporate a mix of slideshows to introduce concepts, hands-on activities to illustrate how the concepts work, and field trips and guest speakers to demonstrate concepts in real world applications.

***Subject Areas: Nontraditional Students, Supply Chain Management, Teaching Using Games, and Teaching Using Projects.***

## INTRODUCTION

According to the economic development organization Conexus Indiana (2011), more than 250,000 people in Indiana are employed in supply chain and logistics jobs with an estimated 75,000 more employed by the state's manufacturers in logistics positions. Moreover, a 20% increase in the number of these jobs has been predicted for central Indiana over the next 5 years. In spite of these numbers, colleges and universities in Indiana are challenged to recruit undergraduates to their supply chain management degree programs.

Gardner, Gausman, and Silvers (2009) reported on a pilot program create supply chain curriculum for middle and high schools in Indiana. This curriculum needs to be implemented on a widespread basis for it to be effective at recruiting students into supply chain degree programs and careers. One obstacle to widespread implementation is that teachers are not informed about opportunities in supply chain management. Since teachers, along with parents, are among the greatest

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influences on high school students' career choices (Dick & Rallis, 1991), enlisting teachers to introduce educational and career opportunities to high school students is a viable strategy. A pilot program of workshops to educate teachers and guidance counselors in Indiana about the opportunities in supply chain management and to enable them to integrate supply chain curriculum into their classes has been funded by grants from the U.S. Department of Education and the Indiana Department of Education.

## WORKSHOP FORMATS

The workshops were piloted in two formats:

- A 2-week workshop meeting providing a broad overview of supply chains, and
- Two-day workshops focused on math applications.

The 2-week workshop format was piloted for high school and middle school math teachers in 2009 and for a broader audience of guidance counselors, and math, science, technology, economics, and business teachers in 2010. The 2-day format was piloted for high and middle school math teachers in 2011.

The first 8 days of the 2-week workshops were a mix of slideshows to introduce concepts, hands-on activities to illustrate how the concepts work, and field trips and guest speakers to demonstrate concepts in real world applications. The ninth day was devoted to developing a lesson integrating supply chain management with a lesson in the workshop participants' teaching discipline. These lessons were presented to the other participants and to representatives from the Indiana Department of Education and Indiana STEM network on the last day of the workshop. This allowed the workshop participants to share curriculum development ideas with each other and with state officials who could disseminate the materials further. The schedule for the 2009 workshop is summarized in Table 1. The main differences in the schedule for 2010 were the addition of some hands-on activities (Table 2) and the substitution of field trips to Dow AgroSciences (agricultural chemicals and biotech products) and Roche Diagnostics for the presentation on life science industries. Presentations on life science industries and medical devices were integrated with the field trips.

When possible, speakers and learning experiences related to a field trip were scheduled immediately before or after the field trip. For example, speakers on transportation issues and entrepreneurship were scheduled in the morning to prepare workshop participants for a field trip to FedEx in the afternoon. In 2010, the field trip to Garrity Tool, a machine shop, was scheduled in the morning followed by a trip to rapid prototyping lab at in the afternoon. Speakers and field trip guides also talked to the teachers about their own educational backgrounds, their own career paths, and typical educations and career paths of people in their companies to enable the teachers to tell their own students about educational requirements and career paths in supply chain management. Workshop materials are posted at <https://supplychainnworkshop.pbworks.com/>.

**Table 1:** 2009 schedule for 2-week workshop.

Day	Morning	Afternoon
1	<p>Introductions</p> <p>Presentation – What is supply chain management and why is it important for Indiana?</p> <p>Presentation – Introduction to JIT and flow of materials</p> <p>Activity – JIT Simulation</p>	<p>Activity – Manufacturing a no-bake key lime cheesecake</p>
2	<p>Presentation – Introduction to manufacturing and supply chain information systems and ERP</p>	<p>Field trip – Nucor Steel</p>
3	<p>Field trip – Garrity Tool</p> <p>Presentation – Manufacturing issues</p>	<p>Presentation – Quality management, Kaizen, and Deming's Fourteen Points</p>
4	<p>Field trip – Subaru auto assembly plant</p>	<p>Presentation – Economic development</p> <p>Field trip – Birk Nanotechnology Center at Purdue Research Park</p>
5	<p>Presentation – Transportation issues</p> <p>Presentation – Entrepreneurship</p>	<p>Field trip – FedEx</p>
6	<p>Presentation – Life sciences industries</p> <p>Presentation – Public policy for manufacturing, transportation, and distribution industries</p>	<p>Presentation – Global supply chains, foreign trade zones, customs, and international business</p> <p>Presentation – Workforce development and public policy</p>
7	<p>Field trip – Redcats distribution center</p>	<p>Presentation – RFID, material handling automation</p>
8	<p>Activity – Beer distribution game</p> <p>Presentation – Purchasing and the bullwhip effect</p> <p>Presentation – Forecasting</p>	<p>Presentation – Packaging</p> <p>Activity – Making boxes to protect eggs when dropped</p>
9	<p>Lesson planning</p>	<p>Lesson planning</p>
10	<p>Presentation of lesson plans by teachers</p> <p>Presentation – Indiana STEM network</p> <p>Presentation – Trends in math education</p>	<p>Presentation of lesson plans by teachers</p>

The 2-day workshops followed the format of introductory material and learning experiences in the mornings with a field trip on the first afternoon and the teachers working in groups on their project on the second afternoon. Each of the 2-day workshops culminated with a project where the teachers applied some aspect of mathematics that supports supply chain management. The themes, related field trips, and projects for the two workshops are summarized in Table 3.

Both workshops were assessed using formative evaluations of each field trip, activity, and presentation and using a summative evaluation allowing each participant to rate aspects of the workshop on a four point Likert scale. Teachers were incented to attend the workshops by stipends of \$75 per day paid out of the grant supporting each workshop. Additionally, teachers received continuing education credit that could be used to meet state licensure requirements.

**Table 2:** Hands-on learning experiences.

Experience	Description
Just-in-time simulation	Poker chips and dice simulation of an assembly line or supply chain to illustrate variance reduction, batch size of one, and pull systems.
Process design exercise	Making key lime pies to learn PERT/CPM and process design.
Beer game	Popular classroom exercise for demonstrating material and information flows in a supply chain.
Airplane game	Making paper airplanes to learn about cycle time, line balancing, and how to lay out an assembly line for material handling.
Packaging lab	Making foam lined corrugated cardboard boxes to hold an egg to be dropped from about 10 feet high.
Rapid prototyping lab	Designing an object using computer aided design and prototyping it in plastic.

**Table 3:** Themes of 2-day workshops.

	Workshop 1	Workshop 2
Theme	Designing quality into the processes of teaching and learning	Mathematical modeling – linear programming models of supply chains
Field trip	Cummins Engine	Wal-Mart Distribution Center
Project	Redesign the teaching of some topic using quality tools	Build a linear programming model of a simple supply network and solve it in Excel

## SELECTION OF WORKSHOP TOPICS

The goals of the 2-week workshops were

- to give the teachers an overview of supply chains,
- to enable them to create and adapt lesson plans that incorporate teaching about supply chain management into the topics and standards of the subjects they teach,
- to demonstrate exemplary hands-on learning experiences, and
- to challenge the teachers to think about teaching and learning as processes and about building quality into the process of education.

Even though process design is listed as the fourth goal, it was the first topic covered in the workshop following the introduction, but because it is foundational to supply chain management. The process design experiences readied the teachers to observe processes in the manufacturing and distribution enterprises that they would visit on field trips during the rest of the workshop. Following process design, the workshop topics flowed through the supply chain starting with manufacturing,

and proceeding through packaging, transportation and distribution. The supporting topics of information systems, ERP, entrepreneurship, public policy, quality management, Kaizen, Six Sigma, purchasing, and RFID were selected because they are essential to an overall understanding of supply chain management. Specific manufacturing industries were selected because of their role in Indiana's economy. For example, steel was selected because of its foundational role in all supply chains and life science industries and automotive industries because they are important sectors of Indiana's economy.

Choices of whether to use a field trip, hands-on learning experience, or guest speaker to illustrate supply chain concepts were based on:

- The impact and effectiveness of field trip, speaker, or learning experience, and
- The availability of field trip, speaker, or learning experience.

For example, the choice of doing a hands-on packaging lab rather than visiting a packaging plant was because the packaging plants available to visit in the Indianapolis area really did not force teachers to think through all of package design issues, such as strength of materials and resiliency of filler, the aspects of using a scale diagram, and measuring and folding that the hands-on experience did. On the other hand, visiting a steel mill with the thunder of the furnaces and the fireworks of tapping of white hot steel is one of the highest impact experiences in manufacturing. Most of the field trips and presentations were arranged with companies and individuals having relationships with the workshop organizer developed over years of participation in local chapters of professional societies such as the Association for Operations Management (APICS), the American Society for Quality (ASQ), the Institute of Packaging Professionals (IoPP), the National Association of Purchasing Managers (NAPM-ISM), and the Council of Supply Chain Management Professionals (CSCMP). However, providers of field trips and presentations were contacted specifically for this program.

In contrast to the 2-week workshops, the goals of the 2-day workshops were

1. to introduce the teachers to a math related theme in supply chain management,
2. to have them do a supply chain mathematics project so they can see project based learning from the learner's perspective, and
3. to introduce teachers to career opportunities for their students in supply chain management and logistics.

The theme of the first 2-day workshop was building quality into the design of a process, because of its relevance to building quality into educational processes. The two process design exercises from the 2-week workshop were combined with a brief introduction to quality, kaizen, and Six Sigma, in preparation for the afternoon field trip to Cummins Engine, a Six Sigma company. We followed this with an in depth discussion of the meaning of quality and Deming's fourteen points with a goal of identifying what it means to design quality into the processes of teaching and learning. For their project, the teachers developed flow charts of the processes of teaching addition, subtraction, multiplication, and division of fractions, did an

**Table 4:** Overall rating from summative evaluation.

Year	Number of Participants	Overall Rating
2009	21	3.94
2010	32	3.46
2011	13	3.64

exercise of applying a five whys root cause analysis to why students have difficulty with fractions, and then developed cause and effect diagrams incorporating the difficulties they identified in the root cause analysis.

The second 2-day workshop began with an introduction to formulating linear programming problems followed by the graphical method for solving two variable linear programs. We visited a Wal-Mart Distribution Center during the afternoon. On the second day, participants learned to do the Simplex Method for three variable problems on paper and use Excel to solve larger problems. For their project, the teachers created a linear programming model of a simple supply network that could be done in 35 variables based on Bassett and Gardner (2010). Workshop materials are posted at <https://supplychainworkshop.pbworks.com/>.

## WORKSHOP EVALUATION RESULTS

The summative evaluations for each workshop had a combination of open-ended questions and questions allowing participants to rate various aspects of the workshop on a four point Likert scale. Most of these questions are not comparable for the different workshops due to differences in format and objectives. The overall ratings are comparable because those rate of the workshop on a scale of 1 to 4 with 4 being excellent. The results of the overall evaluation are in Table 4.

In spite of the fact that feedback from the 2009 workshop was used to improve the 2010 workshop, ratings were lower. Drilling down into the questions on improving the workshop revealed that satisfying a broader audience that included guidance counselors and science teachers was more difficult than satisfying narrower audience of math teachers only. Ratings for 2011 workshops were higher than for 2010, probably due to having all math teachers and not trying to satisfy the broader audience. Drilling down into detailed questions indicated that the amount of math covered was too much and too intense for the short duration of the workshop but this can be corrected.

The ratings and the level of enthusiasm at the close of each workshop confirmed that these were successful pilots. Many of the participants in the 2010 workshop signed up because their colleagues who attended the 2009 workshop recommended it. Also, most of the participants from the first 2-day workshop who had not signed up for the second weekend, signed up for the second workshop when they realized how beneficial the first workshop was.

The grants funding the workshops did not include a detailed follow-up study on the impact on the teaching of participants. However, a survey of 2-week workshop participants with a 19% response rate indicates that participants are incorporating information and materials from the workshops in a variety of ways including

**Table 5:** How workshop participants use workshop materials?

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**From a business teacher** – We use a format of the airplane game using legos to demonstrate an assembly line in my Business Foundations class. We also went to Subaru again this year. At different times during the year, I have described some of the places we visited, particularly Garrity Tool, FedEx, and the steel mill.

**From a biology teacher** – I discuss the green ideas used by the Subaru plant and the steel plant in my Environmental Science classes when we talk about the three Rs (reduce, reuse, recycle) and proper disposal of hazardous wastes.

**From a math teacher** – I have used examples from our field trips on many occasions:

- Students are fascinated by the nano-technology stuff at Purdue.
- I have talked about Nucor Steel many times because it was just a cool experience.
- I use the location planning unit in Pre-Algebra when we are graphing.
- I have often referred to math test that is used in the job application process for packaging technicians. In fact, I have since learned that Subway also has a math skills test for prospective employees.
- I use Garrity Tool as an example of a well-paying job that requires a 2-year technical degree in an attempt to motivate students about education after high school.
- Fed Ex, Subaru, Redcats have all been mentioned at one point or another in my classroom to illustrate math concepts.
- Students have been very interested in the RFID technology when I have discussed it.
- When I teach discrete math, logistics always came up when discussing paths and circuits.
- Of course, I always relate the discussion to math or the importance of further education.

**From a technology teacher** – In my classes, we discuss why this section of interstate is under constant construction and how important it is to move commerce in this part of our nation. Rarely do people, even professional adults, grasp the connection of semi-trucks and interstate construction.

**From an economics teacher** – I always give examples of the workplaces we visited in my economics classes.

**From a guidance counselor** – I take classes exploring careers to the computer lab to visit the Dream-It-Do-It Web site. The kids find it very beneficial.

**From a technology teacher** – I have told many stories of the field trips we went on to my students. Although not full blown lesson plans, I have gotten many interesting facts to my students. I would advise anyone of my colleagues to take your class. It also enabled me to meet counselors in your class, who are now recruiting students for my classes.

**From a math teacher** – I have mentioned the crossroads of Indiana information (why we are such a nice central state) all the time. I have talked about the beer game (not mentioning beer, but just the inventory piece) as well as the Fed Ex trip and the visit to Subaru. I mention these any time I am trying to link math to any type of real world use.

**From a math teacher** – I have told stories about several of our experiences. I often mention the steel factory, explaining several processes, heating the metal, and rolling the steel. We often talk about Subaru and the efficiencies of its assembly line.

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full-blown lesson plans, examples, and stories to illustrate concepts in their teaching. Comments from the survey are summarized in Table 5.

These workshops have a very wide potential reach. If the 60 teachers and counselors who participated in the workshops are telling their students about supply chain management and each teacher has 100–150 students each year in the classes they teach, then approximately 6,000–9,000 students per year are hearing about supply chain management.

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