



Transportation System Based Summer Academy for Teachers (RTP, Strand 4)

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Shashi Nambisan is a Professor of Civil Engineering at University of Tennessee, Knoxville (UT). Since 1989, he has led efforts on more than 165 research, education, and outreach projects that have addressed local, statewide, regional and national issues in transportation and infrastructure systems management related to policy, planning, operations, safety, and risk analysis. He has authored or co-authored more than 125 peer reviewed journal and conference publications. Along with his students and colleagues, he has made over 230 technical presentations at international, national, and regional conferences and at universities. One of Professor Nambisan's passions is the development of the future workforce, including efforts at the pre-college level. He enjoys working with students. For his contributions as an educator, researcher, and leader, Professor Nambisan has received several awards and honors. Among the awards and honors he has received is a proclamation by the Governor of Nevada designating January 31, 2007 as the "Professor Shashi Nambisan Day" in recognition of his leadership role in and contributions to enhancing transportation safety.

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Transportation System Based Summer Academy for Teachers (*RTP, Strand 4*)

Introduction

This paper summarizes efforts related to and outcomes from the development and implementation of 3-day long transportation summer Academy (workshop) for teachers in 2014. The Academy was organized by the University of Tennessee's Southeastern Transportation Center (STC) and the Department of Civil and Environmental Engineering (CEE). It also includes lessons learned and suggestions for the adoption of this program in other settings.

The importance of developing the future transportation workforce has been recognized across the US. The literature documents many efforts that define the needs, challenges, and opportunities in this regard (e.g., Council of University Transportation Centers' National Transportation Workforce Development Summit in 2012 - http://cutcbanquet.com/wp-content/uploads/2013/06/NTWS_Summary-of-Results.pdf). One key strategy for ensuring a diverse, well qualified future workforce is building the employment pipeline starting with students in the pre-collegiate system - i.e., Kindergarten to 12th grade (K-12). This requires alerting, attracting, engaging, motivating, and exciting students about educational and career opportunities in transportation. Further, context-based (or authentic) educational strategies that link real-world situations to concepts and principles are extremely effective in attaining deeper and long-term understanding of the subject materials.

Background

Summer camps and academies for students have been used, and anecdotal information suggests that they have had some amount of success. However, while students tend to enjoy such activities and learn from them, this approach tends to have limited cost-effectiveness based on the number of students impacted and the long term yield has not been well documented. One potential alternative approach is to target teachers, who play a critical role in the K-12 system. Each teacher interacts with dozens of students annually, and they can be extremely influential on their students' educational and career choices. So, providing teachers valuable resources would have a multiplicative effect in reaching students in the K-12 system. However, a vast majority of these teachers have little or no information about educational and career opportunities in transportation. Further, they have very limited time and resources to develop new learning experiences based on transportation systems. Thus, providing teachers first-hand transportation system related experiences and resources to develop relevant lesson plans (curricular materials) is one strategy to remedy this shortcoming.

This paper reports on a summer program that brought together a cohort of teachers from different schools with an expectation that this would also help them develop a peer network as well as contact with subject matter experts. This has been adopted in various forms (e.g., the Nebraska Transportation Center). These teachers were expected to build on the experiences from the summer Academy and the lesson plans developed therein, so as to help inform and attract other teachers to such opportunities. The plans are to post on-line the lesson plans developed by participants in the Academy. This would make them available for worldwide access and help broaden the program's reach and impacts.

Review of relevant literature

Research has identified five core features of best-practices for teacher professional development Academies. These include: (a) content focus, (b) active learning, (c) coherence, (d) duration, and (e) collective participation. *Content focus* is defined by pedagogy and instructional practices that are specific to the discipline (i.e. science, math, etc.), but also includes an emphasis on raising teacher background knowledge of skills and concepts associated with the content. Professional development with a sharp content focus on the discipline and how students learn that content has been shown to significantly increase students' conceptual understanding.^{1,2} *Active learning* in professional development (PD) can involve a variety of different strategies including modeling of lessons, observing expert teachers, and participating in hands-on examples of best instructional practices. Active PD strategies, such as participating in inquiry-based lab exercises, have been demonstrated to be effective at improving active student engagement in the classroom.^{3,4} *Coherence* is the extent to which teacher learning is consistent with teachers' knowledge and beliefs.^{5,6} Gess-Newsome et al.⁷ described these beliefs as a "personal practical theory" of teaching in which the teachers' experiences and philosophies dictate an image of how teaching and learning in their classrooms should look (p. 758). Moreover, ignoring teachers' knowledge and beliefs can be perceived as a threat to a teacher's expertise and his/her ability to engage students in meaningful learning.^{8,9} Effective PD accounts for the fact that meaningful instructional change takes time and that increased *duration* of PD leads to positive changes in teacher knowledge and practices.^{1,2,10} In fact, the quantity of time a teacher spends in professional development addressing new skills and strategies is strongly related to their use of those skills and strategies in their regular instructional practice.^{2,11,12} Estimates of what constitutes sufficient duration vary from study to study; however, the common consensus is at least 20 contact hours either spread out over time or as part of an intensive model with regular follow-ups.¹³ These five core elements comprise the framework upon which the Transportation Systems Summer Academies were designed.

Description of the Summer Academy

In July 2014, teachers (participants) attended a 3-day core program at the University of Tennessee which was designed around best practices identified in the literature for teacher professional development.¹³ The participants were recruited using existing E-mail distribution lists and personal contacts with teachers in the K-12 system. Applicants were required to provide some specific information related to their teaching responsibilities and their anticipated plans on building on the outcomes of the Academy. There were 35 applicants to the program. A few applicants who were invited withdrew in time to enable alternates to be invited. Twenty teachers from 15 schools in East Tennessee participated in the Academy. Each participant received Professional Development Hours credit as well as a nominal stipend of \$200.

The Academy consisted of field trips to provide real-world, hands on experiences for teachers related to transportation in our region combined with seminar style discussions of how teachers' experiences on these field trips related to STEM content standards. The program

overview for the 2014 Academy is shown in Figure 1. The participants also were engaged in short work sessions to promote collaboration and inter-disciplinarily of lesson planning. Instruction on curriculum development and mini-lessons on effective instructional strategies for generating high levels of active student engagement related to STEM disciplines were woven throughout the Academy.

**FIGURE 1 Learning Enhancement through Active Participation in Transportation
Transportation Academy for Teachers July 15-17, 2014
Southeastern Transportation Center (STC), University of Tennessee (UT)**

Tuesday	Activity
8:30 – 9:00 am	Check in and Welcome
9:00 – 10:00	Get Acquainted Activity, Program Overview
10:00 – 11:00	Overview of Transportation Systems and Safety
11:00 – 12:00	Overview of Logistics & Supply Chain Management
12:00 – 1:00 pm	Lunch
1:00 – 1:30	Travel to Tennessee Dept. of Transportation (TDOT)
1:30 – 3:45	Tour of TMC, Sign shop, Discussions with TDOT Staff
3:45 – 4:15	Travel back to STC
4:15 – 4:30	Day 1 Wrap-up and Evaluations
4:30 pm	Adjourn
Wednesday	Activity
8:30 – 9:00 am	Recap Day 1 Activities
9:00 – 9:15	Overview of activities for the day
9:15 – 9:45	Travel to McGhee Tyson Airport (TYS), Knoxville
9:45 – 12:30 pm	Airport Activities
12:30 – 1:15	Lunch
1:15 – 2:30	TYS Airport Activities (continued)
2:30 – 3:00	Travel to National Transportation Research Center / STC Lab
3:00 – 4:00	Traffic Signal Systems Laboratory tour
4:00 – 4:15	Travel back to STC
4:15 – 4:30	Day 2 Wrap-up and Evaluations
4:30 pm	Adjourn
Thursday	Activity
8:30 – 9:00 am	Recap of day 1 & 2 Activities
9:00 – 9:15	Overview of activities for the day
9:15 – 9:30	Travel to UT's Tickle Engineering Building
9:30 – 11:30	Safety Activities: Simulator, Crash Reconstruction, Seat belt Convincer
11:15 – 11:30	Travel to STC
11:30 – 12:30 pm	Lunch
12:30 – 1:30	Day 3 Wrap-up and Evaluations
1:30 – 4:15	Curriculum discussions and group activity
4:15 – 4:30	Review and Evaluation of Overall Program
4:30 pm	Adjourn

Participants were asked to use the 5-E inquiry model for developing their lesson plans as shown in Table 1. The 5-E model divides the learning experience into five stages: Engage, Explore, Explain, Elaborate, and Evaluate (www.nasa.gov/audience/foreducators/nasaclips/5eteachingmodels/). The Engage stage prompts participants to pose their own questions about a topic. The Explore stage guides participants through the key concepts and encourages curiosity. The Explain stage is designed to reinforce understanding and interpret previous observations. The Elaborate stage prompts participants to synthesize, create, and apply their newfound knowledge. And the Evaluate stage provides participants embedded opportunities to demonstrate mastery of learning objectives to the instructor.

At the conclusion of the Academy, the participants were asked to develop the initial outlines of their transportation-based lesson plans. Instead of requiring all participating teachers to develop, implement, and evaluate lesson plans based on the Academy, only a subset (9 out of 20) of teachers were selected for this Phase 2 part of the Academy. The teachers selected for Phase 2 were offered additional stipends of \$300 for successfully completing Phase 2.

The nine teachers participating in Phase 2 met for 2 hours with the subject matter experts (transportation and educational pedagogy) on August 26, 2014. They discussed detailed plans for their unit plan lessons including planned timeline for instructing lessons. They were also teamed with a curriculum coach (peer-mentor) who provided guidance, as needed, to complete Phase 2. After this meeting, the participants developed, implemented, and assessed their lesson plans. On December 2, 2014, the teachers met again with the SMEs and one of the two peer mentors. At this time and submitted their completed unit plan lessons, reflections on their unit as well as ways in which they refined or improved their unit after using it in the class. However, only four of the teachers had utilized their lesson plans in their classes and evaluated them.

The budget for the 2014-2015 program had direct costs of about \$20,000. It was funded primarily through a grant from the US DOT to the STC at the Center for Transportation Research (CTR), a unit at the University of Tennessee. Figure 2 displays the logic model of the program.

Table 1 Inquiry Learning 5 Es-Science (Apply to Transportation Concepts)

Inquiry Event	Description	Activity
Engage	Make connections between past and present learning experiences, lay the organizational ground work for the activities ahead and stimulate their involvement in the anticipation of these activities	
Explore	Provides an opportunity to get directly involved with the scientific materials and develop a base of experience with new concepts	
Explain	Helps students begin to understand, in greater depth, the materials and concepts they explored in the previous activities	
Elaborate	Provides opportunities for students to expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them	
Evaluate	Determines if students are successfully meeting the learning objectives for this lesson	

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Figure 2 Logic Model of The STEM Academy

INPUTS	ACTIVITIES	OUTPUTS	OUTCOMES		
Resources dedicated to the program	Inputs transformed by the program	Products of the program	Benefits of the program		
			Initial	Intermediate	Longer-term
<ul style="list-style-type: none"> • University facilities • 20 teachers participated • Faculty and Staff • 2 peer mentors • Supplies (letters, stamps, whiteboard) • Time (spent on application, recruitment process) • Workshop Arrangements 	<ul style="list-style-type: none"> • Three day workshop • Site visits • Presentations • Group activities and discussion in workshop • Post workshop discussions about lesson plans 	<ul style="list-style-type: none"> • Pre-post test about transportation knowledge • 5-E inquiry model based lesson plans • Several completed group activities • Knowledge of transportation educational and career opportunities 	Positive: <ul style="list-style-type: none"> • Increasing teachers' knowledge about transportation concepts • Increasing teachers' knowledge about transportation career opportunities • Improving teachers' competency to develop transportation related lesson plans 	<ul style="list-style-type: none"> • Increasing participating teachers' application of transportation related lesson plans in their classroom • Helping non-participating teachers develop transportation related lesson plans 	<ul style="list-style-type: none"> • Motivating students about educational and career opportunities in transportation • Helping students better learn STEM related concepts and knowledge

Assessment and evaluation of program implementation and outcome

In order to examine the effectiveness as well as to ascertain the extent to which the program is implemented with fidelity, both formative evaluation and summative evaluations were conducted.

Formative evaluation of the program implementation

At the end of each day of the 3-day workshop, the participants were asked to provide anonymous responses to five questions: 1) What was your favorite activity today? Explain why it was your favorite. 2) What was your least favorite activity? Explain why it was your least favorite. 3) What, if anything would you like to see done differently and why? 4) What connections do you see between the activities from today and the subjects that you teach? 5) Is there anything else about your experience today that you'd like to share with us? These five questions asked the participants to reflect on the activities each day and provide their preference as well as suggestions to the workshop activities.

Summative evaluation of program outcomes

All of the participating teachers, including the 2 peer mentors were requested to complete an after workshop survey. The survey investigated participants' content knowledge in different transportation topics, comfort level with developing transportation related lesson plans, and satisfaction about the workshop. See table 5-8 for the survey details.

All of the participants were tested to determine their awareness and knowledge of key concepts about transportation systems before and after the workshop. The tests consisted of the following questions.

1. List types of work activities carried out by individuals who work in transportation (up to 8 items – for 8 points)
2. List “modes” of Transportation. (up to 8 items – for 8 points)
3. List some “Financing and Revenue Generation Options” for road transportation. (up to 8 items – for 8 points)
4. At the McGhee Tyson airport (TYS) in Knoxville, what are typical dimensions of the following (in feet)? (for 4 points)
 - a. Length of Runway: _____
 - b. Width of Runway: _____
 - c. Depth / Thickness of Runway: _____
 - d. Height of Airfield Signs: _____
5. List key automobile technology advancements that improve safety. (for 4 points)

Results

The program met most of its original goals and objectives. Some of the activities and experiences of the participants are illustrated in Figure 3.



A. FedEx Ramp @



B. Runway @ XYZ Airport



During



After

C. Sobriety Check Simulation with Goggles



Before

D. Seat Belt Use Convincer



After

FIGURE 3 Example Site Visits and Activities

Formative evaluation of the program implementation

Overall, the responses to the daily assessment were very positive. Table 2 summarizes the top 2 most frequently reported activities that teachers liked on each day of the workshop.

Not many teachers reported their least favorite activities during the workshop. Especially in day 3, most of the teachers reported in their daily evaluation that they were satisfied with every activity and enjoy all of the third day field visits. The least favorite activities reported by the participants were long presentations by the guest speakers and a desire for more interactions during the presentation. Some sample quotes from the participants are “The traffic light section, he talked way too much. The first of his talk

was interesting though” and “I did not enjoy sitting approximately 5.5 hours today. Active engagement for me is more productive.”

Table 2 Teachers’ Favorite Activities in the Academy

Day 1	Monitor Room at TDOT	Teachers enjoyed the tour of monitor room at TDOT.	Downstairs at TDOT. Visual and engaging. Seeing the ins and outs of how it worked was a very useful tool. I enjoyed going to TDOT because I found it interesting that their range of responsibilities is so vast. I especially liked the monitoring room.
	Supply Chain Presentation	The information and activities of presentation by the Supply Chain professor.	Supply chain, I thought it was fascinating all of the different components, jobs in this part of transportation Lecture on supply chain. Very interesting and engaging. Not just reading a list of facts.
Day 2	Air Traffic Control Tower at airport	Teachers enjoyed the tour of air traffic control tower at the airport	Visiting the air traffic control center because I had never been and it was very interesting to see how it works. Traffic control tower. I liked seeing something I can’t normally see.
	FedEx tour	FedEx tour at Airport	Fedex was amazing, so much useful information FedEx tours and control tower
Day 3	Car simulation	The car simulation provided by a CEE graduate student.	Car Simulator – any age would be able to create a testable question. Each student complete roadway assignment. I enjoyed the simulations at the engineering building. I thought they were quite fun, and learning should be fun!
	Accident reconstruction	The accident reconstruction provided by the forensics engineer.	Accident reconstruction – I was not aware of the amount or kind of information available after a crash regarding your driving speeds, braking, seat belt use, etc. The truck crash. I can see exciting ways to do an investigative/forensics kind of lesson using calculations to see what happened.

When asked about what can be done differently to the summer Academy, participants provided their suggestions to different aspects of the workshop. The major

aspects of the suggestions were: improvement to the schedule and arrangement of the workshop, shorten lecture time and incorporate more activities, connections to state education standards. Other suggestions are related to specific lecture or sites visits such as facility related matters. Table 3 summarizes the participants' suggestions. The Academy leaders reviewed the suggestions every day and tried their best to address participants' needs and concerns in the subsequent days.

Table 3 Suggestions on the Academy

Categories (in order of frequency)	Definition	Selected Quotes
Time Schedule and Arrangement	Teachers suggested keeping with schedule and not schedule too any activities.	<ul style="list-style-type: none"> • Keep with tight schedule please! • Spend a little more time at traffic control center because we were a little rushed • I really enjoyed today! More time at the station?
Shortening Lectures and Incorporating More Activities	Teachers request more interactive activities during the workshop while shortening the lectures.	<ul style="list-style-type: none"> • More interactive discussion throughout the day. This allows us to get multiple ideas from multiple sources. • Less lecture, the traffic signal info was interesting but too long
Lesson Plan Development	The workshop provides more opportunities to talk about connections between lesson plans and transportation knowledge.	<ul style="list-style-type: none"> • Take more time to discuss potential lessons. • Examples of activities that could be integrated into discipline • A sheet to show relation to different subject matters • Have teachers bring an overview of standards just so we can look at all of them.

Teachers also reflected on the connections they could make between the knowledge and information they learned at the workshop and their content area of teaching. Most of the teachers stated in the daily evaluation that the workshop inspired them to make connections between transportation knowledge and content they teach, some of them even provided some examples of the knowledge application.

The last questions of the daily evaluation asked the teachers to share things related to their experience at the workshop. Some of the teachers repeated their suggestions while a majority of the teachers expressed their appreciation and thanks to the workshop organizers and facilitators.

Participants' awareness and knowledge of key concepts about transportation systems

A pre-test and a post-test were administered to the participants in the 2014-2015 Academy to assess the extent of their awareness and knowledge of key concepts about transportation systems.

The maximum possible score was 32 for each test. There were 5 questions in the test, the maximum possible score for the questions were 8, 8, 8, 4, and 4 respectively. Responses were received from 19 of the 20 participants. The results of the participant performance in the pre- and post-test are summarized in Table 4. Paired sample t-tests were used to examine whether or not participants' knowledge in the areas increased significantly after the workshop. The results indicated that post-tests scores were significantly higher than pre-test scores in each section with very large effect size. The effect size used here is Cohen's *d*.¹⁴ According to Cohen, effect size larger than 0.8 is considered as a large effect and larger than 0.5 is considered as a medium effect. As indicated by the "t-statistics," the results show that the improvement in scores were significant at the 99 percent level of confidence in three questions, at 99.9 percent level of confidence for one question, and 95 percent level of confidence for one question. These clearly demonstrate that the participants learned transportation related concepts during the workshop.

TABLE 4 Summary of Participant Performance on Pre-Test and Post-Test

	Pre (<i>M/SD</i>)	Post (<i>M/SD</i>)	Difference	<i>t</i>	<i>df</i>	Effect Size
Q1	5.00/1.49	7.53/0.84	2.53	5.64***	18	2.09
Q2	6.95/0.91	7.68/0.48	0.74	3.24**	18	1.01
Q3	3.47/0.77	3.89/0.32	0.42	2.39*	18	0.71
Q4	1.21/0.98	3.63/0.60	2.42	10.37***	18	2.99
Q5	4.63/1.57	6.74/1.15	2.11	4.66***	18	1.53
Total	21.26/2.68	29.47/1.84	8.21	10.65***	18	3.57

Note. M = Mean; SD = Standard deviation; *** $p < 0.001$ ** $p < 0.01$, * $p < 0.05$

Post Workshop Survey Result

Twelve out of 20 teachers and two peer mentors responded to the survey after the workshop. These results consist of the participants' content knowledge in different transportation topics, comfort level with developing transportation related lesson plans, and satisfaction about the workshop. Table 5 summarizes the responses to these items. The following is a brief summary of the major findings.

Confidence in Content knowledge before the Workshop

- Half of the participants 50% (n=6) were not confident or slightly confident about their knowledge on typical transportation activities.
- None of the teachers very or extremely confident on the supply chain career opportunities, safety technology in transportation, and financing and revenue generation options for road transportation.

- From the participants 16.7% (n=2) were not confident or slightly confident about modes of transportation

Table 5 Content Knowledge

How confident are you in your content knowledge of...?	Frequency (%) of Response					
	Not or Slightly Confident ¹			Very or Extremely Confident ²		
	Pretest	Exit	Difference	Pretest	Exit	Difference
Typical transportation activities	6 (50.0)	2 (16.7)	4	2 (16.7)	10 (83.3)	8
“Modes” of transportation	2 (16.7)	0 (0.0)	2	4 (33.3)	12	8
Transportation career opportunities	10 (83.3)	0 (0.0)	10	0 (0.0)	8 (66.7)	8
Supply chain career opportunities	9 (75.0)	0 (0.0)	9	0 (0.0)	9 (75.0)	9
Safety technology in Transportation	10 (83.3)	0 (0.0)	10	0 (0.0)	8 (66.7)	8
Financing and revenue generation options for road transportation	11 (91.7)	2 (16.7)	9	0 (0.0)	4 (33.3)	4

¹Those who rated either “Not confident” or “Slightly confident”

²Those who rated either “Very confident” or “Extremely confident”

Confidence in Content knowledge after the Workshop

- None of the teachers were “not” or “slightly confident” on their knowledge about modes of transportation, transportation career opportunities, supply chain career opportunities, and safety technology in transportation.
- From the teachers 16.7% (n=2) were “not” or “slightly confident” on the knowledge of typical transportation activities and financing and revenue generation options for road transportation.

Comparison between before and after Confidence on Content Knowledge

- For all content areas there was an increase in number of participants in “very confident” or “extremely confident” categories.
- For all content areas there was a decrease in number of participants in “not confident” or “slightly confident” category.

Comparison between Before and After Comfortable Level in Developing Transportation Related Lesson Plans:

- None of the teachers were “very comfortable” or “extremely comfortable” in developing transportation related lesson plans before the workshop.
- Most of the teachers 83.3% (n=10) were “very comfortable” or “extremely comfortable” developing transportation related lesson plans after the workshop.

Satisfaction with the Workshop

- All of the teachers (100%) were satisfied with the field trips except TDOT and NTRC trips. From the qualitative response we could find that they thought the presentations at TDOT and NTRC were too lengthy. Teachers also reported the travel time problem in the trip to NTRC.
- Most teachers (over 90%) were satisfied with the format and content of the Academy.
- Some of the teachers (8.3%) were not satisfied with the administrative matters.
- Table 6 summarizes the responses.

Strengths of the Academy

- Field trips, format and content of the Academy, informative instructors/presenters, and interaction among participants and instructors were considered the major strengths of the Academy.
- Other strengths were care, respect, and classroom instructions.
- The responses are summarized in Table 7.

Suggestions on the Academy

- The major concern was time management. Those included shortening time for presentations, increasing time for engineering lab field trips, and adjusting overall schedule.
- Other suggestions were related to the format and content of the Academy such as adding more activities and real world connection.
- Table 8 provides additional detailed information.

Phase 2 Focus

There were 5 teachers in the second phase who responded to the survey. They did not provide specific content areas of their focus. They wished to focus on curriculum and interactions with other phase 2 participants.

Table 6 Satisfaction Levels with the Academy

Item	Frequency (%) of Responses		Mean (SD)
	Disagree or Strongly Disagree	Agree or Strongly Agree	
I have a better understanding of transportation concepts discussed in the Academy.	0(0.0)	12(100.0)	4.00(0.60)
I learned something new from the Academy	0(0.0)	12(100.0)	4.33(0.49)
The academy will help me develop my instructional materials in the upcoming school year.	0(0.0)	12(100.0)	3.83(0.72)
I was satisfied with the content of the overview of transportation presentation.	0(0.0)	11(91.7)	3.83(0.72)
I was satisfied with the content of the supply chain presentation.	0(0.0)	10(83.3)	3.75(0.62)
I was satisfied with the DOT site visit.	1(8.3)	10(83.3)	3.17(0.72)
I was satisfied with the Airport site visit.	0(0.0)	11(91.7)	3.83(0.39)
I was satisfied with the NTRC site visit.	1(8.3)	9(75.0)	4.58(0.52)
I enjoyed the format of the academy.	0(0.0)	12(100.0)	4.83(0.39)
The length of the Academy was appropriate.	1(8.3)	11(91.7)	4.42(0.52)
The Academy was held at appropriate time of the year.	0(0.0)	12(100.0)	4.50(0.67)
The Academy facilitated the interaction among participants	1(8.3)	11(91.7)	4.33(0.78)
The Academy facilitated the interaction between participants and “instructors”.	0(0.0)	11(91.7)	4.50(0.91)
I was satisfied with the administrative matters PRIOR TO the Academy.	1(8.3)	11(91.7)	4.67(0.65)
I was satisfied with the administrative matters DURING the Academy.	1(8.3)	11(91.7)	3.83(0.84)
I was satisfied with the administrative matters AFTER the Academy.	3(25.0)	9(75.0)	4.42(0.52)
The Academy provided fair amount of stipend.	3(25.0)	8(66.7)	4.17(0.84)
The classroom / meeting space at the Conference Center for the Academy were adequate.	0(0.0)	12(100.0)	4.33(0.49)
I was satisfied with the driving simulator experience at the University.	0(0.0)	11(91.7)	4.42(0.9)
I was satisfied with the crash investigation demonstration at the University.	0(0.0)	12(100.0)	4.50(0.67)
I was satisfied with the seat belt use enforcer demonstration at the University.	0(0.0)	12(100.0)	4.50(0.91)

¹Those who rated either “Strongly disagree” or “Disagree”

²Those who rated either “Strongly agree” or “Agree”

Table 7 Strengths of the Academy

Categories (in order of frequency)	Definition of Category	Selected Quotes
Field trips	TDOT visit, Airport visit, NTRC visit, University Civil Engineering department visit	<ul style="list-style-type: none"> • More ideas and example • More resources, ideas for classes • Do more experiments with chemistry!
Format	The length, time, location, and other format of the Academy	<ul style="list-style-type: none"> • Time of the year provided • Location • Variety of topics • Hands on
Instructor /Presenter	Profession and knowledge of instructors/presenters	<ul style="list-style-type: none"> • Guest speaker • Professional teachers • Instructor knowledge • Supply chain presentation
Interactions	Interaction among teachers	<ul style="list-style-type: none"> • Collaboration • Communication
Others		<ul style="list-style-type: none"> • Care • Respect

Table 8 Suggestions for Improving the Academy

Categories (in order of frequency)	Definition of Category	Selected Quotes
Time management	Suggestions about arrangement of time	<ul style="list-style-type: none"> • Time management • Not enough time on simulator/crash reconstruction/seat belt trip • Shorter days
Format	The length, time, location, and other format of the Academy	<ul style="list-style-type: none"> • Some lectures were too lengthy • Real world connection • Too many activities in one day
Others	Some part/content of the Academy instructors/presenters	<ul style="list-style-type: none"> • Beginning session boring • Traffic light signal • Statistics on velocity

Lessons Learned and Suggestions for Future Implementation

Several lessons were learned from the experience of developing and administering transportation systems based summer academy in 2014. They include the following:

- Start recruiting teachers well in advance – e.g., by no later than March

- Do not underestimate the time required by various university offices to process documents at various stages of the entire “project”
- Improve administrative efficiency with the recruitment process especially with completing the paperwork required to pay the participants their stipends in a timely manner following the completion of their efforts
- Better coordinate content, delivery, and schedule of site visits.
- Reduce the “lecture” format activities and increase site visits
- In the lecture style activities provide a more specific examples of theoretical concepts to the sites visits and potential lesson plan opportunities
- Provide more guidance to develop lesson plans
- Offer an increased stipend to develop, implement, assess lesson plans

Summary and Conclusions

This paper summarized efforts related to and results from the development and implementation of a 3-day long transportation systems based summer academy (workshop) for 20 teachers. The Academy included brief “in-class” overviews of transportation systems, logistics and supply chain management, and how these related to key STEM concepts followed by 2 days of “site” visits to a variety of transportation system settings. These were combined with seminar style discussions of how teachers’ experiences on these field trips related to STEM content standards. The participating teachers were each provided a \$200 stipend. A pre-test and a post-test were administered to the participants in the Academy to assess the extent of their awareness and knowledge of key concepts about transportation systems.

Nine teachers were selected from the summer Academy participants to develop transportation themed lesson plans, implement them in their classes, and evaluate them. This is to help refine the lesson plans for online publication to make them accessible globally. These participants were each offered an additional stipend of \$300 for completing this process. While the goal was for the teachers to complete their efforts by December 2014, many of them have experienced problems in completing their work. The revised schedule now coincided with the end of the school year.

Feedback from participants in the Academy strongly indicate that the summer Academy provided them real-world contexts to not only to help their students better understand theoretical concepts, but also to help the teachers themselves to gain a broader and deeper understanding and knowledge of transportation systems and how they could adopt the same in fostering deeper learning amongst their students, especially in STEM disciplines. These were validated by the statistical analyses of the data from the tests used to evaluate the same.

Efforts are underway to offer a similar summer Academy in June 2015. However, this year’s program will focus on high school teachers.

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