A Workshop on
Integration of Design and hands-on learning into STEM Curriculum

The Great Midwestern Space Grant Region
Integration of Design and hands-on learning into STEM Curriculum

Held on:
June 17-19, 2010

Where:
Missouri University of Science and Technology
Learning Outcomes

Enhance the content of your curriculum in order to improve the flowing student’s learning outcomes

(a) an ability to apply knowledge of mathematics, science, and engineering,

(c) an ability to design a system, component, or process to meet desired needs,

(e) an ability to identify, formulate, and solve problems

(g) an ability to communicate effectively

(k) an ability to use the techniques, skills, and modern tools necessary for engineering practice
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Workshop objectives

1) Teach **applied as opposed to purely theoretical knowledge** where design is emphasized

2) Provide **opportunities for hands-on learning, testing, and experimentation with different design concepts.**

3) Provide opportunities for high-level and **critical thinking**

4) Enhance **process skills** such as teamwork, technical writing, …


**Audience**

- **freshman** engineering programs and/or **sophomore curriculum** of four-year University bachelor's degree programs in aerospace engineering

- Associate's degree engineering/pre-engineering programs in **community colleges**

- institutions who are seeking to emphasize and **integrate hands-on training and implementation of system design, simulation, building, and testing.**
Who Should Attend

- **Directors and Managers**

- **Curriculum developers** in institutions who are seeking to emphasize and integrate hands-on training and implementation of system design, simulation, building, and testing.

- **Faculty members/Graduate students** in four-year University bachelor's degree programs

- **Faculty/instructors** in Associate's degree engineering/pre-engineering programs in community colleges
Engineering/Product development

- Design
- Analyze
- Integrate
- Simulate
- Manufacture
- Test

Product
Future Technical Workforce: Critical Competencies
A Sample Of Competencies Future Graduates Must Have

1. Ability to apply knowledge
2. Ability to identify and solve problems
3. Ability to communicate
4. Ability to collaborate
5. Understanding of basic economics (Cost)
6. Understanding of professional and ethical obligations
7. Commitment to continuous learning
8. Commitment to self assessment
9. Curiosity
10. Creativity
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Workshop Location

Missouri University of Science & Technology
Workshop Participants
Summary

• A 2½ day workshop
• The workshop is designed to provide participants with knowledge of introductory engineering design and hands-on experiences that can be integrated into freshman and/or sophomore engineering programs of four-year university bachelor’s degree programs or in associate degree engineering programs in community colleges or two-year institutions.

• A detailed project on the development of radio-controlled aircraft models was presented to help participants with transferring and implementing of various concepts to students at their institutions.

• Participants from 7 states (AL, IL, OH, MO, NE, MN, and MI)

• Discuss issues related to workforce development (educating the next-generation technical workforce, what should engineering, science, and technology education be doing today to prepare the next-generation of students, …).
Workshop Participants at Missouri S&T Aerodynamic Testing Laboratory
Workshop Participants working on construction of a lifting surface
Sample of Assessment Results

Please rate the following:

1. The information is well organized
2. The material presented is practical and useful
3. I can apply this material in program
4. I would recommend this workshop to others

Assessment of technical contents

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Please list what you perceive to be the strengths of the workshop
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• Well organized and very motivated staff.
• Very nice job of presenting the process used at Missouri S&T. Also, good discussion of how to adapt to other programs.
• Well prepared and hands-on. TA did an excellent job.
• Hands on participation & instruction – your staff is very knowledgeable & experienced?
• It was good to see the details & specifics of what an engineering design case should include. Even though I cannot use many of the sophisticated testing methods, it is good to know what is out there. Also learned A LOT about basic flight concepts.
• Good hands-on training
• Lots & lots of material fit into 2 days.
• Engaging activity. Applicable at multiple levels of students. Suggestions made on Saturday for low-level curricular application were especially useful – maybe write those up and circulate.
• It provided an introduction to ways to integrate content and was completely new to me.
• It gave me lots of ideas, even beyond building aircraft.
• Level of preparation, strong content, practical component
• Discussions about applying the material to other situations.
• Detail to the specifics of this particular course.
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- In presenting the entire program, many felt overwhelmed with the practicality of implementing it at their institution – many good ideas can be taken and applied though.
- None, very well done.
- Not giving the real flying experience to participants.
- Some visuals were small & hard to read the spreadsheets/presentations
- The information was given very quickly, and much of the highly technical information was useless to me.
- More hands-on.
- Could have been even more hands-on (might require more instructors, especially if you had more participants). Could try to get more camaraderie among participants using team-building activities.
- Limited applicability of the presented materials; the course focused too much on exactly the way the materials are presented to MST.
- Airplane design too complex to be completed in 2 days
- Too much nitty gritty building. I’m not understanding what we’re getting for what we paid. Where did the money go?
- More education. Focus – less airplane construction.
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Early Design and hands-on learning in Higher Education Programs
Design/Implement