



*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 following 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, ...

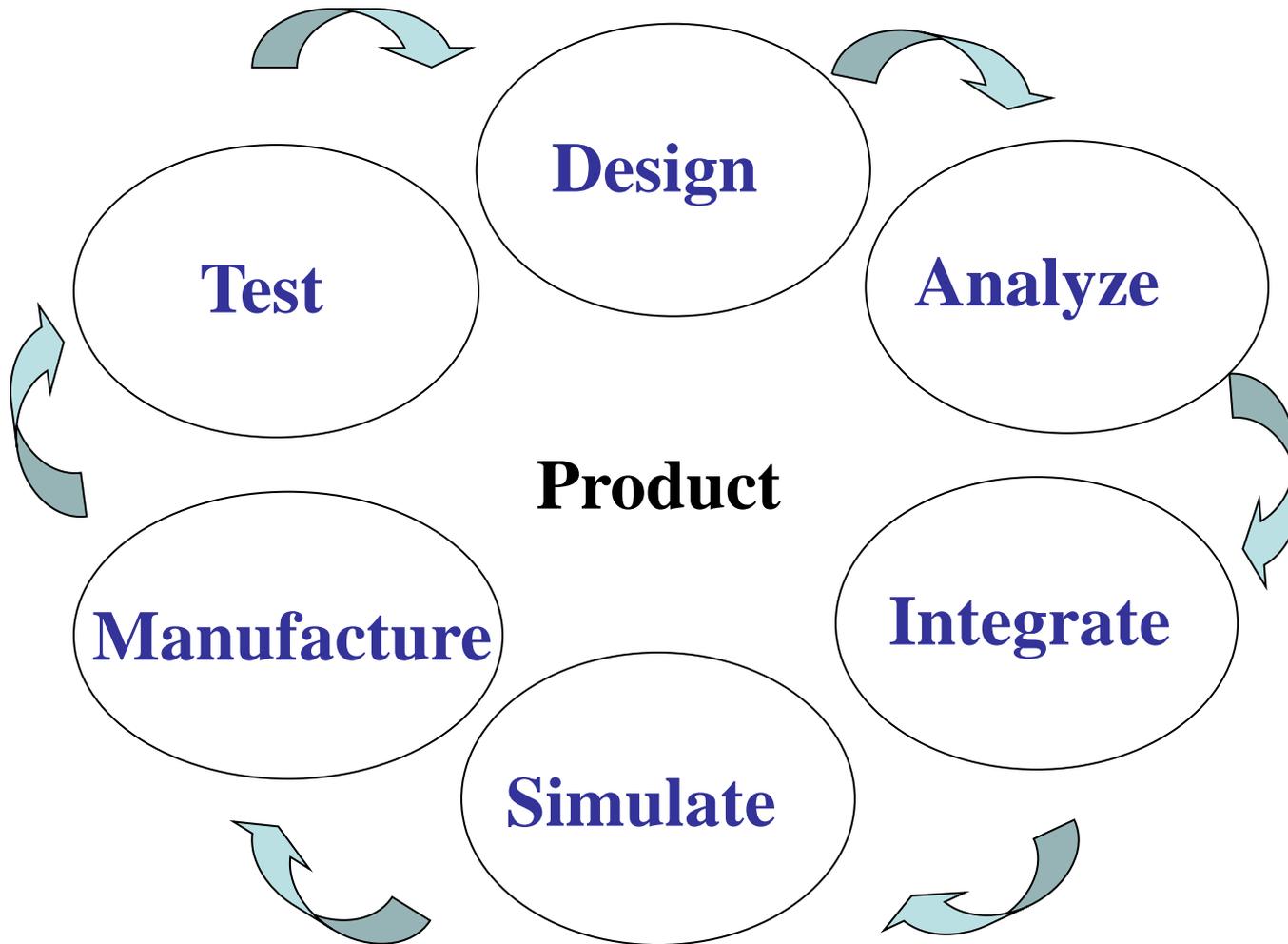
# *Audience*

- **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



# **Future Technical Workforce: Critical Competencies**

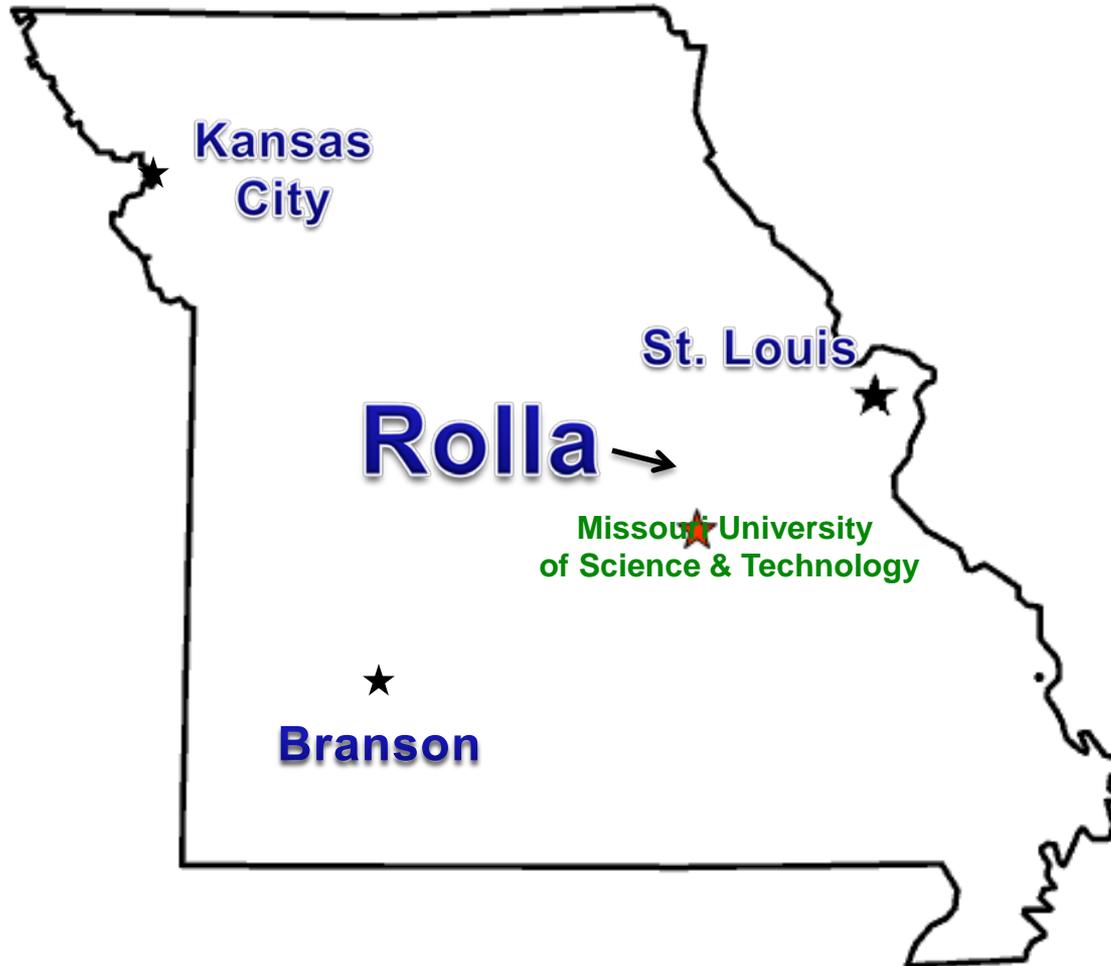
# **A Sample Of Competencies Future Graduates Must Have**

- 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





# Summary

- *A 2 ½ 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

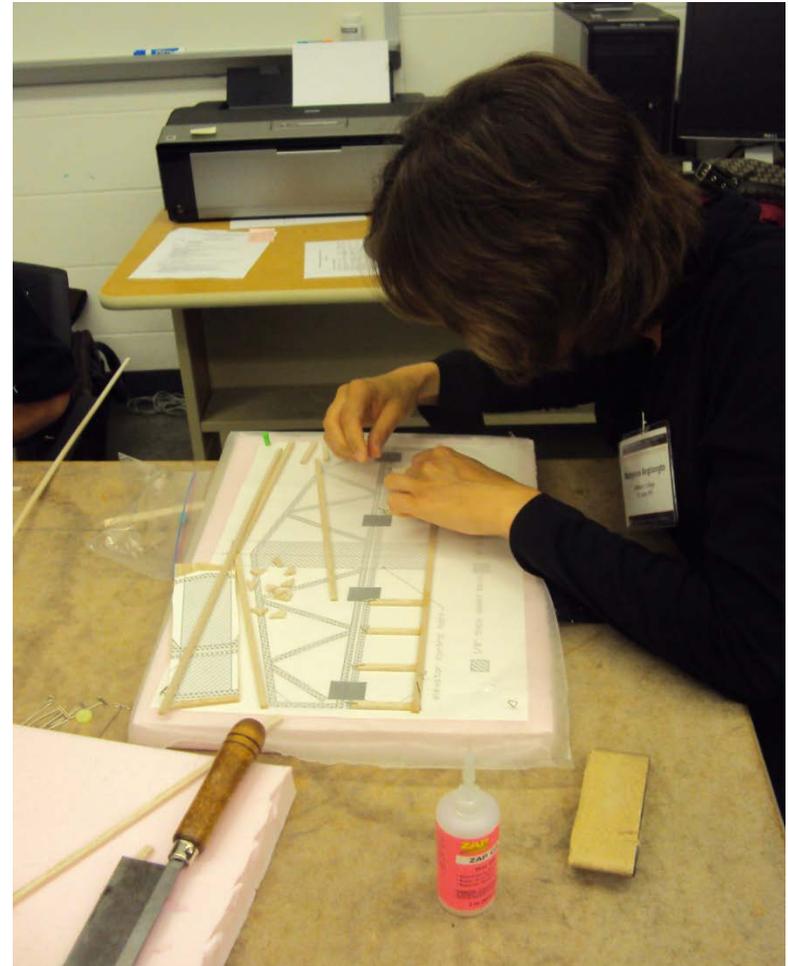
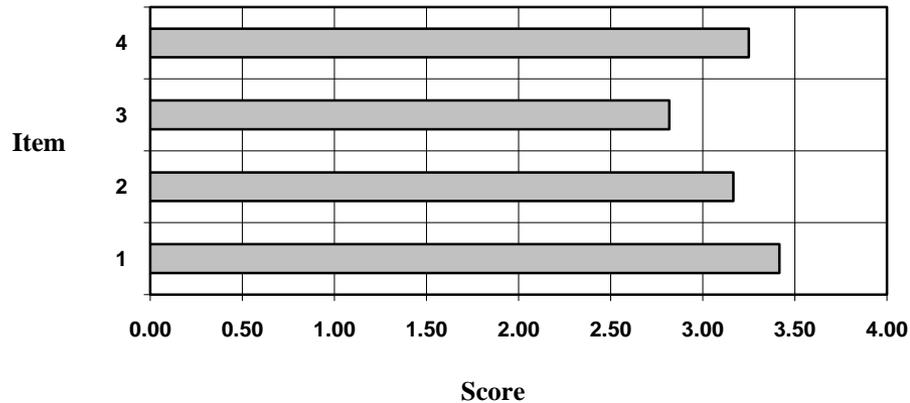


# Sample of Assessment Results

**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



**Please list what you perceive to be the strengths of the workshop**

# **Please list what you perceive to be the strengths of the workshop**

- 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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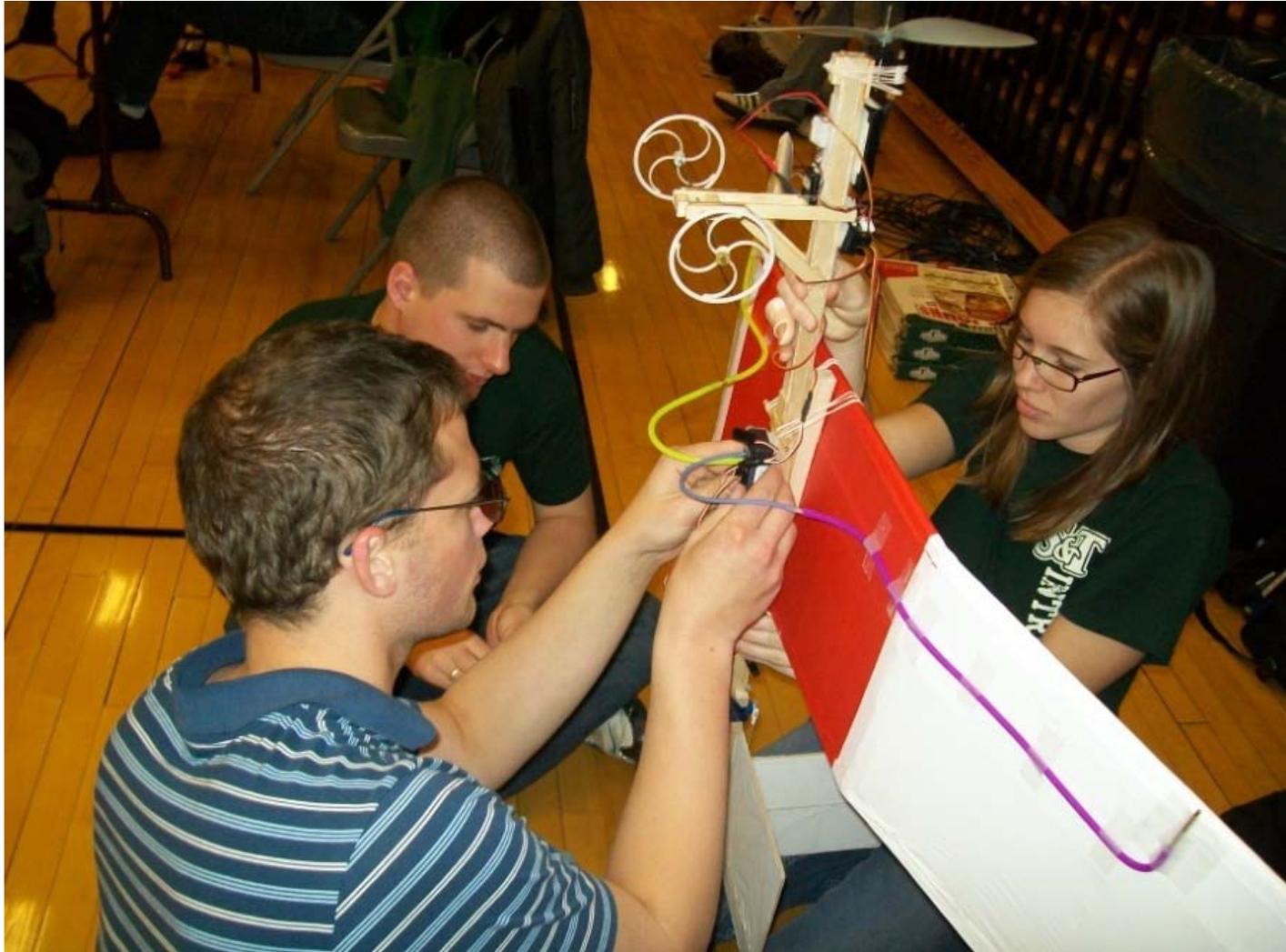
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# Early Design and hands-on learning in Higher Education Programs



# Design/Implement

