NCETE Research Framework

(Note that this is a research framework, not a research agenda)

Research Theme 1

How and What Students Learn in Technology Education

Learning and Cognition

1. How do students learn technological and engineering concepts?
2. How do students learn concepts (e.g. model, control, systems), processes (e.g. tinkering, and forward and backward design), and social practice (kids designing their own problems)?
3. Can we help people to develop visual/spatial skills?
4. How do students learn creative problem solving?
5. How do students learn to visualize while engaging in engineering design activities?
6. How can we use brain-based research to understand how students learn?
7. What is the correct balance between hands on/minds on approaches?
8. What is the difference between hands-on learning versus book learning?
9. What is the role of experience in learning? When should it happen? Before, during or after exposure to theory?
10. Do informal science activities typically offered by museums or schools lead to learning (of science, mathematics, technology education) in the formal curriculum.

Engineering Processes

1. What are the core-engineering concepts that are foundational to all branches of engineering and how are they best organized for learning?
2. What are the “core abilities" of engineers?
3. How do broader concepts associated with technological literacy relate to engineering concepts and analytical methods?
4. What is the core content knowledge for this new approach (not welding or specific skill development)?
6. Design, systems, modeling, descriptive analytical
7. What is the role of trial and error in engineering design and problem solving?
8. What is the thought process behind engineering design and problem solving?

Creativity

1. How should we look at things in a different way?
2. How can we adapt what current approaches that already exist to help students go through the development process?
3. How does one know when to be creative since the creative solution is not always the appropriate or best solution?
4. What kind of learning environment supports creativity?
5. What are the "mental conditioners" that can trigger improved creative performance among children in technology education?
6. In developing creativity in technology education, we should:
   - Study classic cases of creativity in engineering and design
   - Evaluate efforts to be creative
   - Work out procedures for moving people along (a creativity continuum).
7. The field does not have a way to assess progress along a continuum of creativity. When is a student performing at the beginner's level, the middle, and the upper level on a creativity continuum? (There are obvious implications here for the development of assessment instruments).

Perceptions

1. Perceptions of the public and of students: computers/electronics = technology
2. Perception that theory classes lead to engineering specifically math
3. Why are the professional schools (medical school, law, engineering) so popular?

Diversity and Learning Styles

1. What are the learning style preferences of students?
2. How do multiple intelligences affect learning of engineering concepts?
3. To what extent do engineering activities enhance learning in mathematics and science? (K-12 curriculum and instruction will build on learning and cognition research)

Research Theme 2

How to Best Prepare Technology Teachers

Teacher Education/Professional Development

1. How can we better prepare technology and engineering teachers using cognitive science?
2. How should TTE programs be configured to assure that new teachers acquire the requisite engineering design and analytical knowledge and skills?
3. How are clinical experiences for technology teachers best configured?
4. What are the effective means for delivering ongoing professional development for teachers?

5. What is the relationship between technology and the other disciplines? How do teachers interpret the relationships and differences between other disciplines?
6. How much should be taught before students reach the postgraduate level?
7. How much teacher professional development is needed?
8. How will teachers be trained?
9. How can we get the teachers who have been teaching a certain curriculum for years to get on board?

Curriculum/Instruction

1. What are specific benchmarks for quality programs? (not the general ones we have with technology education right now)
2. How do we effectively teach problem solving and design?
3. What teaching methods are best suited for learning engineering principles?
4. How can group and cooperative learning be used to infuse engineering into technology education?
5. How should K-12 laboratories be equipped and configured for teaching engineering concepts?
6. What will it cost to infuse engineering into the curriculum?
7. Would a typical engineering student get frustrated in a technology class where everything isn't exact all the time… that is, the answers to technology questions aren't always in the back of the book?
8. What should become the standard of expectations for a knowledge base before inviting students into an engineering program? What will they need to know before the class in order to succeed?
9. Can we develop academic concepts (such as "force") from the study of technology?
10. How can technology education effectively offer both general courses related to technological literacy and specialized courses in engineering?

Diversity

1. How can the involvement of females and minorities be enhanced?
2. In working with other cultures, what should technology look like?

Change

1. Will technology teachers lose their jobs? Will physics teachers teach the tech/engineering courses?
2. Examine other examples of interdisciplinary attempts and where they succeeded or failed
3. How does the curriculum change, what needs to be integrated?
4. How much do I have to change my courses?
5. Would the administration be behind the merge?
6. Will our name need to be changed (to go along with what F-4 said)
7. How will a school district deal with curriculum changes?
8. How will our standards need to change?

Research Theme 3

Assessment and Evaluation

Student Assessment

1. What are the effective strategies for assessing student learning of engineering concepts?
2. How do we best measure engineering knowledge and skill acquisition?
3. What multiple assessment strategies can be used?
    - Both formative and summative assessment
    - Written assessment of concepts and practical application of their designs or of the design process.
4. How does a product reflect understanding or what is the relationship between understanding of theory and the ability to create a product. What is the balance?

Teacher Assessment

1. What are the effective strategies for assessing effective teaching of engineering concepts?
2. To what extent do the national curriculum standards in mathematics, science, and technological literacy guide program assessment?
3. How can authentic assessment be used to evaluate a teacher and what they teach based on the community, their abilities, how well they have improved, etc.?
6. Can common assessment methods be used?
7. How can useful information be extrapolated from assessment data?