(Source: https://scholarsteamk12plus.weebly.com/research-project-for-the-vision-paper.html)

WORKING FOR AN INNOVATION DEAL USA IN THE 21ST CENTURY
TRABAJANDO POR UN TRATO DE INOVACIÓN EEUU EN EL SIGLO XXI
为实现 21 世纪美国创新之政而奋斗

RESEARCH PROJECT FOR THE VISION PAPER

by Edward Locke (Gosingga-Daicin Mergen-Dasan Sakda)

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Hard copies of my Graduation Project for the Education Specialist degree from the University of Georgia College of Education, with all relevant research papers and other documents that constitute the foundation for my published Vision Paper.

This page is reserved for online publications of my research data, articles, and other documents, peer-reviewed or not, as well as any constructive criticism, comments and advice, in support of a new vision to improve K-12 engineering and technology education, as outlined in the vision paper titled Proposed Model for a Streamlined, Cohesive, and Optimized K-12 STEM Curriculum with a Focus on Engineering, published in *The Journal of Technology Studies*, a peer-reviewed scholarly journal associated with Virginia Institute of Technology (Winter 2009 Issue No. 2). The vision paper is available at http://scholar.lib.vt.edu/ejournals/JOTS/v35/v35n2/pdf/locke.pdf. Please click the underlined titles of the documents to access the PDF files.

Please note that due to time constraint and lack of experience, some mistakes might exist in the research papers, and some terms need to be changed; for example, "high School Appropriate" throughout all documents should be changed to "High School Age-Possible" instead.

HIGH SCHOOL APPROPRIATE ENGINEERING CONTENT KNOWLEDGE IN THE INFUSION OF ENGINEERING DESIGN INTO K-12 CURRICULUM

(UNDER THE GENERAL TOPIC OF "ENGINEERING DESIGN IN SECONDARY EDUCATION" AND OF "VISION AND RECOMMENDATIONS FOR ENGINEERING-ORIENTED PROFESSIONAL DEVELOPMENT")

THE GRADUATION RESEARCH PROJECT

The Graduation Research Project for my Education Specialist degree from the College of Education, the University of Georgia, is the final outcome of my graduate studies at the University of Georgia as one of the 18 National Center for Engineering and Technology Education Doctoral Fellow (2007-2009) . It laid the foundation for the publication of my Vision Paper on a futuristic but practical K-12 engineering and technology education.

Table of Content (for the Graduation Research Project) and The Graduation Research Paper

(Summary: This Research Project seeks to identify high school age-possible engineering content knowledge (to be more specific, the analytic and predictive principles plus computational formulas) related to the subjects of statics and fluid mechanics, using rationally established criteria and procedures. The criteria and procedures used in this Research Project will be used as a working model for identifying high school age-possible engineering content knowledge in other subjects (such as dynamics, mechanism design, thermodynamics, heat transfer, and engineering economics or decision-making), which shall be aimed at (1) Infusion of engineering design into secondary education: Creating a list of high school appropriate topics featuring both analytic and predictive principles as well as computational formulas, to be well organized into relevant and cohesively related subjects (such as statics and dynamics, material strength and selection, fluid and aerodynamics, mechanism design and selection, etc.). This could serve as a reference for systematically infusing engineering design into K-12 curriculum, through collaborative efforts of many stakeholders in K-12 engineering and technology education. (2) Vision and recommendations for engineering-

oriented professional development: Developing a working model for systematically training new generations of K-12 engineering and technology teachers who could implement K-12 engineering and technology curriculum).

Appendix 1 - Proposed Four-Stage Model for Infusing Engineering Design into K-12 Curriculum Table of Content and Research Paper

(Summary: The objective of this paper is to propose a four-stage curriculum model for infusing engineering design concepts and activities into a Bachelor's of Science in K-12 Engineering and Technology Teacher Education program. The model to be proposed is independent from any existing programs (reflecting the idea of "change" which appears to be necessary), but also interdependent with most of the exiting programs (under the proposed model, components from existing programs could be either incorporated into the new model of a regular K-12 Engineering and Technology curriculum, or serve as after-school curriculum enrichment modules); in addition, for the purpose of being practical (reflecting the idea of "continuity" which is a workable philosophy of education), the proposed model will draw reference from many sources related to K-12 technology education and teacher training).

Appendix 2A - Report on the Achievements of K-12 Engineering Education in Australia & its Positive Referential Values for the Evolution of a Potentially Viable K-12 Engineering & Technology Curriculum in the United States Table of Content and Research Paper, and

Appendix 2B - State of Victoria (Australia) versus State of Georgia (United States) Comparison Charts for K-12 Mathematics and Science Performance Standards

(Summary: The above research materials are based on a PowerPoint presentation given by Peter Thompson (Head Teacher for Teaching and Learning at Bossley Park High School, Sydney, Australia, and Ruth J. Thompson (Head Teacher for Technology, at the same school), titled "*Engineering Education in Australian High School*," Thursday, March 26, 2009, during the International Technology Education Association 2009 Conference, at the International Convention Center, Room KICC 209, 4:00PM-4:50PM, in Lousville, Kentucky, USA. The presenters gave the attendants a CD that is rich in information on high school engineering education in Australia, with a total of 178 files (including articles, government documents, PowerPoint presentations, pictures and 3D digital animations), which have been analyzed and compared to U.S. standard and practices in K-

12 engineering and technology education to come up with the above documents).

Appendix 3A - High School Appropriate Statics Tables
(Summary: This document lists the topics of statics, a traditional foundation course for most of engineering majors, which have been determined to be possible for high school classroom pedagogic experiment).

Appendix 3B - High School Appropriate Fluid Mechanics Tables
(Summary: This document lists the topics of fluid mechanics, a traditional major course for mechanical engineering program, which have been determined to be possible for high school classroom pedagogic experiment).

RESEARCH PAPER ARCHIVES

NCETE Core 4 Research Paper Table of Content

NCETE Core 4 Research Paper Pages 1-57, Pages 58-102, and Pages 102-End

NCETE Core 4 Research Paper PowerPoint Presentation (High School Appropriate Engineering Content Knowledge: Statics)

NCETE Core 4 Research Paper Appendix 1: Proposed Model for Infusing Engineering Design into K-12 Curriculum

(Summary: Most of the content and information from the above documents has been incorporated into the Graduation Research Project. They are listed here for archival purposes only.)

Leadership White Paper: Streamlining Engineering and Technology Education Across K-12 and University Spectrum, a New National Direction

(Summary: The general objective of this White Paper corresponds to two of the research goals of the National Center for Engineering and Technology Education (NCETE): (1). "define the current status of engineering design experiences in engineering and technology education in grades 9-12;" (2). "identify guidelines for the development, implementation, and evaluation of engineering design in technology education" (NCETE, 2008). The particular purposes of this Leadership White Paper are to: (1) Review the problem of critical shortage of engineering graduates from American schools and identify the emerging direction in engineering and technology education throughout K-

12 and college-level: The emerging new direction might provide possible solutions to the critical shortage in the numbers of college graduates in engineering and technology majors, by increasing the numbers of American high school students interested in and well prepared for four-year undergraduate majors and engineering and technology, by strengthening math and science (physics and chemistry) education, and by integrating current career and technical education curriculum at high schools with four-year university programs. (2) Explore possibilities that might contribute to the solutions of the above-mentioned critical shortage under the new direction: This White Paper will focus on proposing potential improvement at local level (in the Athens areas surrounding the University of Georgia), but the ideas contained therein could be applied across the State of Georgia and in the entire United States, if appropriate experiments can be proved successful.

Consolidate the Achievements and Working for Further Success in U.S. K-12 Engineering and Technology Education: a Tentative Summary and Proposal for the Future

SAMPLES OF INSTRUCTIONAL & CURRICULUM DEVELOPMENT MATERIALS

The following are samples of instructional materials for K-12 engineering curriculum and for a Bachelor of Science in K-12 engineering and technology teacher education program course list.

Appendix 1-A-1 - Sample Unit 1: Engineering Design Idea Generation ("Creative Conceptual Design" Stage, Using "Brainstorming Sessions")
Appendix 1-A-2 - Sample Unit 2: Engineering Design Experiment ("Technology Education Design" Stage)

Appendix 1-A-3/4 - Sample Unit 3: Well-structured Problem & Simple Engineering Design ("Analytic Reduction" Stage)

Appendix 1-B: The United States Department of Labor State Occupational Statistics - Long Term for Engineering & Technology Professionals

Appendix 1-C: Proposal for Revised and New Course Description for the University of Georgia and the National Center for Engineering and Technology Education

Appendix 1-D-1, 2, 3: Proposed New Course Syllabus

Appendix 1-E: Available Resources for Infusing Engineering Design into K12 Engineering and Technology Curriculum
Appendix 1-F: Proposal for a B. S. Degree in K-12 Engineering and Technology Teacher Education for California State University Los Angeles

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Freedom and opportunities! You will have the right to a high quality K12 science, technology, engineering, arts and mathematics (STEAM) education!
¡Libertad y oportunitades! ¡Usted va a tener el derecho a una K12 educación de alta calidad en ciencia, tecnología, ingenería, artes y matematica (CTIAM)!
自由和机会！你们将拥有接受高质量的、贯穿幼儿园到中小学阶段的科学、技术、工程、艺术和数学教育的权利！