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Excellent Pedagogical and Cognitive Sciences References

Journal of Engineering Education, vol. 94, no. 1, January 2005.

This issue of the journal was a special issue on Engineering Education. In this seminal issue, the top engineering educators were asked to write review articles in their area of specialization. It presents a lot of the cognitive sciences and education theory and how it's used in engineering education. This issue changed the way many engineering educators thought about engineering education. I have listed the papers in this issue of the journal below so that you may find the areas that connect to your interests.

"Building a Community of Scholars: The Role of the Journal of Engineering Education as a Research Journal"

"If Not Now, When? The Timeliness of Scholarship of the Education of Engineers"

"Research on Engineering Student Knowing: Trends and Opportunities"

"Understanding Student Differences"

"Pedagogies of Engagement: Classroom-Based Practices"

"The Role of the Laboratory in Undergraduate Engineering Education"

"Integrated Engineering Curricula"

"Becoming a Professional Engineering Educator: A New Role for a New Era"

"A New Journal for a Field in Transition"

"Assessment in Engineering Education: Evolution, Approaches and Future Collaborations"

"The ABET "Professional Skills" – Can They Be Taught? Can They Be Assessed?"

"Diversifying the Engineering Workforce"

"Engineering Design Thinking, Teaching, and Learning"

"Online Engineering Education: Learning Anywhere, Anytime"

"Centered on Education Research"

"Quality Assurance of Engineering Education through Accreditation: The Impact of Engineering Criteria 2000 and Its Global Influence"

Predating the seminal issue was a set of articles that presents teaching methodologies that are founded in the cognitive sciences research, published in the Chemical Engineering Education journal.

Felder, R.M., Woods, D.R., Stice, J. E., and Rugarcia, A., “The future of engineering education II. Teaching methods that work,” *Chem. Engr. Education*, vol. 34, no. 1, pp. 26-39, 2000.

Woods, D.R., Felder, R.M., Rugarcia, A., and Stice, J. E., “The future of engineering education III. Developing critical skills,” *Chem. Engr. Education*, vol. 34, no. 1, pp. 26-39, 2000.

After the seminal issue, the world of engineering education was greatly impacted. New thoughts on the direction of engineering education became prevalent, which is evident in the new direction of NSF’s sponsorship of educational research (CCLI turning into TUES). The following articles present a picture of the new direction of engineering research that is now embraced by NSF.

Gabriele, G. A., “Advancing engineering education in a flattened world,” *J. of Eng. Edu*., vol. 94, no. 3, 2005.

Fortenberry, N. L., “An extensive agenda for engineering education research,” *J. of Eng. Edu*., vol. 95, no. 1, 2006.

Streveler, R. A. and Smith, K. A.,“Conducting rigorous research in engineering education,” *J. of Eng. Edu*., vol. 95, no. 2, 2006.

Borrego, M., “Developments of engineering education as a rigorous discipline: A study of the publication patterns of four coalitions,” *J. of Eng. Edu*., vol. 97, no. 1, 2007.

Fortenberry, N. L., Sullivan, J. F., Jordan, P. N., and Knight, D. W., “Engineering Education Research Aids Instruction,” *Science*, vol. 317, 2007.

Borrego, M., Streveler, R. A., Miller, R. L. and Smith, K.A., “A new paradigm for a new field: communication representations of engineering education research,” *J. of Eng. Edu*., vol. 97, no. 2, 2008.

The following two articles are review articles discussing qualitative assessment versus quantitative assessment. Many examples are given and the discussions are founded in cognitive science theory.

Leydens, J. A., Moskal, B. M., and Pavelich, M. J., “Qualitative methods used in the assessment of engineering education,” *J. of Eng. Edu*., vol. 93, no. 1, 2004.

Borrego, M., Douglas, E. P., Amelink, C. T., “Quantitative, qualitative, and mixed research methods in engineering education,” *J. of Eng. Edu*., vol. 98, no. 1, 2009.

This article provides a review of different inductive teaching methods.

Prince, M. J. and Felder, R. M., “Inductive teaching and learning methods: definitions, comparisons, and research bases,” *J. of Eng. Edu*., vol. 95, no. 2, 2006.

Sample Rubrics

Rubrics are a nice way to make comparisons between groups, particularly if the assessment item (e.g. exam performance or design project difficulty) is different between groups. The rubric is a specific element you are looking for in the assessment item that is common between the assessment items. If you use the same rubric for both assessment items, then you are finding a common element which can be compared. Two examples are shown below.

The **first example** is a rubric applied to final exam questions in a digital VLSI class to determine whether or not a teaching style change improved learning. If student performance according to the rubrics improved between the first offering and the second offering to a reasonable degree of statistical significance (e.g. a low p-value), then the teaching technique may have improved student performance. Even though the investigator created the rubric, as long as the rubric indicates an accepted level of competency in the subject and was applied equally to all exam questions, significant changes suggest improved performance. The questions being assessed were different in the two groups, but the fundamental concepts underlying the questions were the same.

Sample rubrics:

1. Find the normalized path delay using the logical effort technique.

   Perfect = 4 pts, Minor error = 3 pts, Major error = 2 pts, Wrong = 1 pt, Didn't Try = 0 pts

2. Explain in short answer why one path is faster than another using logical effort terminology.

   Explained with logical effort = 2 pts, Explained without logical effort = 1 pt, Did not attempt = 0 pts

3. Compare the delay of a complex adder to the delay of a carry adder using a propogate-generate diagram.

   Expected 4 items in the comparison: (i) carry propagates through the group of bits, (ii) carry chain is set up in parallel, (iii) recognize the Manchester carry chain symbol, and (iv) the ripple carry adder goes through every chain. The rubric was scored as 1 point for each item with a maximum of 4 points.

The rubric scores were averaged for the control group and the experimental group. An ANOVA analysis was performed between the groups to determine if a significant improvement resulted. Major and minor errors may need to be defined in the paper.

The **second example** is a rubric applied to assess the difficulty of a design project in an FPGA class. The following rubrics are accepted indications of design project difficulty: (i) the number of I/O used, (ii) the number of boards required, (iii) the number of states, and (iv) the number of components in the datapath. Each project was evaluated to determine if they had a high, medium or low score for each of these rubrics. A score representing the difficulty of the project was determined as the average (could be a weighted average) of each rubric. With a score representing project difficulty, statements can be made indicting that a teaching method allowed students to perform better on projects of similar difficulty or similarly on projects of higher difficulty.

Sample Student Survey Questions

The following example is an actual survey that was used to determine if a teaching technique improved the confidence of students with analog circuits. This survey used a 7-point Likert scale that students used to determine their agreement with the statement. Note the combination of questions that would ideally be answered positively and negatively to keep the students aware as they answer the questions.

Survey of Perceptions and Confidence in Analog Circuits

Definitions for survey:
Circuit Analysis: The formal application of KVL and KCL to determine exact circuit voltages and currents or unknown parameters.

Circuit Behavior: General circuit operation based on basic device principles and minimal circuit analysis.
....
ECE250 Instructor Style
Please refer to your ES250 instructor when answering the items in this section
....

1. My instructor explained circuit behavior in addition to circuit analysis.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

2. My instructor explained circuits primarily through numerical examples.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

3. My instructor expected me to be able to solve numerical circuit analysis problems on homework and exams.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

4. My instructor expected me to be able to explain how a circuit behaves.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

5. It was possible to do well in ECE250 by memorizing specific methodologies or applying a specific procedure to get the answer.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

6. My instructor expected me to be able to analyze new circuits on homework and/or exams.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

....

Perceptions of Analog Circuits

....

1. It's easy to understand the behavior of an analog circuit.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

2. Understanding the analysis of analog circuits is hard.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

3. There is no methodical way to work through an analog circuit problem.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

4. Designing analog circuits is hard.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

5. I'm confident in my circuit analysis skills.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

6. I'm comfortable figuring out how a new circuit works.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

7. It is easier to find a pattern from prior examples than it is to apply a general understanding of the behavior when analyzing analog circuits.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

8. I enjoy trying to understand how analog circuits function.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

9. There is no way to know whether the answer you get to an analog circuit problem makes sense.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

....

Confidence with Analog Circuits

Please refer to your ECE351 instructor when answering the items in this section that refer to "your instructor."

....

1. I know how a BJT produces gain in an amplifier.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

2. I don't know how a FET produces gain in an amplifier.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

3. I feel comfortable finding the gain in an amplifier that is new to me.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

4. I don't understand the purpose of a common collector amplifier.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

5. I understand what causes an amplifier to clip.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

6. I don't know how to calculate the swing of an amplifier that is new to me.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

7. I can work through the numerical analysis in analog circuits, but I have no idea whether my answer makes sense.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

8. I understand why a specific procedure is used to analyze a circuit.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

9. Behavior based explanations of how circuits work help me feel comfortable analyzing the circuit.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

10. I would prefer that the instructor spend more time going through numerical examples.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

11. I would prefer that the instructor spend less time explaining how the circuit works.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

12. Understanding the behavior of an analog circuit does not help solve numerical problems.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

13. It is more important to copy down every part of the example than to follow the discussion of how it works.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

14. I don't understand circuit behavior until I see the circuit analysis worked out.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

15. When I study for circuit exams, I primarily work sample exams.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

16. When I study for circuit exams, I primarily review/rework homework examples and sample exams.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

17. When I study for circuit exams, I reread my notes in addition to reworking homework examples and sample exams.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

18. I would feel comfortable designing an analog circuit in my senior design project.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

19. I enjoy the challenge of figuring out how a new analog circuit works.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

20. I don't have much confidence in my ability to solve analog circuit problems.

Agree Strongly, Agree Moderately, Agree Slightly, Unsure, Disagree Slightly, Disagree Moderately, Disagree Strongly

Sample Focus Group Questions

The following example shows questions asked to a small group of students to determine the impact of industrial sponsorship on the analog integrated circuit testing course. The questions were asked and discussion was encouraged by an independent evaluator (e.g. someone who is NOT conducting the research) to ensure that students were free to provide honest opinions and to ensure that concerns were not curtailed by the investigator. Discussion was encouraged, and often the discussion led to topics not directly listed on the focus group questionnaire. This allows more information to be given to the researcher; however such a technique cannot be managed with a large group. Typically, a focus group (with a small group of students) can help the researcher create a meaningful survey that can be used with larger numbers.

Focus Group on the Impact of Industrial Sponsorship on the Analog Integrated-Circuit Testing Course

A. Multiple examples were given from the instructor's industrial experience throughout the quarter.
   1. Did these examples impact your learning of the material? Please explain your answer.
   2. Did these examples impact your perceptions of the integrated-circuit testing field? Please explain your answer.

B. Consider the lectures, labs, and homework on DC tests versus AC tests.
   1. Did you feel that the lectures, labs, and homework on DC tests or AC tests were delivered more clearly than the other? Please explain your answer?
   2. Did you feel that the lectures, labs, and homework on DC tests or AC tests were more relevant than the other? Please explain your answer?

C. Consider the labs throughout the quarter.
   1. Did using the software to write test code for the tests learned in class impact your learning of the material? Please explain your answer.
   2. Did having the schematic of the DIB impact your learning of the material? Please explain your answer.
   3. Do you think that being able to use the ATE would have impacted your learning of the material? Please explain your answer.

Below is the text written in a paper showing how the focus group results were presented in the publication. Notice the description of the “experimental procedure” describing the background of the students and the manner in which the focus group was conducted. Comments were only included if the independent evaluator suggested that it was the opinion of multiple students.

A focus group was conducted to gain student perceptions of the course and the impact of industrial contributions. The focus group contained 9 students, 4 electrical engineering majors, 4 computer engineering majors, and 1 mechanical engineering major with an EE minor. 4 students were master’s students and 5 were undergraduates. The focus group was conducted by an external evaluator so that students would feel comfortable expressing their true opinions. Common themes from the focus group were categorized into three groups: comments about the course, industrial involvement, and labs.

The students felt that the course tied many of their undergraduate concepts together. The AC topics were harder than the DC, but synthesized more topics. The course had a set of clear goals: to fix design problems, reduce test time, and minimize production costs. They felt that the statistics, process control, and yield lectures gave a clear picture of the business side of the industry and how the technical and business sides impacted one another. The fabrication aspects were illuminating because it was unexpected that fabrication played such a strong role in testing. Several of the computer engineers felt that this course was the first clear application for many concepts in their core curriculum. They felt this integration was so important that this course should be strongly advertised to other computer engineering students.

Students appreciated the practical industrial related examples provided by the instructor due to her co-op with TI. As a result, they felt the instructor could explain how tests and data are realized beyond what is presented in the datasheet. They also valued the sample data from actual devices provided by TI. No sample data was provided for the AC tests which students felt hindered their understanding of these topics. The instructor did not allow the students to have some of the device data in hand due to proprietary concerns which many of the students felt hindered their learning experience.

Students felt that the labs helped them understand how tests are actually realized and gave them another dimension to the examples (e.g. using the DIB, ranging, etc.) They felt the DIB schematic was critical to their understanding of how to design a test. They did not like the instructor-led programming style and requested a lab manual to provide examples. They felt gaining the use of an ATE to validate their tests for correct calculations, ranging, wait time, and data repeatability would benefit the course greatly.

Sample IRB and Informed Consent Forms

US Federal government requires that research involving human subject be reviewed by an Institutional Review Board (IRB) to verify that human subject rights are not being violated.

An *IRB form* describes the experiment being performed and indicates any risks involved to the participants (see example on following pages). A trained representative (not the researcher) must look at the IRB form and validate that the experiment poses no risks to the participants.

Your IRB program may require participants to complete an *Informed Consent form* indicating that the students are aware of the experiment and voluntarily agree to participate, and the possibility that the results may be published (see example on following pages). Some issues to consider when writing the informed consent form are

1. Students should sign the form indicating that they agree to participate in the experiment.
2. Participation should be voluntary. A survey or test may be mandatory (e.g. you may require completion of a survey as a HW to encourage participation or require completion of a national standardized test as part of the course); however the students must voluntarily permit you to include their results in the final study.
3. Use of demographics (age, race, gender, academic year, major, etc), current grades, and grades in pre-requisite courses may be used if permission is granted by the students (which is more easily obtained if anonymity is retained), but identifying features should be removed in the reported results (e.g. if you only have 1 or 2 female students in your class, you cannot report the results separated out by gender. It would be very easy for the data to be traced back to the 1 or 2 female students in the course.)
4. Informed consent can be done electronically (ex: students fill out a survey or take an on-line test and the consent form is read and agreed to at the end of the survey/test).

Sample IRB Form from Rose-Hulman

Application for Review of Research
Involving Human Participants

Federal regulations and Rose-Hulman Institute of Technology's Human Research Protection Policy require that all research involving humans as subjects be reviewed and approved prior to the commencement of recruitment and data collection. Any person (RHIT faculty member, student, staff member, or other person) wanting to engage in human subject research must receive written approval from the Institutional Reviewer (IR) or, if required, by the Institutional Review Board (IRB) before conducting the research.

1. Title of Project:

2. Principal Investigator: Name:

☐ Faculty ☐ Student* ☐ Staff ☐ Other—specify ________________

*Students are required to have a faculty, staff, or professional sponsor.

Campus Box No. or Mailing Address:

Phone: Email:

3. Co-Investigator(s) or Sponsor (student research must be sponsored by faculty or qualified staff):

Include all additional investigators with contact information.

☐ Faculty ☐ Student ☐ Staff ☐ Other—specify ________________

Campus Box No. or Mailing Address:

Phone: Email:

4. Project Description: Provide a brief description using layperson's terms of the proposed research, including purpose and research questions or hypothesis. Describe briefly how information will be collected, recorded, stored, and disseminated and procedures for maintaining confidentiality. List any funding sources sought or attained. Describe incentives, if any, being offered for participation in the study and any costs, if any, to the participants.

5. Indicate the categories of participants to be included in the study (check all that apply):

☐ Abortuses/Fetuses ☐ Patients

☐ Decisionally Impaired ☐ Prisoners

☐ Decisionally Impaired (Institutionalized) ☐ Pregnant Women

☐ Minors (17 years of age or less, give age range:____ ☐ Students

☐ Normal Volunteers

6. Does this research involve information that may identify participants? ☐ Yes ☐ No

7. Describe the informed consent procedures to be followed, including circumstances under which consent will be sought and obtained, who will seek it, and the method for documenting consent. Include a copy of your informed consent form.

8. Risks:

> ☐ The risks are minimal (i.e. the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests).
>
> ☐ The risks are greater than minimal.

9. Some categories of research may be exempt from full IRB review, including those below. Check the categories that apply to your research project:

> ☐ 1. Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
>
> ☐ 2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless (i) information obtained is recorded in such a manner that human participants can be identified, directly or through identifiers linked to the participants; and (ii) any disclosure of human participants' responses outside the research could reasonably place the participants at risk of criminal or civil liability or be damaging to the participants' financial standing, employability, or reputation. *Note: According to 45 CFR 46.401, if the participants are children, this exemption applies only to research involving educational tests or observations of public behavior when the investigator(s) does not participate in the activities being observed.*
>
> ☐ 3. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior that is not exempt under #2 (above) of this section if: (i) the human participants are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) require(s) without exception that the confidentiality of the

personally identifiable information will be maintained throughout the research and thereafter.

☐ 4. Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that participants cannot be identified, directly or through identifiers linked to the participants.

☐ 5. Research and demonstration projects which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

☐ 6. Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

10. Estimated starting date: Estimated completion date:

INVESTIGATOR ASSURANCE

I certify that the information provided for this project is correct and that no other procedures will be used in this protocol. I agree to conduct this research as described. I will request approval from the IR for changes to the study's protocol and/or consent procedures and will not implement the changes until I receive approval for these changes. I understand that changes may require approval of the IRB before proceeding. I will comply with the RHIT's Human Research Protection Policy for the conduct of ethical research. I will report significant or adverse effects or noncompliance to the IR via phone or e-mail immediately, and then in writing within 5 days of occurrence. I will be responsible for ensuring that the work of colleagues involved with this project complies with this protocol. I will complete, on request by the IR, a Continuation Request or Completion of Research Activities forms.

______________________________ __________

Principal Investigator's Signature Date

______________________________ __________

Faculty/Qualified Staff Sponsor Date

Sample Informed Consent Form

You are being presented with this form as part of Rose-Hulman's compliance with federal regulations governing research involving human subjects.

You will be asked to fill out a survey at the beginning and the end of the quarter indicating your perceptions and confidence in analog circuits. These surveys are part of a study to assess the impact of a particular teaching style on student confidence with analog circuits. There are no known risks from participating in this study.

We would like your permission to analyze your responses on these two surveys. We would also like your permission to collect some of your demographic information and your past academic performance in related subjects. Specifically, we would like your permission to collect your race, gender, academic year, major, learning style, the quarter you took ECE250, the instructor you had for ECE250, GPA, and your grades for ECE250 and this course. Some of this information will allow us to verify that the teaching style is not biased with respect to race, gender, class year, or learning style. Other information also will allow us to determine the teaching style that you encountered in ECE250 and the extent to which the prerequisite course grades predict confidence with Analog Circuits. You will be assigned an identification number and all information about you and your grades used in the study will be identified by this code number only. Your name will only be recorded to ensure your instructor gives you proper credit for completing the survey. You are free to withhold your permission without penalty. If you withhold your permission, completion of the survey may still be required by your instructor as part of your class grade, but our study will not include the results, nor will we collect the demographic and academic data listed above.

If you have questions about the study or wish to receive feedback about the results of the study, please call me at (xxx) xxx-xxxx, or email me at Tina.Hudson@Rose-Hulman.edu. If you have questions about your rights as a research subject, please contact Robert Throne, at extension xxxx.

Sincerely,

Tina Hudson
Assist. Prof. of ECE

I acknowledge that I have been informed of and understand the nature and purpose of this study and freely consent to allow my survey results, demographic data, and previous grades to be analyzed confidentially for use in this study.

Signed: ____

Name (Printed): ____

Date: ____