Office of the Registrar
FORM 40G REV. 12/09

PURDUE UNIVERSITY

REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF A GRADUATE COURSE
(50000-60000 LEVEL)

Print Form

Graduate Council Doc. No. 10-24 d
EFD 17-11

DEPARTMENT School of Engineering Education

EFFECTIVE SESSION Fall ~~2010~~ 2011

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

- [X] 1. New course with supporting documents (complete proposal form)
- [ ] 2. Add existing course offered at another campus
- [ ] 3. Expiration of a course
- [ ] 4. Change in course number
- [ ] 5. Change in course title
- [ ] 6. Change in course credit/type
- [ ] 7. Change in course attributes
- [ ] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered
- [ ] 12. Transfer from one department to another

PROPOSED:		EXISTING:	
Subject Abbreviation	ENE	Subject Abbreviation	
Course Number	62000	Course Number	
Long Title	Design, Cognition and Learning		
Short Title	Design, Cognition & Learning		

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

TERMS OFFERED
Check All That Apply:
[ ] Summer [X] Fall [ ] Spring

CAMPUS(ES) INVOLVED
[ ] Calumet [ ] N. Central
[ ] Cont Ed [ ] Tech Statewide
[ ] Ft. Wayne [X] W. Lafayette
[ ] Indianapolis

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 3
2. Variable Credit Range: Minimum Cr. Hrs ____ (Check One) To [ ] Or [ ]
Maximum Cr. Hrs. ____
3. Equivalent Credit: Yes [ ] No [X]
4. Thesis Credit: Yes [X] No [ ]

COURSE ATTRIBUTES: Check All That Apply
1. Pass/Not Pass Only [ ]
2. Satisfactory/Unsatisfactory Only [ ]
3. Repeatable [ ]
Maximum Repeatable Credit: [ ]
4. Credit by Examination [ ]
5. Special Fees [ ]
6. Registration Approval Type: Department [ ] Instructor [X]
7. Variable Title [ ]
8. Honors [ ]
9. Full Time Privilege [ ]
10. Off Campus Experience [ ]

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Schedule Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	170	1	16	100
Recitation				
Presentation				
Laboratory				
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):

Design is central to engineering: it is an integral part of the engineering profession and how we educate future professionals. Design cognition and learning is an area of engineering education research that seeks to understand what designers know and how they learn, and what tools best support design activity (e.g., collaboration, innovation, etc.). This research draws from many perspectives including cognitive psychology and the learning sciences, organizational learning, engineering and product design, architecture, human-centered interaction, and creativity and innovation. Themes in the course include (1) what is design knowledge, (2) what theories help understand design knowing and learning, (3) what are ways to study designers and design activity, and (4) how may design research inform design education and practice? Professor Adams.

Calumet Department Head	Date	Calumet School Dean	Date	Calumet Undergrad Curriculum Committee	Date
Fort Wayne Department Head	Date	Fort Wayne School Dean	Date	Fort Wayne Chancellor	Date
Indianapolis Department Head	Date	Indianapolis School Dean	Date	Undergrad Curriculum Committee (R Capra)	11/02/2010
North Central Faculty Senate Chair	Date	Vice Chancellor for Academic Affairs	Date	Date Approved by Graduate Council	APPROVED 2/17/11
West Lafayette Department Head (K Ellis)	11/5/10	West Lafayette College/School Dean (Michael T. Allen)	10/20/2010	Graduate Council Secretary (Tina L. Payne)	2/18/11
Graduate Area Committee Convener (Dan Adams)	3/8/11	Graduate Dean	Date	West Lafayette Registrar (Sandra Helphinstine)	3/21/11

OFFICE OF THE REGISTRAR

3/18/11

Office of the Registrar
FORM 40G REV. 12/09

PURDUE UNIVERSITY

REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF A GRADUATE COURSE
(50000-60000 LEVEL)

Print Form

EFD 17-11

DEPARTMENT School of Engineering Education

EFFECTIVE SESSION Fall 2010

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

- [X] 1. New course with supporting documents (complete proposal form)
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- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered
- [ ] 12. Transfer from one department to another

PROPOSED:	EXISTING:
Subject Abbreviation ENE	Subject Abbreviation
Course Number 62000	Course Number
Long Title Design, Cognition and Learning	
Short Title Design, Cognition & Learning	

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

TERMS OFFERED
Check All That Apply:
[ ] Summer [X] Fall [ ] Spring

CAMPUS(ES) INVOLVED
[ ] Calumet [ ] N. Central
[ ] Cont Ed [ ] Tech Statewide
[ ] Ft. Wayne [X] W. Lafayette
[ ] Indianapolis

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 3
2. Variable Credit Range:
Minimum Cr. Hrs
(Check One) To [ ] Or [ ]
Maximum Cr. Hrs.
3. Equivalent Credit: Yes [ ] No [ ]
4. Thesis Credit: Yes [X] No [ ]

COURSE ATTRIBUTES: Check All That Apply

1. Pass/Not Pass Only [ ]
2. Satisfactory/Unsatisfactory Only [ ]
3. Repeatable [ ]
Maximum Repeatable Credit: [ ]
4. Credit by Examination [ ]
5. Special Fees [ ]
6. Registration Approval Type
Department [ ] Instructor [X]
7. Variable Title [ ]
8. Honors [ ]
9. Full Time Privilege [ ]
10. Off Campus Experience [ ]

Schedule Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
	170	1	16	100
Lecture				
Recitation				
Presentation				
Laboratory				
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):

Design is central to engineering; it is an integral part of the engineering profession and how we educate future professionals. Design cognition and learning is an area of engineering education research that seeks to understand what designers know and how they learn, and what tools best support design activity (e.g., collaboration, innovation, etc.). This research draws from many perspectives including cognitive psychology and the learning sciences, organizational learning, engineering and product design, architecture, human-centered interaction, and creativity and innovation. Themes in the course include (1) what is design knowledge, (2) what theories help understand design knowing and learning, (3) what are ways to study designers and design activity, and (4) how may design research inform design education and practice?

Calumet Department Head	Date	Calumet School Dean	Date	Calumet Undergrad Curriculum Committee	Date
Fort Wayne Department Head	Date	Fort Wayne School Dean	Date	Fort Wayne Chancellor	Date
				X R. Capra	11/02/2010
Indianapolis Department Head	Date	Indianapolis School Dean	Date	Undergrad Curriculum Committee	Date
North Central Faculty Senate Chair	Date	Vice Chancellor for Academic Affairs	Date	Date Approved by Graduate Council	
X [signature]	11/5/10	[signature]	10/28/2010		
West Lafayette Department Head	Date	West Lafayette College/School Dean	Date	Graduate Council Secretary	Date
Graduate Area Committee Convener	Date	Graduate Dean	Date	West Lafayette Registrar	Date

OFFICE OF THE REGISTRAR

To: The Faculty of the College of Engineering
From: School of Engineering Education
Subject: New Graduate Course, ENE 62000

The faculty of the School of Engineering Education has approved the following new graduate ENE course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

ENE 62000 - Design Cognition and Learning

Sem. 1, Class 3, Cr. 3.

Prerequisite: Open to students in graduate standing.

Course description: Design is central to engineering: it is an integral part of the engineering profession and how we educate future professionals. Design cognition and learning is an area of engineering education research that seeks to understand what designers know and how they learn, and what tools best support design activity (e.g., collaboration, innovation, etc.). This research draws from many perspectives including cognitive psychology and the learning sciences, organizational learning, engineering and product design, architecture, human-centered interaction, and creativity and innovation. Course topics include (1) what is design knowledge, (2) what theories help understand design knowing and learning, (3) what are ways to study designers and design activity, and (4) how may design research inform design education and practice?

Reasons: This is an elective course for graduate students in the School of Engineering Education (ENE). This new course will also be of interest to graduate students in other Departments, Schools, and Colleges with design practice, learning, and teaching interests. One goal of the course is to provide opportunities for ENE graduate students to develop an area of specialization in an area that is central to engineering practice and engineering education research – design cognition and learning. Another goal is to address a crucial gap in existing courses in the School, College and University. While there are many excellent courses at Purdue that provide design experiences or particular design methods (e.g., sustainable design, human-centered design, instructional design, global design, etc.), this course is unique in its focus on understanding fundamental theories on how designers think, work, and learn. As such, it provides a crucial "interdisciplinary" resource for those interested in developing and assessing design education experiences and creating tools to support design activity and designers. A third goal is to meet degree requirements in the ENE program in which students must develop a specialization in engineering education. A final goal is to provide a unique perspective on design that has

value for engineers (e.g., how designers innovate), those who teach engineers (e.g., design learning experiences for students to learn how to design), and those who want to understand how engineers learn (e.g., how they learn design).

This course was previously taught in Spring 2007 (10 students), Fall 2008 (7 students), and Fall 2009 (11 students). The course was offered as ENE 695G – Design Cognition and Learning. The course attracts graduate students and faculty in the College of Engineering (e.g., Engineering Education, Mechanical Engineering, Civil Engineering, Materials Science and Engineering, Electrical and Computer Engineering, Construction Management, Biomedical Engineering), the College of Education, and Krannert's School of Management. For each offering, the course has received high evaluations. The course has also played a central role in the thesis research of students in the ENE program as well as students in Mechanical Engineering and Residential Construction.

David Radcliffe, Kamyar Haghighi Head
Epistemology Professor of Engineering Education
School of Engineering Education

APPROVED FOR THE FACULTY
OF THE SCHOOLS OF ENGINEERING
BY THE ENGINEERING
CURRICULUM COMMITTEE

ECC Minutes #4

Date 10/19/10

Chairman ECC R. Cipra

Supporting Document for a New Graduate Course

To: Purdue University Graduate Council

From:
Faculty Member: Robin Adams
Department: School of Engineering Education
Campus: West Lafayette

Date: July 27, 2010

Subject: Proposal for New Graduate Course-Documentation Required by the Graduate Council to Accompany Registrar's Form 40G

For Reviewer's comments only
(Select One)

Reviewer:

Comments:

Contact for information if questions arise:
Name: Cindey Hays
Phone Number: 494-3884
E-mail: isenberg@purdue.edu
Campus Address: ARMS 1321

Course Subject Abbreviation and Number: ENE 62000

Course Title: Design, Cognition and Learning

A. Justification for the Course:

- Provide a complete and detailed explanation of the need for the course (e. g., in the preparation of students, in providing new knowledge/training in one or more topics, in meeting degree requirements, etc.), how the course contributes to existing fields of study and/or areas of specialization, and how the course relates to other graduate courses offered by the department, other departments, or interdisciplinary programs.

- Justify the level of the proposed graduate course (50000- or 60000-level) including statements on, but not limited to: (1) the target audience, including the anticipated number of undergraduate and graduate students who will enroll in the course; and (2) the rigor of the course.

B. Learning Outcomes and Method of Evaluation or Assessment:

- Describe the course objectives and student learning outcomes that address the objectives (i.e., knowledge, communication, critical thinking, ethical research, etc.).

- Describe the methods of evaluation or assessment of student learning outcomes. (Include evidence for both direct and indirect methods.)

- Grading criteria (select from dropdown box); include a statement describing the criteria that will be used to assess students and how the final grade will be determined.

Criteria Papers and Projects

- Identify the method(s) of instruction (select from dropdown box) and describe how the methods promote the likely success of the desired student learning outcomes.

Method of Instruction Lecture

C. Prerequisite(s):

- List prerequisite courses by subject abbreviation, number, and title.
- List other prerequisites and/or experiences/background required. If no prerequisites are indicated, provide an explanation for their absence.

D. Course Instructor(s):

- Provide the name, rank, and department/program affiliation of the instructor(s).
- Is the instructor currently a member of the Graduate Faculty? X Yes — No
  (If the answer is no, indicate when it is expected that a request will be submitted.)

E. Course Outline:

- Provide an outline of topics to be covered and indicate the relative amount of time or emphasis devoted to each topic. If laboratory or field experiences are used to supplement a lecture course, explain the value of the experience(s) to enhance the quality of the course and student learning. For special topics courses, include a sample outline of a course that would be offered under the proposed course.

F. Reading List (including course text):

- A primary reading list or bibliography should be limited to material the students will be required to read in order to successfully complete the course. It should not be a compilation of general reference material.
- A secondary reading list or bibliography should include material students may use as background information.

G. Library Resources

- Describe the library resources that are currently available or the resources needed to support this proposed course.

H. Example of a Course Syllabus (While not a necessary component of this supporting document, an example of a course syllabus is available, for information, by clicking on the link below, which goes to the *Graduate School's Policies and Procedures Manual for Administering Graduate Student Programs*. See Appendix K.)

http://www.gradschool.purdue.edu/downloads/Graduate_School_Policies_and_Procedures_Manual.pdf

ENE 62000 - Design Cognition and Learning

A. Justification for the Course:

Provide a complete and detailed explanation of the need for the course (e. g., in the preparation of students, in providing new knowledge/training in one or more topics, in meeting degree requirements, etc.), how the course contributes to existing fields of study and/or areas of specialization, and how the course relates to other graduate courses offered by the department, other departments, or interdisciplinary programs.
Justify the level of the proposed graduate course (50000- or 60000-level) including statements on, but not limited to: (1) the target audience, including the anticipated number of undergraduate and graduate students who will enroll in the course; and (2) the rigor of the course.

Explanation of need for the course:

This course fulfills the following needs:

1. Opportunity for students both in the ENE program and across the university to develop their specialization in an area that is central to engineering practice and engineering education research – design cognition and learning. This course, currently in its third offering, has played a central role in 3 dissertation theses (all in ENE), a master's thesis (in Mechanical Engineering), and at least 6 future thesis proposals (4 in ENE, 1 in Residential Construction, 1 in Mechanical Engineering). The course has enrolled students from Engineering Education, Mechanical Engineering, Chemical Engineering, Civil Engineering, Environmental and Ecological Engineering, Materials Science and Engineering, Education, Biomedical Education, Krannert School of Management, and Computer Science.

2. Addresses a crucial gap in existing courses in the ENE program, the College of Engineering, and the University. While there are many excellent courses around the campus that provide design experiences or experiences in particular design methods (e.g., sustainable design, human-centered design, mathematical modeling, graduate design, global design, etc.), this course is unique in its focus on understanding how designers think, what they know, and how they learn. As such, it provides a crucial "interdisciplinary" resource for those interested in developing and assessing design education experiences (P-12 through higher and professional education) and creating supports for design activity (e.g., interdisciplinary communication and collaboration tools). It also provides a bridge to specific curricula in programs outside of ENE – e.g., curriculum and instruction or cognitive psychology courses in the College of Education, innovation courses in the College of Engineering and the Krannert School. Some examples of "bridge" classes include: ME 55300 – Product and Process Design, ME 57300 – Interactive Computer Graphics, CE 51200 – Comprehensive Urban Planning Process, EDCI 57200 – Introduction to Learning Systems Design, EDCI 61900 – Learning Science, EDPS 53200 – Measuring Educational Achievement, EDUC H5380 – Critical Thinking and Education, MGMT 52200 – New Product Design, and MGMT 68600 – Knowledge Management Systems.

3. Meets degree requirements in the ENE program and has been used in Plans of Study for students outside of the ENE department (e.g., Mechanical Engineering, Civil Engineering, Education, etc.).

4. Provides a unique perspective on design that has value for engineers (e.g., reveals opportunities for understanding how engineering designers innovate and how to better support innovation), those who teach engineers (e.g., design instructional systems for students to learn design), and those who want to understand how engineers learn (e.g., how they learn design).

Justification for course level:

The level of the proposed course is at the 60000-level because (1) the target audience is ENE PhD students (approximately 10-20 students per year) and graduate students interested in design knowing and learning (approximately 7-14 students per year), (2) successful completion of the course requires students of high intellectual

rigor who can synthesize and critique diverse perspectives, make and support claims regarding design cognition and learning, and apply their knowledge to articulate a design research study, education plan, or philosophy statement, (3) instructional techniques require a substantial level of reflection, critique, and argumentation, and (4) course assignments are based on an ability to critique, synthesize, and apply knowledge (which represent attributes of higher level thinking). While there are no specific prerequisites for this course beyond graduate student standing, the course is not intended for undergraduate level students.

B. Learning Outcomes and Method of Evaluation or Assessment:

- *Describe the course objectives and student learning outcomes that address the objectives (i.e., knowledge, communication, critical thinking, ethical research, etc.).*
- *Describe the methods of evaluation or assessment of student learning outcomes. (Include evidence for both direct and indirect methods.)*
- *Grading criteria (select from dropdown box); include a statement describing the criteria that will be used to assess students and how the final grade will be determined.*
- *Identify the method(s) of instruction (select from dropdown box) and describe how the methods promote the likely success of the desired* student learning outcomes.

Course objectives:

The objective of this course is to "unpack" design cognition and learning through multiple perspectives with an ultimate goal of motivating efforts to enable design learning and effective design practice. The focus of discussion, reflection, and application activities in this course is organized by the following themes:

- What is design knowledge – what do designers know and how does that guide their actions?
- What theories help understand design cognition and learning?
- What are ways to study designers and design activity (in relation to these theories)?
- What are design learning trajectories – what changes and how does it change?
- How may design research inform design education and practice?

Student learning outcomes:
Describe and critique the ways that design is understood, including variations among different ways of understanding design

- Instructional objectives: Opportunities to (1) explore and critique multiple perspectives on design cognition and learning – some of which are synergistic and some of which conflict – to develop a more sophisticated understanding that acknowledges and builds on different perspectives, (2) stretch, broaden, and challenge perspectives, and (3) share and clarify ideas through writing and discussion.
- Mapping to course tasks: Class discussion – participation and engagement, (2) reflection blogs, (3) final synthesis and application project (particularly, analysis of designers and design activity, final report)
- Link to ENE Graduate Competencies: Synthesize knowledge, Communicate knowledge, Think critically and reflectively

Identify examples of, and trends in, empirical approaches to studying design activity

- Instructional objectives: Opportunities to (1) develop a landscape view of cognition knowing and learning that may also reveal gaps in knowledge, (2) critique and discuss a variety of ways people study design to better understand what methods are appropriate for what kinds of research goals, and (3) examine data drawn from a variety of methods (e.g., verbal protocol analysis, sketches, surveys, debrief interviews and reports).
- Mapping to course tasks: (1) Class discussion – participation and engagement, (2) reflection blogs, (3) final synthesis and application project (particularly, analysis of designers and design activity, final report)

- Link to ENE Graduate Competencies: Synthesize knowledge, Communicate knowledge, Think critically and reflectively.

Identify quality resources for investigating design cognition and learning such as journals, community, and individual researchers.

- Instructional objectives: Opportunities to (1) experience different resources across disciplinary communities, (2) identify central resources for finding information, and (3) develop an awareness of differences across diverse design communities (e.g., differences in language, values, approaches).
- Mapping to course tasks: (1) Selection of readings for class discussion, and (2) final synthesis and application project (particularly, finding resources in support of final project)
- Link to ENE Graduate Competencies: Think critically and reflectively

Articulate your own view of design and become more confident about your ability to work as a designer

- Instructional objectives: Opportunities to (1) experience and reflect on design through in class activities, and (2) examine other designers (peers as well as existing design data) to develop skills of noticing and seeing that may be used to guide personal reflections on a design philosophy, to develop a research proposal, or to develop an awareness of the kinds of challenges learners experience about design knowing.
- Mapping to course tasks: (1) engagement in class activities, (2) reflection blog posts, and (3) final synthesis and application project (particularly, develop a personal philosophy of design)
- Link to ENE Graduate Competencies: Synthesize knowledge, Communicate knowledge, Think critically and reflectively

Translate research on design knowing and learning into practical implications for design education

- Rationale: The overarching goal of research is to inform practice. However, making this translation is not self-evident and requires multiple experiences to understand how to transfer ideas between research and practice.
- Instructional objectives: Opportunities to (1) synthesize ideas through class discussion, activities, and out-of-class reflection blog posts, (2) give and receive feedback on the final course project at multiple points in the term, and (3) develop an application of research on design knowing and learning (a philosophy statement, a research proposal, an education proposal, a synthesis to identify gaps).
- Mapping to course tasks: (1) Final synthesis and application project
- Link to ENE Graduate Competencies: Synthesize knowledge, Create knowledge, Communicate knowledge, Apply engineering education principles to the solution of instructional or curricular problems

Methods of evaluation and assessment: Grading criteria - Papers and tasks (see table below for Grading Criteria)

Grading criteria used to assess students and articulate final grades are based on three tasks weighted as a percentage of the total final grade (see table below).

Grading Tasks	Portion of total grade	Assessment
Task 1 is "discussion": based on weekly class discussion (attendance and engagement). Goals are (1) engage in collaborative learning, (2) test ideas and receive feedback, and (3) enable reflective practice. Students are required to contact the instructors regarding absences and must complete an additional task as a substitute for missing class discussion. Students may complete additional work to compensate for up to 2 absences.	20% (assessed weekly)	The total grade is based on the following guideline: an A for engaging in all classes, a B for missing 2 classes or not contributing during 75% of the class meetings, a C for missing 3 classes or not contributing during 50% of the class meetings, a D for missing 4 classes, and an F for missing 5 or more classes.

Grading Tasks	Portion of total grade	Assessment
Task 2 is "reflection blog posts", based on contributions to the course blog that are used to prepare students for substantive class discussions. Goals are (1) to support deep class discussion, (2) enable reflective practice, and (3) provide a place for out-of-class conversation.	15% (assessed weekly)	Individual contribution grades are based on the following guideline: 0 = not turned in; 1 = contribution substantially lacks clarity, organization, depth of reflection; 2 = made substantive claims that are grounded, clear, and/or persuasive.
Task 3 is a design synthesis / application project that is made up of 4 activities. The project may be (1) a design philosophy statement, (2) a research proposal, (3) an education proposal, or (4) a synthesis of an area of design research that identifies opportunities for future work. The goals are to (1) synthesize ideas and (2) put ideas into action (application).	65%	A series of projects with feedback: Part I (10%) – 3 page statement as a starting point for the final project (in class review) – "Design as X, for X" Part II (10%) – 3 page analysis of design data Part III (10%) – outline of final project (in class review) Part IVa (10%) – a "storyboard" of the final project (presented in class) Part IVb (25%) –final project report (maximum 30 pages, double spaced) The feedback criterion addresses levels of "completeness", "grounded arguments", "well-organized", "clear", and "engaging". The final grade is based on incorporating feedback based on the criterion.

Method of instruction: Lecture

The instructional approach is based on extensive classroom discussion, reflection assignments, hands-on design activities (both doing design and studying design), and instructor and peer feedback on course projects. Course projects complement instruction by providing opportunities to iteratively synthesize course topics and apply knowledge to develop a personal philosophy of design, a design research proposal, a design education proposal, or a synthesis of design research to identify future needs in design research and education.

Instruction focuses on five discussion themes that provide a consistent point for reflection, iteration, and integration. These five themes include: What is design knowledge – what do designers know and how does that guide their actions? What theories help understand design knowing and learning? What are ways to study designers and design activity (in relation to these theories)? What are design learning trajectories – what changes and how does it change? How may design research inform design education and practice? Hands-on activities, peer feedback, and synthesis activities are used to promote deeper understanding of the ideas present in these themes and opportunities to organize their own learning outcomes.

Instructional methods promote likely success of desired student learning outcomes because they focus on building skills in reflection, critique, argumentation, and synthesis necessary for producing high quality course projects that target course learning goals. Hands-on activities allow opportunities to learn through doing. In addition, course projects are iteratively developed with multiple opportunities for peer and instructor feedback.

C. Prerequisite(s):

- *List prerequisite courses by subject abbreviation, number, and title.*
- *List other prerequisites and/or experiences/background required. If no prerequisites are indicated, provide an explanation* for their absence.

There are no course prerequisites. Because ENE does not provide a Master's degree and students apply to ENE from a broad range of disciplines (engineering, physics, math, etc.) it would be difficult to define a set of course prerequisites. Similarly, it would be difficult to identify prerequisite courses because the course enrolls diverse students from across the University and to the instructor's knowledge there are no relevant courses in design cognition and learning that may serve as prerequisites. However, significant design experience as well as completing the course ENE 695000 Theories of Development and Engineering Thinking would contribute to students' success in this course.

While there are no prerequisites, interested students must be currently enrolled in a graduate program at Purdue University.

D. Course Instructor(s):

- *Provide the name, rank, and department/program affiliation of the instructor(s).*
- *Is the instructor currently a member of the Graduate Faculty? (If the answer is no, indicate when it is expected that a request will be submitted.)*

Course Instructor(s):

Dr. Robin Adams, Assistant Professor, School of Engineering Education

Dr. Adams is currently a member of the Graduate Faculty.

E. Course Outline:

- *Provide an outline of topics to be covered and indicate the relative amount of time or emphasis devoted to each topic. If laboratory or field experiences are used to supplement a lecture course, explain the value of the experience(s) to enhance the quality of the course and student learning. For special topics courses, include a sample outline of a course that would be offered under the proposed course.*

Course Outline:

The tentative syllabus below describes course topics and indicates the relative amount of time devoted to three topic areas: design knowing, design cognition and learning, and design learning trajectories. The readings below suggest the current plan and may be modified over the course of the semester.

Week 1 (Aug 26) Class Cancelled
Week 2 (Sept 2) Starting the conversation..."What is design?"

- Introductions and overview; Activity - Representing design
- Resource: Dubberly, Hugh (2004). How do you design? A Compendium of Models. Dubberly Design Office, San Francisco CA.

Week 3 (Sept 9) Design as...knowledge; investigating design

- Knowledge:
- Niedderer, K. (2007). "Mapping the Meaning of Knowledge in Design Research." Design Research Quarterly, 2(2).
- Dorst, K. and Lawson, B. (2009). Design Expertise. Architectural Press. Chapter 2: Understanding design.
- Investigating design:

- Craig, D.L. (2001). "Stalking Homo Faber: A Comparison of Research Strategies for Studying Design Behavior." In C.M. Eastman, W.M. McCracken & W. Newstetter (eds.), Design Learning and Knowing: Cognition in Design Education. New York: Elsevier Press.
- Matthews, B. (2007). "Locating design phenomena: a methodological excursion." Design Studies, 28, pp 369-385.

Week 4 (Sept 16) Design as process

- Atman, C. J., Chimka, J. R., Bursic, K. M., & Nachtman, H. L. (1999). A Comparison of freshman and senior engineering design processes. Design Studies, 20 (2), 131-152.
- Mehalik, M.M. & C. Schunn (2006). "What constitutes good design? A review of empirical studies of design processes." International Journal of Engineering Education, 22 (3), Special Issue on Learning and Engineering Design.
- Mosborg, S., R. Adams, R. Kim, C. J. Atman, J. Turns & M. Cardella (2005). "Conceptions of the Engineering Design Process: An Expert Study of Advanced Practicing Professionals," Proceedings of the Annual American Society of Engineering Education Conference, Portland, June.

Week 5 (Sept 23) Design as reflective practice (design as learning)

- (Revisit) Dorst, K. and Lawson, B. (2009). Design Expertise. Architectural Press. Chapter 2: Understanding design.
- Schön, D. A. (1993). The Reflective Practitioner: How Professionals Think in Action Basic Books, New York. Selected chapters.
- Examples:
- Teams: Valkenburg, R. (1998). The Reflective Practice of Design Teams. Design Studies, 19, 3, pp. 249-271.
- Individuals: Adams, R. S., Turns, J. and Atman, C. J. (2003). "Educating effective engineering designers: The role of reflective practice". Design Studies, Special Issue on Designing in Context, 24(3), pp. 275-294.
- Tools: TIDEE Capstone Assessment tools [used in class]

Week 6 (Sept 30) Design as a social process

- Bucciarelli, L. L. (1996). Designing engineers. Cambridge: MIT Press. Chapter 1-2, 6.
- Kleinsmann, M., and Valkenburg, R. (2008). "Barriers and enablers for creating shared understanding in co-design projects." Design Studies, 29, 269-386.

Week 7 (Oct 7) Design as way of knowing

- Nelson, H. & Stolterman, E. (2003). The Design Way: Intentional Change in an Unpredictable World. New Jersey: Educational Technology Publications. Chapters 1-3
- Rowland, Gordon. 2004. "Shall We Dance? A Design Epistemology for Organizational Learning and Performance." ETR&D 52:33-48.
- Optional:
- Cross, N. (2006). Designerly Ways of Knowing. London: Springer-Verlag. Chapter 1-2.

Week 8 (Oct 14) Design as...human-centered, contextual, participatory (Jigsaw activity)

- Sanders, E.B. (2006). Design Research in 2006. Design Research Quarterly, Vol 1(1), September, pp. 1-8. (http://www.designresearchsociety.org)
- Human-centered selection:
- Krippendorf, K. (2006). The Semantic Turn: A New Foundation for Design. Boca Raton: Taylor and Francis. Chapter 2.
- Norman, D. A. (2002). Emotion and design: Attractive things work better. Interactions Magazine, ix (4), 36-42. OR Norman, D.A. (2004). Emotional Design: Why we love (or hate) everyday things. New York: Basic Books. Chapter 1.1 – Attractive things work better.

Sustainability selection:

- Mann,L., Radcliffe, D. and G. Dall'Alba (2007). "Experiences of sustainable design among practicing engineers: Implications for engineering education." Proceedings of the annual ASEE Conference, Hawaii, June.
- A reading from Harvey Mudd Design Education Workshop on Sustainability.

Participatory design selection:

- Carroll, John M. (2006). "Dimensions of Participation in Simon's Design." Design Issues, 22, 2, pp 3-18.
- Cahill, C. (2007). "Including excluded perspectives in participatory action research." Design Studies, 28, pp. 325-340.
- Peer feedback: Design as X, for X "project" with 3 options for final project

Week 9 (Oct 21) Design problems engage design thinking

- Dorst, K. (2004). "The problem of design problems – problem solving and design expertise. Journal of Design Research, Vol. 4, Issue 2.
- Goel, V. & Pirolli, P. (1992). "The Structure of Design Problem Spaces." Cognitive Science 16, pp. 395-429.
- Jonassen, D.H. (2000). "Toward a Design Theory of Problem Solving." Educational Technology: Research & Development, 48 (4), pp. 63-85.

Week 10 (Oct 28) Design as cognition

- National Research Council (2000). How people learn: Brain, mind, experience, and school, Expanded edition. Committee on Developments in the Science of Learning. J.D. Bransford, A.L. Brown, and R.R. Cocking (Eds.), with additional material from the Committee on Learning Research and Educational Practice. Commission on Behavioral and Social Sciences and Education. Washington, DC: National Academy Press. Chapter 2.
- Svinicki, M.D. (1999). New Directions in Learning and Motivation. New Directions in Teaching and Learning, 80, p 5-27.

Examples of cognitive studies in design:

- Adams, R. S. (2002). "Understanding design iteration: Representations from an empirical study," Proceedings of the International Conference of the Design Research Society, September, London.
- Ball, L.J. and Christensen, B.T. (2008). "Analogical reasoning and mental simulation in design: two strategies linked to uncertainty resolution." Design Studies, 30, pp. 169-186.
- Christensen, B.T. and Schunn, C.D. (2007). "The relationship of analogical distance to analogical function and pre-inventive structure: the case of engineering design. Memory and Cognition, 35 (1), pp. 29-38.
- Gentner, D., & Markman, A. B. (1997). Structure mapping in analogy and similarity. American Psychologist, 52, 45-56.
- Huang, Y. (2007). "Investigating the cognitive behavior of generating idea sketches through neural network systems." Design Studies, 29, pp. 70-92.
- Kim, M.H., Kim, Y.S., Lee, H.S., and Park, J.A. (2007). "An underlying cognitive aspect of design creativity: Limited Commitment Mode control strategy." Design Studies, 28, pp 585-604.
- Jin, Y. and Cusilp, P. (2005). "Study of mental iteration in different design situations." Design Studies, 27, pp. 25-55.
- Kokotovich, V. (2007). "Problem analysis and thinking tools: an empirical study of non-hierarchical mind mapping." Design Studies, 29, 49-69.
- Purcell, A. T., & Gero, J. S. (1996). Design and other types of fixation. Design Studies, 17(4), 363-383.

Optional:

- Hunt, E.B. (2002). Précis of Thought on Thought. New Jersey: Lawrence Earlbaum. Selected chapters.
- Kitchener, K. S. (1983). Cognition, metacognition, and epistemic cognition. Human Development, 26, 222-232.
- Simon, H. A. (1969). The sciences of the artificial. Cambridge, MA: MIT Press. Chapter TBD

Week 11 (Nov 4) Design as situated cognition - communication and collaboration

- Greeno, J. (1998). "The situativity of knowing, learning, and research." American Psychologist, 53, pp. 5-26.

Examples of situated cognitive studies in design:

- Dong, A. (2006). "The enactment of design through language." Design Studies, 28, pp. 5-21.
- Crilly, N., Good, D., Matravers, D., and Clarkson, P.J. (2008). "Design as communication: exploring validity and utility of relating intention to interpretation." Design Studies, 29, pp. 425-457.

- (Revisit) Schön, D. A. (1993). The Reflective Practitioner: How Professionals Think in Action Basic Books, New York.
- (Revisit) Bucciarelli, L. L. (1996). Designing engineers. Cambridge: MIT Press. Chapter 1-2, 6.

Week 12 (Nov 11) Design as situated cognition – interaction with cognitive artifacts

- Fish, J and Scrivener, S. A. (1990). Amplifying the mind's eye: Sketching and visual cognition. Leonardo, 23, 117-126.
- Goldschmidt, G. (1991). "The Dialectics of Sketching." Creativity Research Journal, 4(2), pp 123-143.
- Blanco, E. (2003). "Rough drafts: Revealing and mediating design." In D. Vinck (ed), Everyday Engineering: An Ethnography of Design and Innovation. Cambridge: MIT Press. [In the pdf document, this is the second chapter.]
- Goldschmidt, G. and Smolkov, M. (2006). "Variances in the impact of visual stimuli on design problem solving performance." Design Studies, 27, pp. 549-569.

Week 13 (Nov 18) Analyzing designers; design in the wild

- Expert – novice data of individual designers (Adams et al)
- Design Council (2008). Eleven lessons: managing design in eleven global brands: A study of the design process. www.designcouncil.org.uk
- Design in wild option (see Hutchins – Cognition in the Wild)

Week 14 (Nov 25) Thanksgiving

- Outline of final project due Wednesday at midnight (topic, objective, layout, key references)

Week 15 (Dec 2) Design expertise

- Atman, C.J., Adams, R.S., Mosborg, S., Cardella, M. E., Turns, J. and J. Saleem (2008). "Engineering Design Processes: A Comparison of Students and Expert Practitioners." Journal of Engineering Education.
- Cross, N. (2001). "Design cognition: Results from protocol and other empirical studies of design activity." In C.M. Eastman, W.M. McCracken & W. Newstetter (eds.), Design Learning and Knowing: Cognition in Design Education. New York: Elsevier Press.
- Cross, N. (2004). "The Expertise of Exceptional Designers." Proceedings of the Design Thinking Research Symposium (DTRS6), Sydney, AU.

Week 16 (Dec 9) Design learning trajectories; understanding learners

- Crismond, D. (2007). "Contrasting Strategies of Beginning and Informed Designers: One Representation of Learning Progressions in Engineering Design." Unpublished document.
- Dorst, K. and Lawson, B. (2009). Design Expertise. Architectural Press. Chapter 3: Design Expertise.
- Newstetter, W.C. and McCracken, W.M. (2001). "Novice conceptions of design: Implications for the design of learning environments." In C. M. Eastman, W. M. McCracken, & W. Newstetter (Eds.), Design Learning and Knowing: Cognition in Design Education. (pp.63-78). New York: Elsevier.

Optional:

- Adams, R., J. Turns & C. J. Atman (2003). "What could design learning look like?" Proceedings of the annual Design Thinking Research Symposium VI, November, Sydney.
- Dall'Alba, G. and J. Sandberg (2006). "Unveiling Professional Development: A Critical Review of Stage Models." Review of Educational Research 76(3): 383-412.

Finals week (Dec 16 or TBD) Synthesis and translation (personas of learners)

- Pruitt, J., & Grudin, J. (2003). Personas: practice and theory. Proceedings of the 2003 Conference on Designing for User Experiences (pp. 1 – 15). ACM Press. Retrieved 1 Dec 2004 from http://doi.acm.org/10.1145/997078.997089
- Storyboards of final projects
- Final project due Dec 18 by 5:00 pm.

F. Reading List (including course text):

- *A primary reading list or bibliography should be limited to material the students will be required to read in order to successfully complete the course. It should not be a compilation of general reference material.*

- *A secondary reading* list or bibliography should include material students may use as background information.

F. Reading List (including course text):

- All readings are identified in the syllabus above.

G. Library Resources

- *Describe the library resources that are currently available or the resources needed to support this proposed course.*

Library resources:

- All readings are available on Blackboard Vista.