

CYSE 700

Research Methodology and Pedagogy in Cyber Security Engineering

Paulo Costa
Department of Cybersecurity Engineering
George Mason University
pcosta@gmu.edu
<https://c5i.gmu.edu/~pcosta>

Course Description

Spring 2025

The course will explore the dynamic intersection of theory and practice in the area of cybersecurity. It will delve into advanced research methodologies, including qualitative and quantitative approaches, ethical considerations, and data analytics specific to cybersecurity contexts. Simultaneously, students will gain insights into cutting-edge pedagogical strategies tailored for cybersecurity education. Students will develop expertise in curriculum design, teaching methodologies, and industry collaboration. The course will prepare students for a future in academia or industry leadership roles by getting familiar with methodologies in teaching and research in the area of cybersecurity.

Class Details

Classes

- * Online, via Zoom.
- * Mondays, from 4:30 pm to 7:10 pm.

Office hours

- * Room 330 of the Research Hall.
- * Thursdays, from 3 to 4pm, or by appointment.
- * Dr. Costa's contact data: (703) 993-9989 / pcosta@gmu.edu.

Administrative

- * Last day to add classes: Tuesday, Jan 28.
- * Last day to drop with full tuition refund: Monday, Feb 4.
- * Last day to drop with 50% tuition refund: Monday, Feb 11.
- * Last day to drop with no tuition refund: Monday, Feb 25.
- * Last day of classes: May 5.

Course Logistics:

- [1] CEC IT support has answers to many questions about school systems on their web site: <http://labs.vse.gmu.edu> and will try to help you if you have problems connecting to school computing systems. However, they will not assist with general computing questions or course assignments. Please contact me if you have any questions about how to use software to complete your assignments.
- [2] Accommodations for disability: If you have a documented learning disability or other condition that may affect your academic performance you should: a) make sure this documentation is on file with Office for Disability Services (SUB I, Rm. 4205; 993-2474; <http://ods.gmu.edu>) to determine the accommodations you need; and b) let me know about your accommodation needs as soon as possible. If you have contacted the Center for Disability Services and are waiting to hear from a counselor, please keep me updated during the whole process.

Expected Behavior:

- [1] Attendance in class is essential. If you need to miss a class, you must contact me in advance.
- [2] This is an online course. When class is active you must have your camera on. It is the student's responsibility to ensure his computer's audio and video are working.
- [3] Be polite with others and make sure you have control of your background noise (cell phones, barking dogs, etc.) – headphones with microphones are the best strategy. Give yourself a quiet environment to follow the class.
- [4] Course deliverables will be submitted electronically (e.g. classwork and homework), scheduled in advance, and with some flexibility for students to change. Should any scheduled event impact your participation in class activities and assignments, it is your responsibility to coordinate with me in advance.
- [5] You are permitted and even encouraged to interact on homework assignments, use AI tools, and other forms of productivity enhancement. Yet, your write-up must be your own. Assignments are intended to provide practical, hands-on experience with the ideas presented in the course.
- [6] Late assignments, when justified, will receive reduced credit following the late assignment policy (below in this document). No points will be awarded if the assignment is turned in after solutions have been posted.
- [7] Religious observances are one typical example of events that might impact students' activities. Students are responsible for planning. Please, refer to the GMU's calendar of religious holidays at <http://ulife.gmu.edu/calendar/religious-holiday-calendar/>.
- [8] Academic Integrity: we will fully abide by the academic integrity guidelines, which include the Honor System. These are available at <https://masononline.gmu.edu/student-resources/academicintegrity/>.

Course Outline

This outline is here as a reference only. The most updated version is in the course’s page in Blackboard.

Week	Date	Unit	Notes
1	1/27	Unit 1a – Introduction PhD Program Topics	Course overview, introductions, PhD IT program, related software, advising.
2	2/3	Unit 2a – Foundations of Research PhD Program Topics	Research areas, types, and challenges, cybersecurity research, the scientific method, identifying gaps.
3	2/10	Unit 3 – Literature Review and Theoretical foundations	Conducting a systematic literature review, reference management tools.
4	2/17	PhD program topics	Developing a theoretical or conceptual framework
5	2/24	Unit 4 – Research Design and Methodology overview PhD program topics	Differences between qualitative, quantitative, and mixed methods, choosing an appropriate research design.
6	3/3	Unit 5 – Quantitative Research Design PhD program topics	Experimental and non-experimental designs, sampling techniques and data collection, introduction to statistical analysis
	3/10	SPRING BREAK	No Classes
7	3/17	Unit 6 – Qualitative Research Design PhD program topics	Types of qualitative research, data collection, thematic analysis
8	3/24	Unit 7 – Mixed Methods Research CEC/CYSE Faculty Seminar	When and why to use mixed methods, sequential vs. concurrent designs, integrating qualitative and quantitative data
9	3/31	Unit 8 – Ethical Considerations in Research CEC/CYSE Faculty Seminar	Research ethics and the Institutional Review Board (IRB), informed consent and participant rights, biases and conflicts of interest
10	4/7	Unit 9 – Data Analysis and Interpretation	Choosing appropriate data collection methods, ensuring reliability and validity in data, common challenges in data collection
11	4/14	CEC/CYSE Faculty Seminar	Quantitative data analysis, qualitative data analysis, interpreting research findings
12	4/21	Unit 10 – Writing and Presenting Research	Structuring a research paper or dissertation, academic writing, preparing for conferences and presentations
13	4/28	CEC/CYSE Faculty Seminar	Revising and refining research proposals, addressing gaps and limitations, planning future research
14	5/5	Individual project presentations to CYSE Faculty	

Textbook:

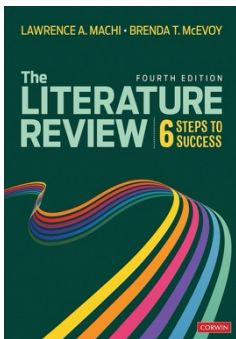
The course will cover a variety of techniques and subjects that will be mostly based on class notes provided by the instructor, so there is no mandatory textbook.

Supplementary Material (Optional)

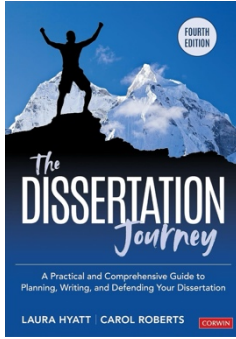
The following references will be used during the course at different levels of intensity. However, the instructor will provide class notes on the topics extracted from it. Therefore, although recommended, none of the references below are necessary:



Research Methods for Cyber Security
by Thomas W. Edgar and David O. Manz
Syngress; 1st edition (April 19, 2017); 409 pp.
ISBN-10: 0128053496
ISBN-13: 978-0128053492
(available both online and hard copy at GMU Library)



The Literature Review: Six Steps to Success
by Lawrence A. Machi and Brenda T. McEvoy
Corwin; 4th edition (December 22, 2021); 260 pp.
ISBN-10: 1071852906
ISBN-13: 978-1071852903
(3rd ed. available from the GMU Library, online)



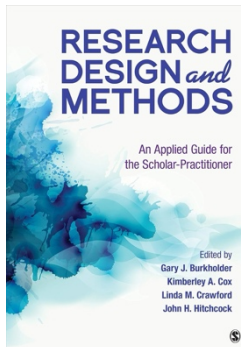
The Dissertation Journey: A Practical and Comprehensive Guide to
Planning, Writing, and Defending Your Dissertation

by Laura Hyatt and Carol M. Roberts

Corwin; 4th edition (August 17, 2023); 264 pp.

ISBN-13: 978-1071891285

(4th ed. available from GMU library, hardcopy)



Research Design and Methods: An Applied Guide for the Scholar-
Practitioner; by Gary J Burkholder, Kimberley A. Cox, Linda M.
Crawford, and John Hitchcock (Editors)

SAGE Publications, Inc; 1st edition (July 26, 2019); 400 pp.

ISBN-10: 1544342381

ISBN-13: 978-1544342382

Grading

The grading structure of this course is as follows:

- Assignments (30% of course grade)
- Exam (35% of course grade)
- Dissertation Proposal (35% of course grade)

Assignments

Assignments include regular homework posted via Blackboard during the course, as well as quizzes and class activities. Each homework will have its respective due date defined during the announcement. *You are not prevented from working with your peers on the assignments and are even encouraged to do so.* However, each student must provide his/her answers. I might verify whether he/she worked in his/her respective exercise and understood the solution provided. In any case, experience consistently shows that students who did not keep up with the assignments do not do well with their grades.

Assignments must be submitted via Blackboard.

Exam

The only exam in the course will be held at the following date:

- Final: April 14nd

Details will be provided later.

Research Proposal

Students will choose a research topic and develop a proposal for conducting research on that topic based on what they learned in class. There will be multiple deliverables associated with this proposal, which will be paced according to how the materials are presented in class. These include:

- Background and description of the problem
- Research questions
- Literature review
- Preliminary solution and evaluation plan
- Written proposal
- Oral presentation

More details will be provided as the course progresses.

BEST WISHES FOR A GREAT SEMESTER!!!

Fairfax, January 27th, 2025.