

Enhanced Radio Lab Experience Using ePortfolios

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Abstract

Historically, the technical writing portion of our electrical engineering program's required core course RF Systems Laboratory has been fulfilled using bi-weekly memos. Now, however, the lab utilizes eportfolios to fulfill the technical writing requirement. The primary goal of the decision to switch from memos to eportfolios was to improve the learning outcomes of the students by encouraging them to use reflective writing to reinforce what they learned in the lab. Additionally, the eportfolio format allows the students to express their findings more creatively, with fewer boundaries and more opportunity to use multiple types of media.

Background – the radio lab

The RF Systems Laboratory is a required 1 credit hour junior-level course for the Electrical Engineering program at Auburn University [1]. Students simulate, breadboard, and measure the performance of a variety of AM radio building blocks (various amplifiers, detectors, etc.) on their way towards building a functional radio. The course has a common Monday lecture followed by a 2-hour lab section meeting later in the week. It is not tied to a specific class; it draws from and integrates concepts from several electrical engineering courses. An advantage to this approach is that students can more readily appreciate the interrelation between electrical engineering subdisciplines [2].

Table 1 shows the course timeline. The first part of the course, through week 8, consists of studying and assembling the different components that make up a single-station AM radio as shown in Figure 1. The open source circuit simulation tool LTspice is used in the study of each functional block prior to bread-boarding, usually as part of a pre-lab assignment. For instance, Figure 2(a) shows the LTspice circuit schematic for a two stage audio amplifier, while Figure 2(b) shows the same circuit after a student constructs it on their breadboard.

Students begin working in teams of two or three students when designing and building the antenna. This is good practice for them as the team must then work together for the heterodyne version of the radio, and for the design project to enhance their radio. After successful completion of this simple version of the radio, students proceed in weeks 9-10

Table 1: RF Systems Lab Course Timeline

Week	Topic
1	Course introduction, basic AM radio operations, test and measurement
2	Common emitter amplifier
3-4	Audio amplifiers
5	AM detectors
6-7	RF amplifiers and overall radio
8	Antennas
9-10	Heterodyne radio
11-13	Radio enhancement project

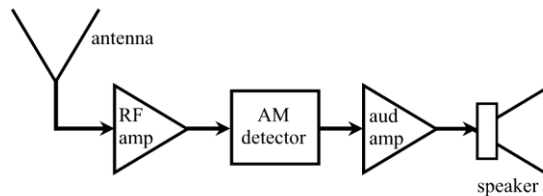
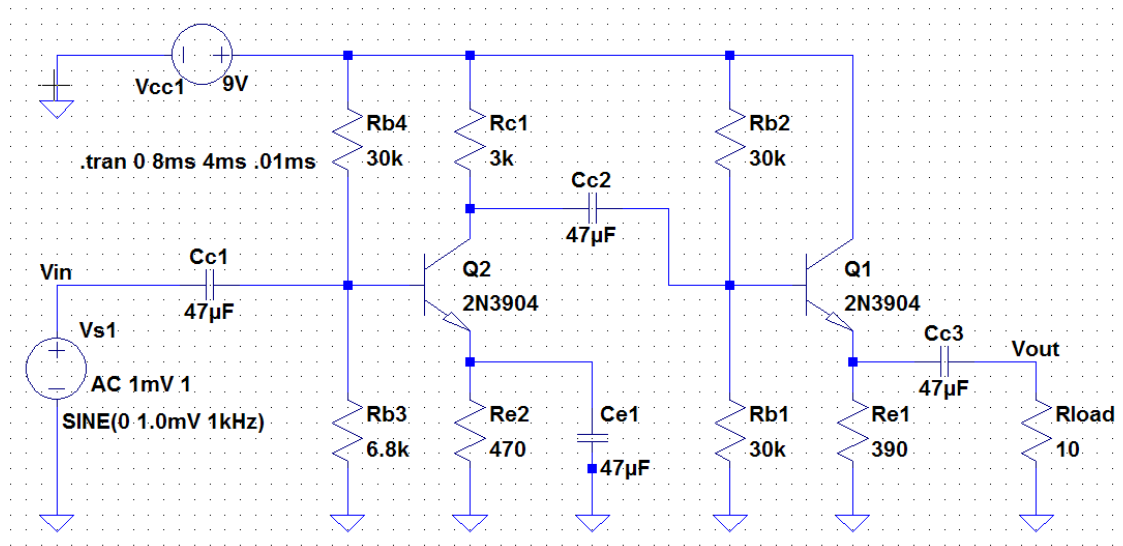
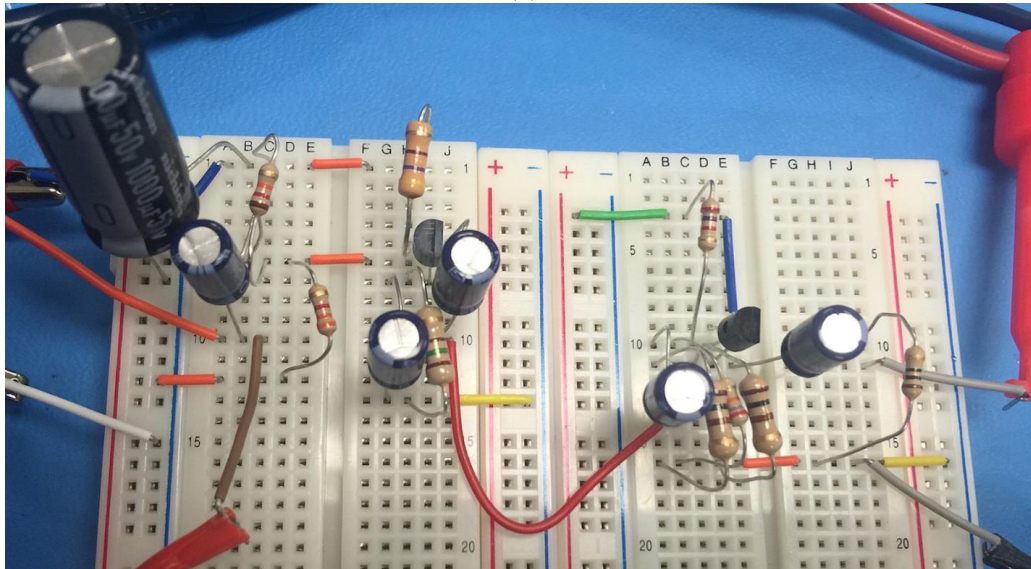


Figure 1: Block diagram of a generic single station AM radio



(a)



(b)

Figure 2: (a) LTSpice circuit schematic of a two stage audio amp, (b) breadboarded version of the audio amp (picture is from a student's eportfolio).

with a more advanced heterodyne version of their radio which would allow tuning for different stations. Finally, weeks 11-12 are devoted to a team project to improve the radio. Students are free to select their own project. Notable recent projects include design of a better audio amplifier to drive larger speakers, a bass/treble controller, and a remote controller for the radio.

In addition to the technical content, the core laboratories are also tasked with helping to develop our students' teaming and communications skills (both oral and written). One of the objectives of the RF Systems Laboratory is to develop the students' writing ability. Historically, this has been accomplished by requiring bi-weekly technical memos. The course syllabus described the memo requirement this way:

Your memo will most often pertain to your lab experience and lecture experience, although homing in on a particularly interesting aspect of lab or radio design is also fair game. Occasionally there will be specific topics you are to write about. Your one-page **typed** memo (*space and a half, 12 point times font*) is due at the beginning of the Monday lecture session, and is to be placed in the folder appropriate for your lab section. The memo will be graded based on spelling, grammar and content.

In 2012 Auburn University began encouraging eportfolios across campus as part of its Quality Enhancement Plan. A description of eportfolios and its educational justification is given in the next section. Thus, in support of the university's plan, and with the hope and anticipation of providing a better learning experience for our students, we decided to replace the RF Systems Laboratory technical memos with eportfolios as our method to develop the writing ability of the students.

Supporting Theory

The use of eportfolios in higher education has become increasingly common. Some estimates say that more than 50% of college students in the United States have used eportfolios in some fashion [3]. While eportfolio use is common, the purposes for eportfolio implementation vary widely. Purposes generally fall into one of three broad categories: assessment, learning, and career/professional (though in practice these purposes often overlap). Some universities have large scale eportfolio initiatives to assess general education programs [4,5], but learning eportfolios are also widely used on many campuses in the context of a single course [6].

The hallmark of the eportfolio is the critical reflection it enables [7-9]. ePortfolios invite, if not require, students to reconsider and synthesize their learning experiences and explain the significance of those learning experiences to an audience (sometimes inside a course, sometimes outside). The process of creating an eportfolio also fosters deep learning, which is linked to critical reflection [10]. Reflective writing, then, is a key element in the process of creating an eportfolio. In addition to reflective writing, students must also think critically to determine what to include in the eportfolio (artifacts and experiences) and how to organize what they include so that the portfolio makes a curated, coherent argument.

ePortfolios are widely used in design fields as well as in nursing and education programs, but they are also present in engineering programs. Teacher-researchers in engineering have explored how eportfolios aid graduate students' professional identity development [11,12] as well as how eportfolios promote lifelong learning among engineering students [13]. ePortfolios, regardless of the field in which they are used, are strongly linked to lifelong learning [14].

Implementation

The first time the eportfolios were implemented in the RF Systems Laboratory was the Fall 2015 semester. Students were given the option to participate in the eportfolio trial or write the technical memos as was done in previous semesters. Of the 35 students in the class, 14 decided to participate in the eportfolio option.

The first task given to the students was to create the basic frame for their eportfolio so that they could modify and add to it continually through the semester. There are several free platforms available online for students to create eportfolios. For this iteration, the students used the free platform Wix [15]. The first submission included an “about me” portion, a home page, and a section where students could add their comments and reflections on the labs. An example eportfolio was created by the teaching assistants (TAs), and the students were also given a link to the university’s sample eportfolio page [16] hosted by the Office of University Writing. Students were then required to submit a link to their eportfolio on Canvas [17] (our university’s learning management system) so that the teaching assistants could grade and provide feedback on their work. The eportfolios were graded on technical content, reflective writing, visual literacy, use of media, and writing mechanics. The students were responsible for submitting updated websites after every two lab topics were covered. Upon completion of the lab and final project presentation, a final eportfolio update was due. After each submission, the teaching assistants provided feedback on how the students could improve their work. To maintain grading consistency, the TAs team-graded the initial eportfolio submission. Further submissions were graded by a single TA to maintain consistent grading across sections. The TAs took turns with this. The final submission was again team-graded. Finally, at the end of the course the students were anonymously polled about their eportfolio experience. The survey questions and responses are provided in appendix A.

Since this was an initial foray into the implementation of eportfolios in the lab, we did not know what to expect. We discovered that the benefits of eportfolio use fell into four categories:

1. Student Learning
2. Creativity
3. Student Satisfaction
4. Pedagogical Insight

Student Learning

A primary goal of the eportfolio is to promote student learning. This was demonstrated both from observation and from survey results. The TAs noted that the students participating in the eportfolio option demonstrated enhanced learning of material from the lab versus the students that continued with the standard memo format. This was determined based on the performance in lab along with the performance on the pre-lab assignments. Additionally, students that participated in the eportfolio option were more engaged in class and asked more relevant questions about the lab material. Much of the feedback provided by the TAs was then integrated into the students’ eportfolio updates. This was also detailed when students were encouraged to incorporate more reflective writing as they attempted to describe the relationship between this lab and other courses.

At the end of the semester students that volunteered to participate in the eportfolio option were asked to complete an optional, anonymous survey about their experience (see Appendix A). Seventy-five percent of the students believed creating the eportfolio helped them to better understand the course material. Several students stated that writing about what they did and integrating media to support their writing encouraged them to think more deeply about the concepts they were applying in the lab. The majority of the students commented that the ability

to use media to describe what they accomplished was the most beneficial aspect of the eportfolio process over the technical memo format.

Creativity

The students were given very few guidelines on how to format their respective eportfolios which led to aesthetic individuality. In order to quickly get started creating their eportfolios, the students used free templates offered by Wix. Due to the multitude of available templates and ease of editing, none of the students' eportfolios looked the same. Many students noted in the survey that allowing them to be creative with their formatting made the process more enjoyable.

The students utilized multiple types of media to convey their descriptions and reasoning. In Figure 3, one student embedded a video in their eportfolio as a creative introduction. Several students also used some humorous puns in their writing as can be seen in Figure 4.

At the beginning, some students were not being creative with their writing style and with the eportfolio in general as they were emulating the style of the traditional technical memo in the eportfolio. When these students were encouraged by the TAs to be more creative they made interesting improvements to their work. One student used video blogs to supplement his or her writing. By encouraging students to utilize multiple types of media in the report they put more detail into explaining the figures and plots they presented which helped to demonstrate what they



Figure 3: Screenshot from student's eportfolio shows the beginning of an embedded video

The screenshot shows a blog post on a light blue background. At the top left, there is a black redaction box. The main title is "Reflections on a Lab - It Hertz" in a dark blue font, with a date "4-Dec-2015" and a black redaction box below it. To the left is an illustration of a vintage portable radio with a speaker and a vertical antenna. To the right of the radio is a text block: "Three and a half months ago, I showed up to my first radio lab. A naive Electrical Engineering student with senior status, I though I knew everything. I soon found out that I knew nothing about actually building transistor circuits and operating common lab...". Below the text is a grey "Read More" button. On the right side of the page is a sidebar titled "About the Author" in a dark blue font. Below the title is a large black redaction box. Underneath the redaction box is a short bio: "██████████ is an Electrical Engineering Student at Auburn University. He plans to graduate in ██████████ and then pursue a graduate degree." Below the bio is a grey "+ Read More" button. At the bottom of the main content area, there is another post title "Karaoke Radio Project" in a dark blue font, with a date "2-Dec-2015" and a black redaction box below it.

Figure 4: Screenshot from a student's eportfolio (personally identifiable information redacted)

had learned in the lab, (see Figure 5 for example). Importantly one hundred percent of the students responded that they enjoyed the creative aspect of the eportfolio.

Student Satisfaction

When asked if they would choose to do the eportfolio option over the memo option after completing the course, one hundred percent of survey responders stated they would. The reasoning ranged from enjoyment of the creative process to being able to easily look up their previous lab data on their website. Sixty-three percent of the students believed the eportfolio would be useful to them beyond the scope of the lab. One student wanted to create a website for a personal project and with the knowledge he or she gained this semester it was an easy transition. Another student planned to create an eportfolio and use it as a resume enhancement device. All students responded that they enjoyed creating the eportfolio, which allowed them a chance to exercise their creativity and to utilize a variety of media. The assignments were submitted to Canvas and the TAs provided quick feedback on the submissions. The students expressed that the quick and detailed feedback was useful as it allowed them to edit their eportfolio and be aware of how to improve it going forward.

Pedagogical Insight

The final of the four primary benefits is the pedagogical insight gained from the students' use of the eportfolio. The eportfolios were more useful in judging how well the material was learned since they are more reflective while the technical memos are more descriptive. The students were encouraged to write as much as they wanted about the material and they were encouraged to create a "reflection" section in which they described what they learned and understood from the

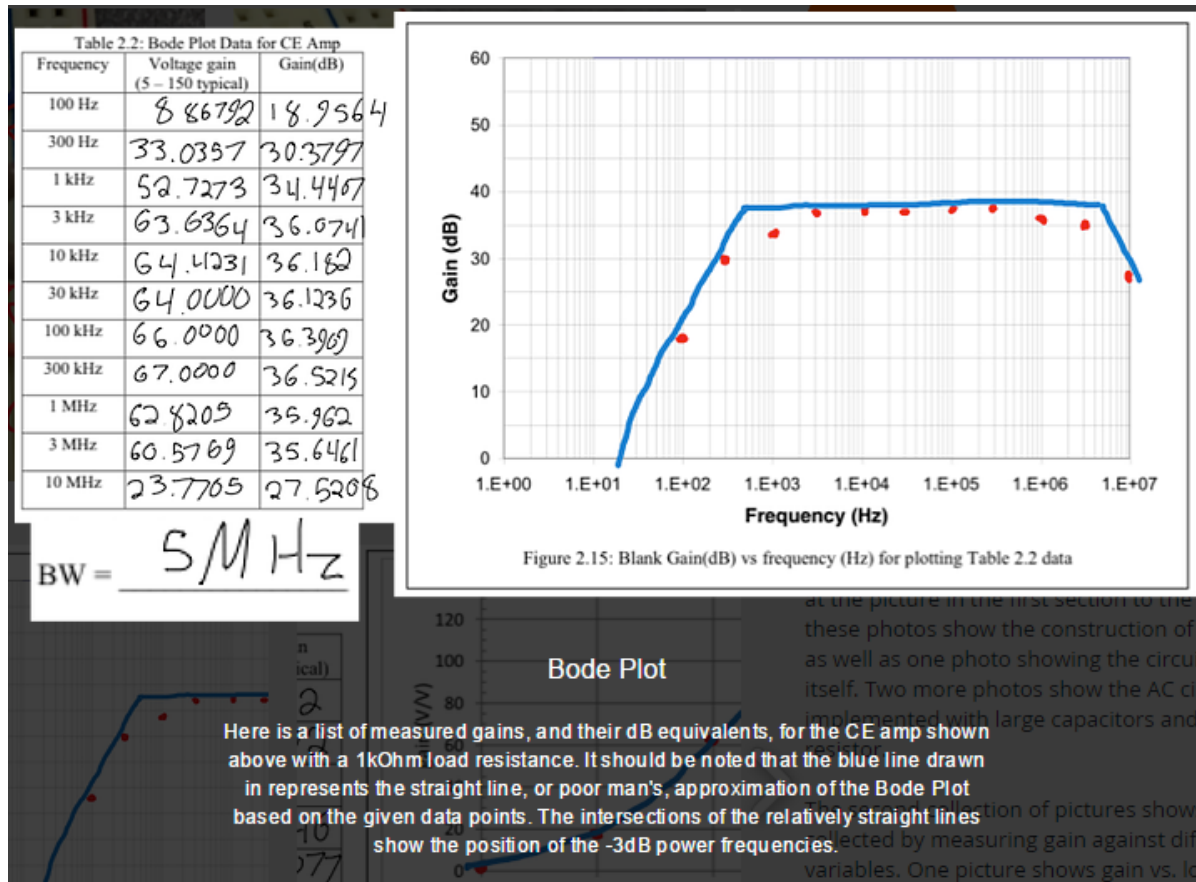


Figure 5: Screenshot from a student's eportfolio

lab. From the writing the TAs were able to ascertain what material the students were grasping individually and as a whole. This was something that was not as easily discernable from the memos since they did not include a reflective writing portion nor did the memos foster the same level of creativity and use of artifacts. The students' use of reflective writing in the eportfolios promoted tying the lab material together and several students further extended this idea and discussed the relationship the lab has with other courses' material. Since the TAs were better able to assess what a student had learned they were able to tailor the instruction to an individual student. For example, one student was taking this lab even though it was outside of his or her major due to personal interest in the material. The TAs found his or her eportfolio to be invaluable as it identified a lack of understanding of certain fundamental concepts that the rest of the students already knew. The TAs were then able to personally aid the student to be sure that he or she learned the concepts from the lab.

Grading the assignments was a much more enjoyable process than grading a traditional written assignment. The assignments were aesthetically varied and this made them more interesting to grade than the technical memo. Several students also integrated humor that they would not have put into a standard technical memo in the "about me" section and in the individual lab sections. Since all of this material was submitted and graded electronically, the TAs were able to provide rapid feedback. The students were then able to update what they had done and use the comments

to address future work. By removing the traditional constraints of the bi-weekly technical memo the students are able to improve their writing in a less formulaic way.

Conclusion and Future Implementation

Over the course of the introductory semester much was learned about the process. For the future semesters several changes will be implemented to the course. The facet we found most useful from both the pedagogical standpoint and the standpoint of the students' learning was the reflective writing portion. This portion was the primary focus as the semester went on, and it will be given greater emphasis at the onset in future semesters. The experiences gained led to development of a detailed grading rubric (see Appendix B), which will be provided to students to assist them in preparing their eportfolios. A lecture will also be presented at the beginning of the semester with a brief overview of the mechanics of the Wix website. The eportfolio will be used by all future students in the radio lab.

In summary, the results of implementing eportfolios in the radio lab exceeded our expectations. It was perceived by both observation and survey results that the students learned more from utilizing the eportfolio than they would have without it. The students also reported satisfaction from the use of the eportfolio primarily due to the creative format. Finally, the use of the eportfolios provided additional pedagogical insight that was not readily available from the technical memo format.

References

- [1] S. Wentworth, "AM Radio Construction: A Junior Level Electrical Engineering Core Laboratory," *2009 Annual Conference & Exposition, Austin, Texas*. <https://peer.asee.org/4535>
- [2] T. Roppel, J. Y. Hung, S. W. Wentworth, and A.S. Hodel, "An Interdisciplinary Laboratory Sequence in Electrical and Computer Engineering: Curriculum Design and Assessment Results," *IEEE Transactions on Education*, Vol. 43, No. 2, pp. 143-152, May 2000.
- [3] E. Dahlstrom, J.D. Walker, and C. Dziuban, *ECAR Study of Undergraduate Students and Information Technology*, EDUCAUSE Center for Analysis and Research, 2013.
- [4] D. Hubert and K. Lewis, "A Framework for General Education Assessment: Assessing Information Literacy and Quantitative Literacy with ePortfolios," *International Journal of ePortfolio*, vol. 4, pp. 61-71, 2014.
- [5] G. Ring and B. Ramirez, "Implementing ePortfolios for the Assessment of General Education Competencies," *International Journal of ePortfolio*, vol. 2, pp. 87-97, 2012.
- [6] J. Milne, E. Heinrich, and I. Lys, "Integrating e-Portfolios: Guiding Questions and Experiences," *Journal of Open, Flexible, and Distance Learning*, vol. 14, pp. 47-61, 2010.
- [7] J.D. Jenson, "Promoting Self-regulation and Critical Reflection Through Writing Students' Use of Electronic Portfolio," *International Journal of ePortfolio*, vol. 1, pp. 49-60, 2011.
- [8] T. Penny Light, H. Chen, J. Ittelson, *Documenting Learning with ePortfolios: A Guide for College Instructors*, Jossey-Bass, 2012
- [9] D. Cambridge, B. Cambridge, and K. Yancey, *Electronic Portfolios 2.0: Emergent Research on Implementation and Impact*, Stylus, 2009.
- [10] J. Zubizarreta, *The Learning Portfolio: Reflective Practice for Improving Student Learning*, Jossey-Bass, 2009.
- [11] M. Svyantek and L. McNair, "Tricks of the Trade: Using Digital Portfolios and Reflective Practices to Develop Balanced Graduate Student Professional Identities," *2015 ASEE Annual Conference and Exposition Proceedings*.
- [12] M. Svyantek, R. Kajfez, and L. McNair, "Teaching vs. Research: An Approach to Understanding Graduate Students' Roles through ePortfolio Reflection," *International Journal of ePortfolio*, vol. 5, pp. 135-154, 2015.
- [13] E. Heinrich, M. Bhattacharya, and R. Rayudu, "Preparation for Lifelong Learning using ePortfolios," *European Journal of Engineering Education*, vol. 32, pp. 653-663, 2007.
- [14] D. Cambridge, *ePortfolios for Lifelong Learning and Assessment*, Jossey-Bass, 2010

- [15] Wix. "Free Website Builder." Accessed January 19, 2016. <http://www.wix.com>
- [16] Auburn University Office of University Writing. "ePortfolio Examples." Accessed January 19, 2016. <http://wp.auburn.edu/writing/eportfolio-project/eportfolio-examples/>
- [17] Instructure. "Canvas by Instructure" Accessed January 19, 2016. <https://canvaslms.com>

Appendix A: Survey Questions and Responses

Did creating the ePortfolio help you to better understand the course material?

- Yes – 75%
- No – 25%

Did you enjoy creating the ePortfolio?

- Yes – 100%
- No – 0%

Was using Canvas to return comments and grades a useful tool or method for you?

- Yes – 87.5%
- No – 12.5%

Was learning to create an ePortfolio useful to you beyond the scope of this lab? Please elaborate why or why not.

- Yes. This is something I have always wanted to start for my future as an engineer, and now I have one to work with.
- Creating the ePortfolio has helped me by making me think about how to present what I have learned in layman's terms while still keeping it interesting and educational
- No. It helped me understand the material better, but it did not help beyond the scope of this lab since I do not plan to use it for anything else.
- Yes. It allowed me a way to present research material and more in a creative method
- Yes, I have wanted to make one for my photography hobbies and this ePortfolio helped teach me on what to do and how to use the Wix tool.

Would you retroactively choose to do ePortfolios again instead of memos? Explain why or why not.

- Probably: I hate papers
- Yes I would. I enjoy being able to post blogs online that include pictures.
- Yes, ePortfolios were a lot easier to manage than hard copy lab reports. If I needed to reference what happened in a previous lab I merely just had to have a computer near by.
- Yes. I would like to further my experience in presenting things online to the public
- Absolutely. I think the ePortfolios were much more enjoyable to do rather than the memos.

What aspect of the ePortfolio did you find most useful?

- Posting pictures next to the descriptions
- The ability to include pictures and videos along with the report.
- Posting figures and graphs on my ePortfolio, and correlating what was in those images with my summary.
- The most useful aspect of ePortfolio was the wix tools, because they made it very easy to create an attractive and professional website
- The ability to present pictures and videos

- The convenience of being able to submit on Canvas rather than print out the memo and remember to bring it to class. I also enjoyed the freedom to do whatever on the ePortfolio.

What was the most difficult aspect of creating the ePortfolio?

- Getting everything set up the first time
- I did not know how many figures the graders wanted. Each week it seemed like I was deducted for not having enough. I got past this by saturating some reports perhaps with unnecessary figures. I understand that the content of what I was describing could be enhanced by adding figures. However, a standard should be stated next semester.
- The most difficult aspect of creating the ePortfolio was creating the weekly updates. The writing itself was not hard, but I tried to reduce the jargon and present my progress in the lab in a way that anyone could understand what I had done.
- Ensuring the page navigation was simple

Did creating the ePortfolio for lab make you more likely to use an ePortfolio as a resume enhancement tool? Explain why or why not?

- No, I think that an old fashioned paper resume is better
- Yes it did. I now have experience and feedback from my TA of what was good/bad.
- Yes and no. I would consider making one if I did any sort of research but right now, my LinkedIn is enough for my purposes.
- The ePortfolio format would be a great resume enhancer because it would show an employer the technical skills learned as well as the communication skills required to present that information.
- Due to the simplicity of the site and its cookie cutter design, I would not include this on my resume.

What could we have done to make creating the ePortfolio easier for you?

- Maybe a submission after every lab? Not really sure. I enjoyed the "not having to turn anything in every week" portion but also sometimes couldn't remember if that week was the week to turn in the ePortfolio or not. I really did enjoy it though.
- The ePortfolio could have been easier if I had seen a demo of the wix website creator in order to see how to use it to create nice designs
- Have a standard rubric on what is expected out of us.
- No much, it wasn't too terrible
- Letting us choose the website we want to use.

Appendix B: RF Systems Lab eportfolio grading rubric

		RF Systems Lab ePortfolio Rubric			
		1 – Unsatisfactory	2 – Developing	3 – Meets expectations	4 – Exceeds expectations
Performance Indicators	Technical Content	Inconsistent or few details that may interfere with the meaning of the text.	Some details, but may include extraneous or loosely related material.	Provides adequate supporting detail to support solution/argument.	Provides ample supporting detail to support solution/argument.
	Critical Thinking and Reflection	No attempt made to integrate lab work with past experiences.	Some small attempts made to integrate lab work with past experiences.	Includes discussion that integrates lab work with past experiences.	Demonstrates a professional identity that simultaneously integrates past experiences and projects into the future.
	Effective Communication and Writing Mechanics	Limited or inappropriate vocabulary for the intended audience and purpose. Does not follow rules of standard English.	Limited and predictable vocabulary, perhaps not appropriate for intended audience and purpose. Generally does not follow the rules for standard English.	Uses effective language and appropriate word choices for intended audience and purpose. Generally follows the rules for standard English	Uses effective language; makes engaging, appropriate word choices for audience and purpose. Consistently follows the rules of standard English.
	Supporting Media <i>(Figures, Images, Tables, Videos, etc.)</i>	Media do not support the text, or are poorly designed.	Media sometimes support the text, and sometimes well designed.	Media generally support the text, and are usually well designed.	Media always support the text, and are well designed.
	Aesthetic Appeal	The overall layout is unappealing. There is no consistent theme, and fonts are difficult to read.	The layout is somewhat pleasing. The theme is sometimes consistent, and fonts are occasionally difficult to read.	The layout is generally pleasing, with a somewhat consistent theme. The fonts are not difficult to read.	The overall layout is visually pleasing, with a consistent theme and easy to read fonts.