AC 2010-1018: STUDENT ELECTRONIC PORTFOLIOS FOR PROFESSIONAL DEVELOPMENT USING GOOGLE APPS

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Student Electronic Portfolios for Professional Development Using Google Apps

Abstract

The primary goal of our undergraduate program is to produce engineers who are one step ahead of their peers, who have begun to prepare themselves for more than just their entry-level jobs. In order to accomplish this, we seek improvements to the educational process outside the classroom and ways to encourage students to have a more direct role in their own personal development. For this purpose, we present here the Notre Dame Electronic Portfolio (NDeP) project, which is designed to help us meet this goal. To date, we have successfully launched the NDeP project to a class of ~80 chemical engineering sophomores who were able to create electronic portfolios, and we were able to assess these portfolios using a rubric developed for this purpose.

Introduction

The primary goal of our undergraduate program is to produce engineers who are one step ahead of their peers, who have begun to prepare themselves for more than just their entry-level jobs. In order to reach this goal for our students, our department has developed "six tools" that we feel our graduating chemical engineers need to become successful engineers. These "six tools" include:

- <u>Analytical and problem solving skills</u> – Strong analytical and problem solving skills and overall technical experience in chemical engineering concepts and principles
- <u>Define and understand engineering concepts</u> – Ability to define and understand engineering concepts and phenomena in the context of systems that extend beyond the domain of traditional chemical engineering
- <u>Understand technical problems</u> – Understanding of technical problems in the broader context of society, including external economic and possibly social factors
- <u>Communication skills</u> – Strong communication skills (oral and written; listening, comprehending, ability to interact with peers and professors)
- <u>Creativity and independence</u> – Development of independence and creativity in thought and action, with skills and aspirations such as leadership, teamwork, and entrepreneurism
- <u>Organizational skills</u> – The personal organizational skills, the sense of personal responsibility and commitment, the initiative, and the ability to self-assess necessary to be a consistently successful professional

As with every accredited engineering department in the U.S., our department assesses our program according to the ABET quality standards. Our chemical engineering program has been accredited since 1949, and as part of ABET's new sustainable continuous improvement process, we feel that while we will continue to make small improvements within the classroom, large improvements in the educational process can be made outside the classroom. Additionally, the ability to assess these extracurricular efforts towards our department goals is crucial. Thus, the Notre Dame Electronic Portfolio project (NDeP) was proposed to meet these process goals.

An electronic portfolio (e-portfolio) is a collection of electronic files that is created and maintained by a user as evidence of professional development. E-portfolios are both

demonstrations of the user's abilities and platforms for self-expression, and they can be maintained dynamically over time. Some e-portfolio applications permit varying degrees of audience access, so the same portfolio might be used for multiple purposes. There are benefits to using an electronic portfolio over a traditional portfolio; they can hold a great deal of information while taking up little space, they can be accessed with minimal effort, and they can include collaborative student work. Additionally, e-portfolios can be enhanced by the addition of sound, music, pictures, graphics and even video, and can serve to enhance computer and technology skills.

In particular, we hope to achieve four fundamental objectives with our NDeP project: 1) engage students in their learning and allow students to play a more direct role in their personal development, 2) enable students to link together diverse parts of their learning, including the formal and informal curriculum, and allow for reflection and awareness of learning strategies and needs, 3) encourage students to create a professional portfolio of their achievements, both from the classroom and beyond, with the ability to publicize their achievements as evidence for future employers, etc. and 4) offer the academic department a meaningful mechanism for accessing and organizing evidence of student learning. The e-portfolio also serves as a tool to make communication between students and advisors more efficient. Figure 1 illustrates the proposed NDeP project.
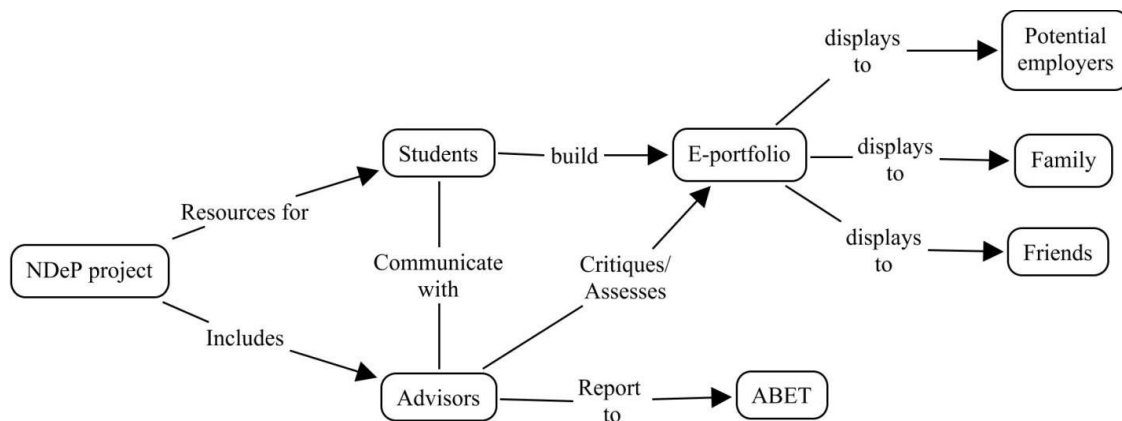

Figure 1: Schematic of the NDeP project

Therefore, in this paper we present the current progress, recent student results, and future goals of the NDeP project.

Methods

To achieve the goals for this project, we chose to implement NDeP through Google Apps using the entire Google Apps suite. There were several reasons for this implementation: (1) the university already employs Gmail as the student's email server and thus every student has a Google account which is maintained by the university, (2) through the student's Google accounts, they have large online storage capacity for their documents which is also controlled within the university's domain, and (3) Google Apps contains the ability to produce professional-looking output for the student's e-portfolios through gSites or gDocs. Additionally, for creating

an e-portfolio, the students have access not only to gDocs, but Picasa, Google Video, Blogger and the like, for creating and storing their portfolio artifacts.

The NDeP project is largely composed of a gSite which was created to serve as an informational resource for students. It is broken into several sections including:

- "About" – resources for learning what an e-portfolio is, why create an e-portfolio, what to include, and also some links and templates for examples of created e-portfolios
- "How To" – resources specific for creating and using Google Apps, maintaining professionalism, how to control access to their e-portfolio, etc.
- "Resources" – departmental resources such as the undergraduate program guide and advising handbook, the general curriculum, and more about the NDeP project and its objectives
- "News" – ticker containing departmental headlines
- "Calendar" – calendar containing important deadlines and departmental seminars
- "Research Opportunities" – links to each of the faculty pages for learning about research projects offered
- "Job Search Information" – links to relevant job information such as the ND career center and the ND job search engine
- "Surveys" – links to the advising/registration surveys for each semester

A snapshot of the NDeP gSite is available in the Appendix, figure A1. While most of these sections were simply compilations of information and links to relevant resources, the main development portion of this site was in the "Surveys" section. In order to enhance the academic advising experience, NDeP developed a survey designed to help students consider their academic goals. The survey has four main sections (available in the Appendix, figures A2-A5): 1) career goals, 2) engineering skills, 3) registration, and 4) career preparation. The career goals section is intended to help the students choose a career option available from their chemical engineering education. In this section of the survey, the students are asked to report on their current career ambitions, why they choose to pursue this career option, whether or not their career goals have changed, and if so, why.

In the engineering skills section, the survey addresses the six main skills (tools) every engineer in our program should have (as mentioned above). For each tool, students are asked to consider how important this particular tool is towards their potential career goals, what their personal perception is of their strength in this area, what deliverable evidence exists that demonstrates their current proficiencies, and finally to reflect on how this evidence relates to this engineering skill and ultimately impacts their career goals. These evidence artifacts can be electronically archived in their own Google account for linking to their e-portfolio.

The registration section of the survey was prepared to enhance communication between the students, their advisors, and ultimately the department. A major goal for this section of the survey was to communicate which courses a student plans to take in the upcoming semester. For each course, they are asked to prepare short term goals and relate these goals to their longer term career ambitions. For the younger students, (sophomores at present) a drop down list of example short term goals for the core courses is available to help them create their own short term goals. We hope that as the students gain experience in making course goals, they will not need to be

prompted in this manner. The survey also asks them if they are pursuing any of the chemical engineering curriculum options, such as pre-med, materials, or environmental, which can help the advisor in suggesting electives relevant to their academic and/or career goals. In addition, this information will help the department in understanding the needs of the students by offering the electives needed in a timely manner.

The final section of the survey involves career preparation. This section is intended to help the students think about what they might want to accomplish while at school to help them on their path towards their potential careers. This section includes research, job experience (internships, etc.), community service, and professional societies. For each choice they make, they are also asked to reflect on how they envision their choice helping them towards their career goals and to provide any specifics they may have, such as which professional societies they belong to and why, or if they have specific companies in mind for internships.

The survey is expected to be filled out before their advising session for the upcoming semester, every semester. The results of the survey also have the ability to be compiled for use in ABET accreditation and other department assessments of student learning, interests, and achievements.

Of course the main objective for the NDeP project is to have the students create their own e-portfolios. We chose to launch this project to the fall 2009 sophomore chemical engineering students (~80 students). To ensure that they made a legitimate attempt to create an e-portfolio, the NDeP project was explained in a recitation section of their Introduction to Chemical Engineering course, then it was given as a homework assignment. The assignment given to the students is available in the Appendix, figure A6. At this time, we chose not to include the NDeP survey as class registration was a significant time away and instead chose to simply focus on the e-portfolio development. The students were given a selection of two formats to complete the assignment, a slideshow presentation (gPresentation) or a website (gSite); templates for both were available to them within the informational NDeP gSite. Their e-portofolios were assessed in six categories: motivation, content, reflection, organization, integration, and mechanics. Of these categories, the integration and mechanics categories were rated at 10 points each, while the remaining categories were worth 20 points each. The e-portfolios were turned in electronically to the professor or to teaching assistants for the course and were assessed with a rubric. The rubric was developed to quickly assess the student's e-portfolios in the six categories previously mentioned and give a numeric score to the student. A copy of the rubric used is available in the Appendix, figure A7.

Results and Discussion

The students were able to access the NDeP informational gSite, develop their own e-portfolios, and receive feedback on their creations. A few examples of student created e-portfolios were quite excellent, and a few of these are available in the Appendix, figures A8-A9. After assessment, a summary of the average scores for the class is given in Table 1. After weighting the categories to their respective point totals, the average for the class was 74.7 out of 100.

Table 1: Summary of average scores from assessment rubric on student e-portfolios

Category (points)	Average Score (out of 4)
Motivation (20)	3.15
Content (20)	3.16
Reflection (20)	2.59
Organization (20)	3.26
Integration (10)	2.59
Mechanics (10)	3.00

The scores illustrate that the students were weakest at reflecting on their engineering skills (Reflection: 2.59/4.00), as one might expect from sophomore students. Most students were able to articulate their career goals through use of a biography (Motivation: 3.15/4.00) and choose artifacts to include for each of the six engineering skills (Content: 3.16/4.00). Additionally, most students created their e-portfolios using a professional-looking format (Organization: 3.26/4.00). Of course none of the students have a complete portfolio at this time, and we would not expect them to after only 2+ semesters of college.

We will be following these students throughout their academic careers here at ND and working with each class to improve their e-portfolios. To date, we have subsequently launched the spring 2010 semester registration survey to the students, and preliminary results indicate that the students were able to successfully fill out the NDeP survey, creating both short and long term goals for their academic careers, reflecting on the importance of the six engineering skills towards their potential careers, self-assessing their skill levels, and thinking about their career preparations. Currently, we are preparing a feedback survey for the students in order to assess their perception of the e-portfolio's usefulness, any enhancement of advising communications, and pros and cons of using Google Apps as the platform.

Since our successful launch of this NDeP project in the chemical engineering department, we have also discussed this project with the other engineering departments at Notre Dame and have received very positive reviews. It is anticipated that in the upcoming semester that we will work to generalize the NDeP project for all the engineering departments, and as early as the next academic year, may launch the project to those departments.

Conclusions

The NDeP project was proposed to make improvements to the educational program outside the classroom and encourage students to play a more direct role in their personal development. Since NDeP's inception just over a year ago, we have developed tools for both the student and their academic advisors, and have recently launched a pilot version of this project for the fall 2009 semester to all of our 80 chemical engineering sophomores. As this project has only recently been launched, to date we have obtained preliminary data concerning the student's progress and have taken the students through one round of assessments with feedback. Our preliminary results indicate that students were able to create an electronic portfolio in an output form that is both professional-looking and informative. While the students appear to have the weakest skills in the reflection of their engineering skills, we hope to see improvement in this area as the students mature and are taken through this e-portfolio process during their academic careers. One exciting

recent development was the introduction of the NDeP project to the other departments in the college of engineering. It is now anticipated that this project may launch college-wide by next year.

Appendix

Figure A1: Snapshot of NDeP Resource gSite

Figure A2: Page 1 of NDeP survey: Section 1 Career Goals

Section 2: Engineering Skills

The following questions (A - F) assess which of the six-tool skills you feel are important to your chosen career path. Each question will ask you to rate the skills' importance to you, assess how far you've come toward obtaining these skills, and prompt you for evidence.

A: Technical expertise in ChE concepts and principles

The ability to apply knowledge of mathematics, science, and engineering; identify, analyze, and solve technical problems.

A.1. Please rate your perception of how important this skill is to your overall career goals. *

	1	2	3	4	5	6	7	8	9	10	
Not important	○	○	○	○	○	○	○	○	○	○	Essential

A.2. Please rate your personal perception of your analytical and problem solving skills. *
proficiency with these skills.

	1	2	3	4	5	6	7	8	9	10	
Weak	○	○	○	○	○	○	○	○	○	○	Strong

A.3. Which evidence do you have to prove your skills in this area to date? *
(Please add all new evidence to your e-portfolio!)
- ☐ Written reports
- ☐ Oral reports
- ☐ Project reports
- ☐ Exams
- ☐ Research
- ☐ Photo/Video
- ☐ Website
- ☐ Community Service
- ☐ Other: _____

A.4. Please use the space below to elaborate on the evidence. For example, this section could be used to explain how your project report shows evidence of this skills, or to fill in notes to yourself or your advisor about your goals. *

[text box]

Other skills you feel are important for your career goals.

2.1. Please provide any other skills you feel would be important towards your career goals.
Feel free to choose different skills or elaborate on above skills (A-F).

[text box]

[« Back] [Continue »]

Figure A3: Page 2 of NDeP survey: Section 2 Engineering Skills (only the first tool (A) shown as reference, followed by the general comments at end of section)

Section 3: Upcoming Semester Registration

This section is intended to assess your goals for the upcoming academic semester.

3.1. Curriculum options *
Which CBE curriculum option do you intend to complete for your BS degree?

☐ Materials
☐ Biomolecular
☐ Pre-med
☐ Environmental (chemical)
☐ Environmental (biological)
☐ General
☐ Other: _____

3.2. Courses (Sophomore, spring semester) *
Which courses do you intend to take this upcoming semester?

☐ MATH 20580, Linear Algebra & ODEs
☐ CHEM 20273, Organic Chemistry II
☐ CBE 20266, Thermodynamics
☐ CBE 20258, Computer Methods

Other Courses/Electives
Please list any other courses you intend to take this upcoming semester in the spaces below.

_____

_____

_____

_____

3.3 Course Goals

For each course you are taking this semester, please describe some short-term goals and relate them to your long-term goals. Please attempt to add your own description of your goals, even if inspired by the examples.

Example: CHEM 30361, Materials. I hope to gain knowledge about the strengths and weaknesses of different metals, which will help me understand appropriate materials for the reaction and transport of oil for my future career goal of obtaining employment in petrochemicals.

MATH 20580, Linear Algebra & ODEs
Example 1: Learn to solve problems with matrices. Example 2: Apply systems of linear equations to engineering problems. Example 3: Assess feasibility of matrices and matrix operations.

CHEM 20273, Organic Chemistry II
Example 1: Learn to handle reaction data without rote memorization. Example 2: Apply chemical concepts to problems in ChE. Example 3: Explain which elements of reactions are important to ChE.

Figure A4: Page 3 of NDeP survey: Section 3 Registration (only a few classes listed as examples)

Section 4: Career Preparation

Please describe what other methods you intend to use to prepare for your career, i.e. research, internships, etc.

4.1. Choose other preparation methods or write in your own! *
You have space to elaborate on your choices below!
- ☐ 4.2. Research
- ☐ 4.3. Job Experience
- ☐ 4.4. Community Service/Volunteerism
- ☐ 4.5. Professional Societies
- ☐ Other: [ ]

Of the above choices, which do you feel is the most important? *
Choose research, job experience, service, professional societies, 'other' or none.
[Research ▼]

4.2 Research

Please answer the questions below if you selected Research above.

4.2.1 What type of research are you interested in?
In what area or with which professor?
[ ]

4.2.2 What skills/benefits do you feel you will gain from research experience?
[ ]

4.3 Job Experience

Please answer the questions below if you selected Job Experience above.

4.3.1. What type of job are you or do you plan on applying for?
(Internship, co-op, etc.)
[ ]

4.3.2. What area of ChE are you looking for a job in?
(Pharma, energy, etc.)
[ ]

4.3.3. Job Experience
Which of these will you need for your job search?
- ☐ Resume
- ☐ Cover Letter
- ☐ References
- ☐ Interview Skills
- ☐ Other: [ ]

4.3.4 What skills/benefits do you feel you will gain from job experience?
[ ]

4.4 Service/Volunteerism

Please answer the questions below if you selected Community Service/Volunteerism above.

4.4.1 How/where do you intend to serve/volunteer?
[ ]

4.4.2 What skills/benefits do you feel you will gain from service?
[ ]

4.5 Professional Societies

Please answer the questions below if you selected Professional Societies above.

4.5.1 Which professional societies do you belong to?
- ☐ AIChE (American Institute of Chemical Engineers)
- ☐ ACS (American Chemical Society)
- ☐ SWE (Society of Women Engineers)
- ☐ ASEE (American Society for Engineering Education)
- ☐ Other: [ ]

4.5.2 What skills/benefits do you feel you will gain from belonging to a professional society?
(Job search/network, leadership opportunities, etc.)
[ ]

Other Skills/Experiences

Please answer the questions below if you selected Other above.

4.6. What are others skills or experiences that you hope to gain from your time at ND?
[ ]

Figure A5: Page 4 of NDeP survey: Section 4 Career Preparation (abbreviated)

Instructions:

As discussed in recitation, an electronic portfolio is a collection of "artifacts" that show one's competency in a number of areas. This portfolio serves as an important professional development tool in terms of self-assessment, collaboration with your academic advisor, and self-promotion when on the job market.

We have suggested presenting yourself in terms of the "Six Tool Engineer":

        Understanding engineering concepts
        Understanding technical problems in societal contexts
        Analytical and problem-solving skills
        Communication skills
        Organization, initiative, and self-assessment
        Independence, leadership, and creativity

By Friday, October 2, you should have a working version of your electronic portfolio available using Google Apps in your ND space. You may choose to format your portfolio as a slideshow presentation or as a website; templates for both are available in the Electronic Portfolio Items folder on Concourse.

You should submit your website or slideshow directly through Concourse. If you have a working Google site that is available (either publicly or to all of ND), you can simply enter the URL as text in the "submission" box below. If you are keeping the site private, you may use Google Apps to "share" the website directly with Dr. McCready (mim@nd.edu), Josh (jenszer1@nd.edu) and Victoria (vfroude@nd.edu). If you have a slideshow, you may share it using Google Apps or submit all necessary files through Concourse using "add attachment" below.

Your portfolio will be evaluated in six categories:

    Motivation (20 points): Is there suitable biography and consideration of future goals and plans?
    Content (20 points): Is there information from both your freshman and sophomore years at ND? Is there more than just material associated with classes?
    Reflection (20 points): Does each artifact have a careful reflection and consideration for why it belongs in the portfolio? Is each artifact's reflection specific to that artifact?
    Organization (20 points): Is the portfolio easy to navigate? Is everything consistent?
    Integration (10 points): Does it make sense why each artifact belongs in the portfolio? Does the portfolio tell a complete story?
    Mechanics (10 points): Is the portfolio free of grammatical errors? Is the overall design, color scheme, font selections, etc, professional?

If you have any questions or suggestions to make this project more worth your while, please contact Josh (jenszer1@nd.edu). This project will certainly be ongoing, but we are requiring this portfolio as part of your homework grade to make sure everyone gets started at this point in their career.

Figure A6: NDeP assignment given to students

Electronic Portfolio Evaluation Sample Rubric

Quality	Excellent	Good	Fair	Poor
Content	Chosen evidence appropriately and accurately reflects goals, clearly showing understanding of concepts and skills. Content includes examples from several aspects of life.	Chosen evidence is appropriate for given concepts and goals. Content includes examples from both work and personal life.	Chosen evidence reflects goals but may not provide a complete or conclusive understanding of concepts. Content may lack examples from academic, work, or personal life.	Selection of chosen evidence is unclear or insufficient.
Integration	Clearly able to connect pieces of evidence to one another and various aspects of personal and work life.	Makes good effort to connect pieces of evidence and experiences in own life.	Connects some pieces of evidence to goals, skills, or personal experiences.	Makes little to no effort in creating portfolio as cohesive whole.
Motivation	Provides clear interest and future goals and plans with support from provided evidence.	Provides mostly complete evidence of interest or consideration of future goals and/or plans.	Provides some evidence of interest or future goals or plans, but with perhaps a shallow treatment of one or the other.	Provides little proof of interest, goal-making, or planning.
Reflection	Provides thorough evaluation of personal strengths and weaknesses and reasoning for evidence to be included in the portfolio. Reflections are careful and deliberate and specific to each piece of evidence.	Provides appropriate consideration of personal strengths as reflected by evidence and reasoning for inclusion in the portfolio. Reflections are specific to each piece of evidence.	Provides perhaps superficial summaries of strengths and weaknesses, or does not make clear why evidence belongs in portfolio. Some reflection may be repetitive or not evidence-specific.	Provides little indication of effort in reflecting on evidence.
Organization	Portfolio is clean, professional, and easy to navigate. Pages are consistent and logical and show evidence of careful consideration. Files are consistently labeled and stored and are readily available.	Portfolio is mostly neat and easy to navigate. Pages are consistent and show careful effort was applied. Files are consistently stored or labeled.	Portfolio layout is sometimes difficult to navigate. Pages are not very consistent. Some files are difficult to locate.	Portfolio is very difficult to navigate and inconsistent. Files are seemingly randomly stored and labeled.
Mechanics	Portfolio is free of errors in grammar and usage. Selections of fonts, colors, and sizes are professional.	Very few grammatical mistakes in portfolio. Fonts, colors, and sizes do not detract from portfolio.	Some errors in grammar and usage present in portfolio. Fonts, colors, and sizes make parts of the portfolio inconvenient to read.	Several errors in grammar and punctuation. Fonts, colors, and sizes are inappropriate.

Figure A7: Assessment rubric for student e-portfolios

Andrew _____'s ePortfolio

Welcome
- Overview
  - Engineering Concepts
  - Societal Context
  - Analytical Skills
  - Communication Skills
  - Organizational Skills
  - Creativity
- Resume
- Sitemap

927 days until Graduation

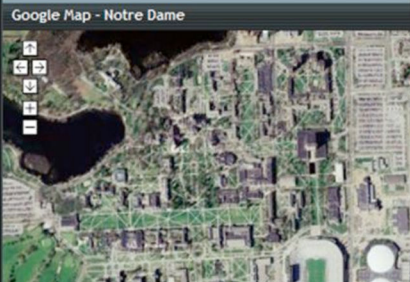## Welcome

Welcome to my electronic portfolio!

Every portfolio has a purpose; I have created this online document in order to demonstrate and record my growth in 6 different skill groups that I believe are fundamental to engineering success. It is also to serve as a development tool in terms of self-assessment, collaboration with others, and self-promotion to prospective employers. It will allow me to highlight my achievements and reflect upon my experiences so that I may guide my education to the fulfillment of my educational and career goals.

First, a bit about me:
I am currently an undergraduate student that the University of Notre Dame, studying to receive a Bachelor of Science degree in Chemical and Biomolecular Engineering. My hometown is Vallejo, CA – a small city located between San Francisco and Napa Valley, in Northern California. I participate on the Notre Dame Water Polo and Boxing teams, and am currently working to be able to study abroad in Australia during my time as an undergraduate. My other hobbies include snowboarding, swimming, and backpacking.

Academically, my interests include energy production and the development of renewable energy, efficient solar cell production, and the application of nanotechnology into daily life. I am working to secure internships over my remaining summers in these or other Chemical Engineering-related fields, so that upon graduation I will be able to enter one of these fields professionally.

As I continue to develop in my education and experiences, I will update this portfolio to accurately represent my skills and accomplishments.

Click here to continue to Overview of Engineering Skills

Google Map - Notre Dame

Hannah _____'s Electronic Portfolio

Hannah Skinner's Electronic Portfolio
- Introduction
  - Engineering Concepts
  - Societal Context
  - Analytical Skills
  - Communication Skills
  - Organization, Initiative and Self-Assessment
  - Independence, Leadership, and Creativity
- Resume
- Sitemap

Introduction

My name is Hannah _____ and I am currently a sophomore Chemical Engineering major at the Un... Denver, Colorado, and in the future I would love to return to Colorado for my career. I am currently inte... undergraduate research opportunities, so that I may continue to explore the field of Chemical Engineer... interest.

After I receive my intended Bachelors of Science in Chemical Engineering degree from Notre Dame... related research project for the U.S. Department of Energy or a similar facility. I am interested in energ... Chemical engineering has the capacity to impact many facets of everyday life, particularly when it co... am intrigued by the innovation occurring in the energy field and the socioeconomic impacts of energy i... engineer to seek developments in this field of research and to continue to improve the energy outlook f...

For the purposes of this e-Portfolio I have presented my competencies, future goals and artifacts of... knowledge of engineering concepts, ability to apply concepts to a societal context, analytical skills, cor... creativity.

Subpages (6): Analytical Skills Communication Skills Engineering Concepts Independence, Leadership, and Creativity Organiza... Context

Figure A8: Sample student portfolios using gSite format (surnames omitted)

Figure A9: Sample slides from a student portfolio using gPresentation format (surname omitted)