



Web publication utilized as a communication tool for first year engineering students

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Abstract:

This work in progress (WIP) paper describes the effectiveness of web publication as a communication tool for first year engineering students. Although the importance of generating a professionally written report has not diminished, web publication is quickly emerging as a necessary means of communicating for engineering students. In this digital age, an engineering education should have not neglect the importance of electronic communication and web based knowledge management. Web based publications provide several benefits compared to traditional portfolios: they allow students a means of enhancing visual/multimedia illustrations, provide students a means of developing project portfolios, as well as providing better data management, knowledge sharing, and easy access and the ability to share their own work. Freshman engineering students in “Introduction to Engineering and Design” were required to develop web pages for their term projects and to turn in URL links or html documents instead of conventional project reports. The quality of the students’ reports was, measured against a rubric as a means of direct assessment along with student feedback obtained in the form of after-class surveys. When compared against the term reports from previous years’ students, the overall quality of communication skills improved by 14% in the overall delivery. Visual communication became enhanced by 60%; however, writing skill and technical depth decreased by 24%. According to survey results, students favored web publication over conventional term report by 92% and felt that it is an effective way to deliver their projects. The results indicate that web publication could be an exciting and effective way to develop communication skills for the digital generation. Students still need training in the art and skill of technical writing.

Introduction:

As we transition from an industrial to digital age, engineering communication must also face the challenges due to the proliferating use of the internet [1]. The internet provides many types of communication opportunities. Technical communication is evolving because of the versatility of the internet. Recent increases in on-line publications, open-access publications, personal webpages and blogs are some examples of how internet communication has evolved from a simple text based webpage. Engineering educators should understand and encourage the new methods of communication in a computer mediated context [2]. Engineering students need to be trained to use the latest technology when communicating with others for their projects and technology. Web publication of their project reports inspire students to develop skills at working with a digital medium while essential elements for written communication is still the same fundamentally. It still encourages students to constantly improve and refine their writing skills.

Engineering education emphasizes that communicating investigation results in a clear and useful way is a key part of a project. In addition, making it available and sharing it with a larger audience can be a good reason for devoting a lot of effort to this aspect. Sharing knowledge with the general public is becoming an important factor in communication. Project reports are in essence a means of presenting facts or storing facts for future use [3]. While traditional project reports were shared only with an instructor and the class, web publication encourage students to

broaden their audience and communicate with their peers and even with unknown audience. [4] As open source sharing is a common practice in this generation, web publication becomes an inevitable and excellent way to share knowledge and experiences from a project. It is also a meaningful educational initiative to connect the gap between engineers and social expectations.

In this paper, we addressed the educational and practical needs for supporting web publication skills as a means of written communication in engineering education. The benefits and caveats for the web publication were also explained. The educational analysis of developing webpages was compared to that of traditional report writing. It should be noted that it was also an excellent way to trigger excitement for writing among freshmen engineering students.

Web publication:

There are several differences between web publication and traditional written document as a project report. In the web publication, audience expands beyond the classroom, the information is stored in the cloud, and shared with general public. Traditional class project reports are shared only with an instructor and teammates, and usually poorly managed afterward. In the web publication, use of graphs, pictures, and video clips becomes essentially important elements to make an effective communication. Developing web publication skills have several benefits, which include:

1. **Visual and multimedia communication:** Visual and multimedia communication skills are becoming more important than ever in digital communication. This growing need should be reflected in engineering communication. With the web publication, students are required to report their projects with more visual illustrations, a guided picture tour of step-by-step procedures and with a video/audio clips to present their deliverables more effectively.
2. **Easy access and visibility:** Web publication makes a global presence instantly by expanding the audience. The knowledge is not only shared with instructor and teammates but also with anyone who are interested. Students themselves gain instant access to their own work after the class period.
3. **Effective data management:** Most of students reported that they no longer keep their class project reports after the class period and lose them within a couple of years. By developing the project description on the web, students can manage the information digitally in a cloud system.
4. **Developing digital portfolio for projects:** Many engineers develop their own digital project portfolio and manage their own professional webpage. This experience will provide a starting point and teach them how to develop a project portfolio.

With all the difference between web publication and traditional project report, production of a good piece of technical writing for a project report is equally important for both. Students still need to describe their projects with adequate technical depth and logic.

Implementation:

The course “Introduction to Engineering and Design” traditionally required freshmen design project, oral presentation with a written report as one of the student outcomes for this course is introducing effective communications. Conventionally students required to present their project through oral presentation and written document. In the year of fall 2015, students in this course were required to develop project web pages and turn in the URL link or html documents instead of a traditional technical report. Although the required elements in the report remain the same (background, project description, methods/design, Results, Discussion, References), students were asked to develop their web page with more visual elements and concise writing.

Tools: Students used web development tools that were free, easy and readily available. These tools are easy to use and intuitive, so there was little to no need to teach any specific tools during class time. Students used a free version of WIX, a free webpage development site. At the time of this study, WIX.com provided easy to use templates, with formatting tools, in addition to providing free webpage hosting. Availability of free web hosting services and their easy-to-use procedures make it applicable to implement this practice in the classroom. An additional resource required was almost “zero” in finance and faculty effort.

A rubric for grading: A rubric for grading was provided to students as shown in Appendix A. The same performance indicators were used for both conventional term paper and web page.

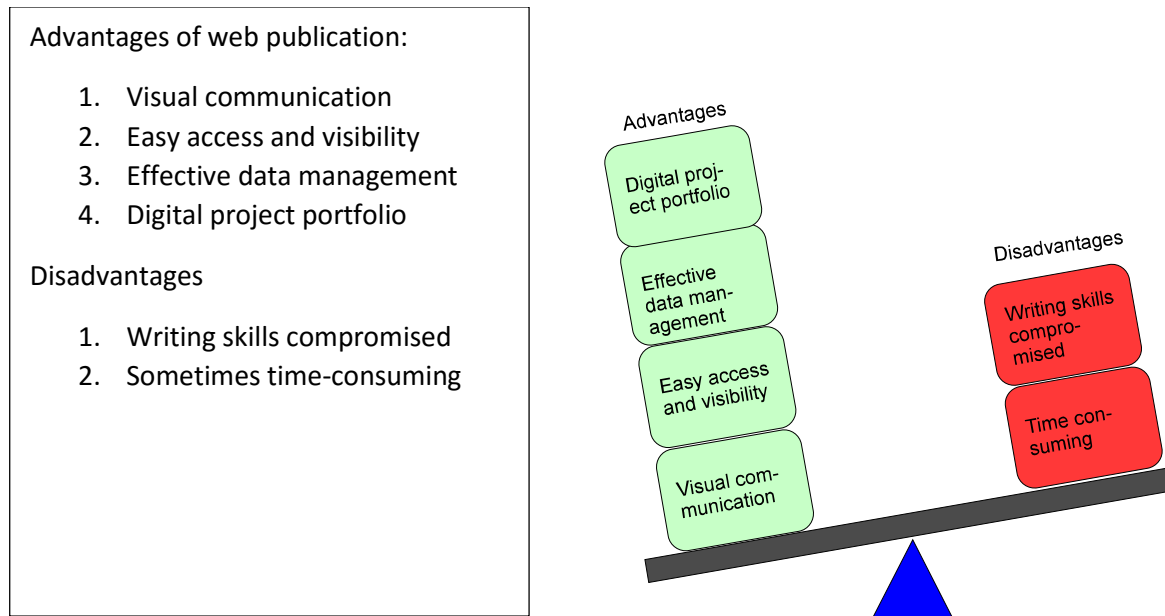


Figure 1. Example of graphical illustration for facts to enhance visual communication. Left, text explanation and Right, graphical illustration of the same content. The message that advantages outweigh disadvantages is easily delivered without making an extra comment. Students were encouraged to provide visual illustration to deliver their messages more effectively.

Students are required to have necessary elements in writing, graphical/multimedia demonstration, and formatting professionally. [5]

Class examples for multimedia use: Presenting data in a visually enticing manner is very important for efficient communication. Figure 1 demonstrates difference between text-based description versus graphically illustrated description to convey their ideas and arguments. Such concise and intuitive graphical illustration becomes important for modern communications, even if it is not for the web page.

Student outcomes: The Accreditation Board of Engineering and Technology (ABET) outcomes that were met by this exercise were [6]:

g. An ability to communicate effectively: Since the ABET included criteria, many engineering schools have been working to implement effective written and oral presentation in their courses. We present web publication as an innovative tool in addition to oral and written communication tools that most schools currently targeting to implement and improve.

i. A recognition of the need for, and an ability to engage in life-long learning: Students were trained to learn how to generate graphs and charts, also motivated to learn how to generate video clips, web blogs, and enticing visual representations. Students taught themselves in using upcoming technology to prepare for those documents.

Assessment: The effectiveness of communication was assessed in two ways. As a direct assessment, the quality of web page was assessed using the rubric in Appendix A. This rubric was also used to assess conventional paper in previous years. As an indirect assessment, student feedback on the web page development was obtained from after-class survey.

Results & Discussion:

Among 16 student teams in the class, 81% of teams successfully generated their project webpages. All the completed student web pages linked through the instructor's course webpage <http://hkwon40.wix.com/kwon#!courses/yxt7r>. Screen capture of a class project list is shown in Figure 2. Each project is linked to each team's own web page. These webpages can serve as a reference for next freshmen class and anyone who are interested in similar projects. There was no class period allocated on step-by-step instructions on how to generate a webpage. Some students with previous experiences did superior jobs while some students experienced technical difficulties. In general, most of the students found it "very easy and intuitive process". Current technical development and free web building services made this exercise implementable without having to devote much of class periods to teach on how to build webpage. The course instruction was focused on what it should contain and writing quality, instead of technical aspect. Overall quality of the web report was evaluated in terms of organization, effectiveness, use of visual/multimedia elements, writing skills on use of adequate language and technical depth, and format details on grammatical or spelling error and citing references as shown in the rubric (Appendix A).

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List of projects in fall 2015 ENGR120 Introduction to Engineering and Design.

From Wind to Fuel
Noah Rupert and Matthew Davis

By building a windmill, which is clean free energy, we can generate the electricity necessary to separate hydrogen from water. We can then use this hydrogen in a fuel cell whenever we need the energy. Storing energy in the form of hydrogen is much more efficient than the use of batteries.

Wind Powered Music Box
Mateusz Kroczyk and Michael McDaniel

Music boxes traditionally use either a wound up spring or a crank to power a system of gears mechanically. The idea sparked within us to create a music box that receives its mechanical energy from the wind.

Windmill pulley system
Andrew Gagli and Matthew Aguard

For our Freshman project, we decided to design and develop our own working windmill. We wanted to use simple parts to show the effectiveness of the device with common materials. We also wanted to demonstrate a unique use of a windmill.

Design and Construction of Wind Powered Pencil Sharpening Device..
Ashton Fletcher and Leodan Morales

As my teammate and I brain stormed about the possibilities that we could produce from the rotatory motion caused by the windmill, we stumbled upon the idea of a wind powered pencil sharpening device. We wanted to design a device that would not only be simple but very effective and helpful. The design itself is very simple, cubic frame with cart wheels on the inside to serve as "bearings" for the pvc which is connected to the blades of the windmill. The other end of the pvc is then connected to the pencil sharpener and rotates it to sharpen the pencils. The device works effectively and is a grand success.

Mousetrap Car Project
Trey Bosfield and Issac Smith

The project was to create a self-propelling miniature car using the stored energy from a set mousetrap as a motor to propel the car forward. This project served as a test of our ability to work under time pressure and to produce a working vehicle on a shoestring budget.

Figure 2. Screen capture of a freshmen class project list that was published through the faculty’s webpage. Each project is linked to each team’s own web page. These webpages can serve as a reference for anyone who are interested in similar projects.

Visual forms, such as drawings, diagrams, real and symbolic pictures are of tremendous importance in the process of knowledge acquisition in general, especially information processing, storage and retrieval. They may also have important implications for the quality of visual communication within a specific profession. It is clear that every engineering profession relies heavily on the use of visual forms as a means of non-verbal communication. With the web publication, grades for the use of graphics and multimedia increased by 60% compared to that of conventional writing as shown in Figure 3. As most of the class projects had moving parts to demonstrate, student teams used short video clips to demonstrate their results. Most of student teams also showed step-by-step procedures with pictures taken from their mobile devices.

Writing is still an essential part of webpage building and it enhance critical thinking and problem-solving skills [7]. Engineering students need to develop the ability to understand technical language and to express that knowledge in a clear, concise, and coherent manner. However, the overall writing skills were compromised when students were instructed to generate a webpage instead of conventional report. It appeared that students paid more attention to build visual illustration rather than polishing their writing. Compared to that of previous class, technical writing skills were 24% reduced on average. Students took the writing part less seriously and developed narratives more personal than technical. These shortcomings must be addressed and improved in the next cycle. Technical writing or any kind of writing does not come naturally to anyone and their skills are acquired with much practice. Our study was only on freshmen who have not trained in the technical writing, so exerting consistent effort in writing should be emphasized.

The other components such as organization and effectiveness were within the error range. Overall quality of communication skills was 14% improved according in the overall delivery. The direct assessment indicated that web publication was an effective way to develop communication skills, especially for visual, multimedia communication skills.

Although oral presentation was not the focus of this report, we discovered that webpage building also affected oral presentation. A recent staple tool for oral presentation has been power point slides. Students usually prepare for PowerPoint slides after they complete the conventional report. In our task, most of student teams presented their project using their webpage because the webpage contained all the visual and multi-media components. It reduced additional work on preparing slides for oral presentation and overall quality of oral presentation increased as the

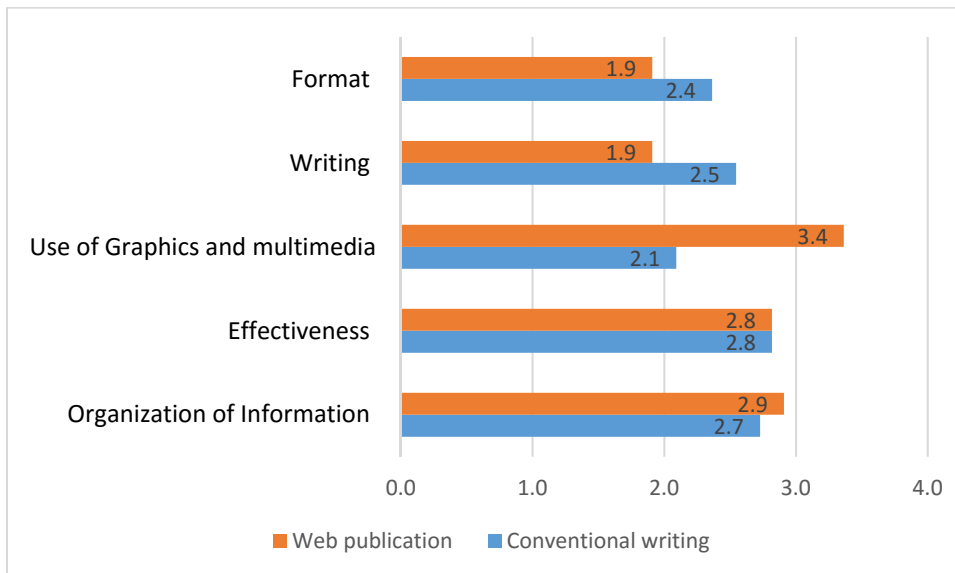


Figure 3. Assessment of web publication and conventional writing based on the rubric provided in Appendix A. Students’ writing skills and formats (reference citing) were compromised while use of graphics/multimedia were enhanced by 60%. Student project reports from fall 2015 was compared to fall 2014 data.

webpage was better organized and deliverables were presented more effectively with pictures and video clips.

At the end of the class, in-class survey was conducted to ask efficacy and efficiency of the web publication. Indirect assessment through survey, students' response was 92% favored in a question that whether the web publication is effective way to deliver their project description. It was expected that students spend more time in preparing the web document than traditional report, because of pressure to be published online and time-consuming nature of visual charts/photographs/video preparation. However, majority of students answered that the time spent on developing webpage was adequate. This also explains that students spent more time for visual graphics and sacrificed developing meaningful texts and policing their writing.

Table 1. After class survey on the webpage building and publication.

	Yes	No	Comments
Do you prefer web page building over conventional report?	92%	8%	Some students are resistant to learn new techniques.
Did you complete the webpage development within time frame?	82%	18%	Some student groups were not used to use new technology.
If yes, do you allow your webpage to be published?	78%	28%	Students who were less confident about their project did not want it to be published.
Time you spent to develop the webpage was adequate?	96%	4%	

In informal conversations, students expressed that they enjoyed the webpage construction as they could directly relate to the impact of their writing effort. A student mentioned that "I was able to show my class project to my parents. They really liked the idea of publishing class projects on internet so they can access it as well." Junior and senior students also wished that they could access their class project reports through the web, as they find theirs all lost over time. Students are encouraged to continue web publication regardless it was mandated or not, as web page building, project videos, and professional blogs are great way to build their online portfolio. Their first project web page will be a part of their portfolio.

The web publication is a great tool to encourage engagement and boost creativity in class projects. Albeit there was a concern that we may miss out the opportunity to generate traditional technical writing, students' feedback was rave and agreed that it was a great way to get excited about their projects. The new emerging paradigm is characterized by the concepts and principle of agility[8]. We face open source movements daily and find numerous technical

sites that share their projects with a great amount of details. Sharing their knowledge online can be a good opportunity to ignite engineering students' creativity and innovative mind. The ideas and their accomplishments can be created into web document with visual elements and shared with peers. This is a new paradigm in conducting class projects to boost creativity and excitement.

Conclusions:

We live in a fast, ever-changing society where communication methods have evolved dramatically just within the past decade. In this paper, we described the effectiveness of web publication to address the growing need of developing communication skills to comply with the digital age. Our results indicate that web publication with multimedia can be an effective tool to replace or compliment traditional written report for class projects. It also benefits students by training them to develop their own project portfolio online and to manage them in a cloud for easy access by themselves and by the world. Web page development can be an effective way to communicate and to share their projects with classmates and the public. In addition, it is a great way to get the students excited about writing project descriptions with enhanced visuals. We incorporated web publication within the freshmen class for this study; however, it can and should be used in other classes including senior capstone projects. We suggest that web publication be incorporated as an additional communication tool for all engineering students.

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Appendix A. Rubric on grading traditional term report and web page.

Performance Indicator	Unacceptable 1	Marginal 2	Good 3	Very Good 4
Organization of Information	There is no clear plan for the organization of information	Some information is logically sequenced.	Most information is organized in a clear, logical way. One or two sections are omitted.	Information is organized in a clear, logical way.
Effectiveness	Project is lacking several key elements and has inaccuracies. Project is completely inconsistent with driving question.	Project is missing more than two key elements. It is rarely consistent with the driving question.	Project is lacking one or two key elements. Project is consistent with driving question most of the time.	Project includes all material needed to give a good understanding of the topic, including a clear introduction. The project is consistent with the driving question.
Use of Graphics and multimedia	Several graphics are unattractive AND detract from the content of the presentation	All graphics are attractive but a few do not support the topic of the presentation	A few graphics are not attractive but all support the topic of the presentation.	All graphics are attractive (size and colors) and support the topic of the presentation.
Writing – proper language and technical depth	Text misrepresents information on the project.	Text describes the project but lacking details and technical depth.	Text captures most of the project details with a proper language and technical depth.	Text excellently describes the project with thorough explanations, a proper language and appropriate technical depth.
Format – Errors and use of references	Presentation has more than 2 grammatical and/or spelling errors. No reference cited.	Presentation has 1-2 grammatical errors and/or spelling errors. Reference were not cited properly.	Presentation has 1-2 misspellings, but no grammatical errors. Collets relevant information and cite them correctly.	Presentation has no misspellings or grammatical errors. Collets extensive relevant information and cite them correctly.