122nd ASEE Annual Conference & Exposition
June 14 - 17, 2015
Seattle, WA
Paper ID #12767

Establishing a Web-Based Dual-Rating System to Centralize and Evaluate Educational Resources for Undergraduate Nuclear Engineering Courses

Dr. Masoud Naghedolfeizi, Fort Valley State University

Dr.Masoud Naghedolfeizi is a senior professor in the Department of Mathematics and Computer Science at Fort Valley State University. His academic background includes a B.S. in Mechanical Engineering with minor in instrumentation and control, an M.S. in Metallurgical Engineering, and M.S. and Ph.D. in Nuclear Engineering. Dr. Naghedolfeizi's research interests include instrumentation and measurement systems, applied articial intelligence, information processing, and engineering education. He is the author of numerous research and pedagogical articles in his areas of expertise and currently the principal investigator for a US NRC funded project entitled: Establishing a Nuclear Science and Engineering Minor at Fort Valley State University.

Prof. Sanjeev Arora, Fort Valley State University

Dr. Arora holds a B.Sc. (Honors) and M.Sc. degree in Physics from University of Delhi, India, and a M.S. and Ph.D. degree in Physics from University of Delaware. Dr. Arora's research interest is experimental atomic physics and he is well-versed in the use of the van de Graaff accelerator, scalars, MCAs, and other physics instrumentation. He has been instrumental in acquiring, through various grants, computers, and software for the physics laboratory at FVSU. Some of his funded grant proposals are as follows: 1) Establishing a Nuclear Science and Engineering Minor at Fort Valley State University 2) Establishing an Undergraduate STEM Teaching and Research Laboratory at FVSU 3)Establishing an Interdisciplinary Bioinformatics Laboratory at Fort Valley State University 3) Computer-based Instrumentation Laboratory for Undergraduate Science and Mathematics Programs at the Department of Mathematics and Computer Science Fort Valley State University. 4) Developing an Undergraduate Minor in Computer-based Measurement and Instrumentation at Fort Valley State University 5) Preparing Teachers for Problem Solving Instruction 6) Developing a State of the Art Physics Laboratory at Fort Valley State College.

Establishing a Web-Based Dual-Rating System to Centralize and Evaluate Educational Resources for Undergraduate Nuclear Engineering Courses

Abstract

Supplemental educational learning resources such as PowerPoint presentations, animations, instructional video clips, and simulations are some important tools that could impact student learning of the subject matter. Nuclear engineering courses often contain obscure and complex topics that need further explanation using visualization techniques or additional learning resources. The Internet/Web contains a wealth of information about various topics of nuclear engineering. However, this information is widely scattered and its effectiveness with regards to student learning has not been established yet.

At Fort Valley State University (FVSU), we have initiated a comprehensive project to collect various learning materials related to the field of nuclear engineering and health physics from the Web and topically organize them for an easy access. In addition, we have created a dual-rating system for each learning resource: one by instructors and the other by students. In this way, students could make a more informed decision for accessing/downloading learning resources. Web pages have been designed to implement the above system.

This paper describes the methods used to construct a website regarding educational resources for undergraduate nuclear engineering and health physics topics. The website will eventually be placed online for student access world-wide.

Introduction

In recent years, digital resources have become an integrated part of teachers' teaching practices and students' learning experience[1-3]. This is due to the explosive growth of World Wide Web (WWW) and the affordability of computers/laptops/tablets and smart phones as well as the low cost of Web access. Web and digital resources have provided both teachers and students with a wide range of teaching and learning tools that were not available previously. Students often search the Web for resources that provide examples, visualizations, and lecture notes/videos about the subjects related to the topics of their courses to further enhance and reinforce their learning or to self-teach topics covered during missed lectures. Teachers also utilize web-based teaching resources that meet their specific pedagogical needs, enhance the quality of their teaching materials, and/or are difficult to generate by themselves such as simulations and animations. These resources are widely scattered over the web and therefore efficient methods of identifying useful resources are often challenging and time consuming.

The Multimedia Educational Resource for Learning and Online Teaching (MERLOT) is perhaps the most centralized source of obtaining web-based learning and teaching resources for various science and engineering disciplines[4]. These resources include tutorials, simulations, lecture notes, demonstrations, and/or online classes/labs. MERLOT also includes a peer-review rating system to evaluate web-based resources based on content, quality, technical presentation, and ease of use.

The MERLOT site includes relatively rich amount of resources for engineering disciplines. However, the resources available for nuclear engineering are limited and only include online classes from major universities such as MIT and Berkeley.

The curriculum of undergraduate nuclear engineering contains courses that often require students to have deeper understanding of physics and engineering. Many topics (e.g.; neutron diffusion, transport theory, reactor theory, etc.) in this field are considered tedious for students to learn and challenging for teachers to teach. The lack of sufficient visualizations, simulations, analogies, and teaching and learning supplemental materials in this field are some contributing factors that make nuclear engineering so difficult to learn and to teach. A majority of textbooks in nuclear engineering do not include PowerPoint presentations or author/publisher's websites to provide students with additional learning materials such as animations, visualizations, and self-evaluation quizzes.

Fortunately, the Web-based teaching and learning resources could alleviate these concerns. There are numerous video clips, tutorials, animations, visualization, and simulations related to the field of nuclear engineering that are widely scattered over the web. These resources could be utilized to supplement traditional teaching materials used in this field. However, the main challenge is to locate and organize these resources efficiently. Perhaps the best practical way to address this issue is to design a website (similar to MERLOT) as a center to locate useful and quality web-based learning and teaching resources for both students and teaching practitioners.

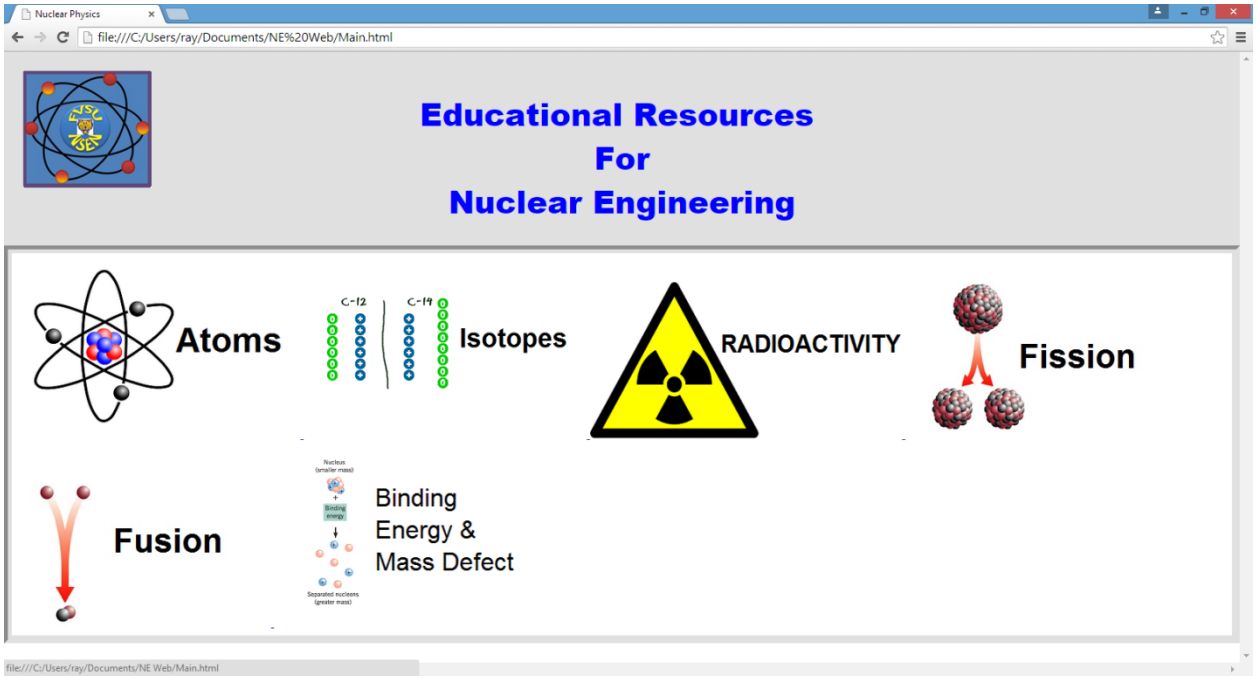
Website for Nuclear Engineering Web-Based Resources

In fall 2014, the authors launched a project to develop a website as a center to access web-based teaching and learning resources in nuclear engineering and health physics. The main motivation was to provide students with an easy access to learning resources that are high quality and related to the curriculum of our minor program in nuclear science and engineering. These resources would be organized topically in a fashion similar to the topics organized in the textbooks used for the minor program courses. The resources considered for each topic could include tutorials, PowerPoint presentations, video clips, images, demos, and/or simulations. A maximum limit of five resources per category (e.g.; images) for each topic was considered as a reasonable limit to avoid confusion while increasing efficient exploration of resources. For video clips and demos, the preference is to include those with a maximum running time of 15 minutes per clip/demo. This is based on our informal survey of students who used YouTube video clips as additional resources for their courses. It appears that long running video clips or demos tend to diminish student interests in watching them. Also, if an instructor needs to adopt such resources to supplement her/his teaching materials in the classroom, then shorter clips and demos lend themselves better for a limited class time period.

The initial collection of these resources was selected by the first author and two students who had agreed to work on this project. The students already took a minimum of two courses in nuclear science and engineering. These courses were Nuclear Science and Engineering I and II. One student was also taking a course in Health Physics and Ionizing Radiations at the time the project started (Fall 2014). A computer science student also agreed to design the website based on the specified template. Figure 1 shows a captured screen of the proposed website. The

website will eventually be placed on university website and will have its own link (in form a button) on the main webpage of the nuclear science and engineering minor program.

Figure 1: The main Web page for the proposed nuclear engineering educational resources



To ensure the web resources are useful and contain relevant materials, a double-rating system has been designed for each resource. Both instructors and students would be able to rate the resources by simply filling out a very short form when they click "Rate Me" button associated with each resource. Figure 2 shows a captured screen shot of this form. A scoring system will track of "Likes (thumbs up)" and "Dislikes (thumbs down)" for each resource. The score of each resource could indicate its usefulness to the users and help first time users to make a more informed decision about visiting a particular resource. It also would be used to make changes if the resource is receiving too many "Dislikes".

Figure 3 shows a typical webpage for resources selected for a specific topic (e.g.; Binding energy & Mass Defect). The page becomes available when the user clicks on an icon of a specific topic on the main page. The user can also navigate to other topic by using the topics bar or going to the home page.

This project is a work in progress and both the identification of resources and the design of the website have not been completed yet. At the time of writing this paper approximately 40% of the project has been completed. We are hoping by Fall 2015, the website would be launched and students within our university as well as other interested students and instructors from all over the world would be able to visit the website.

Figure 2: Web form to rate learning/teaching resources

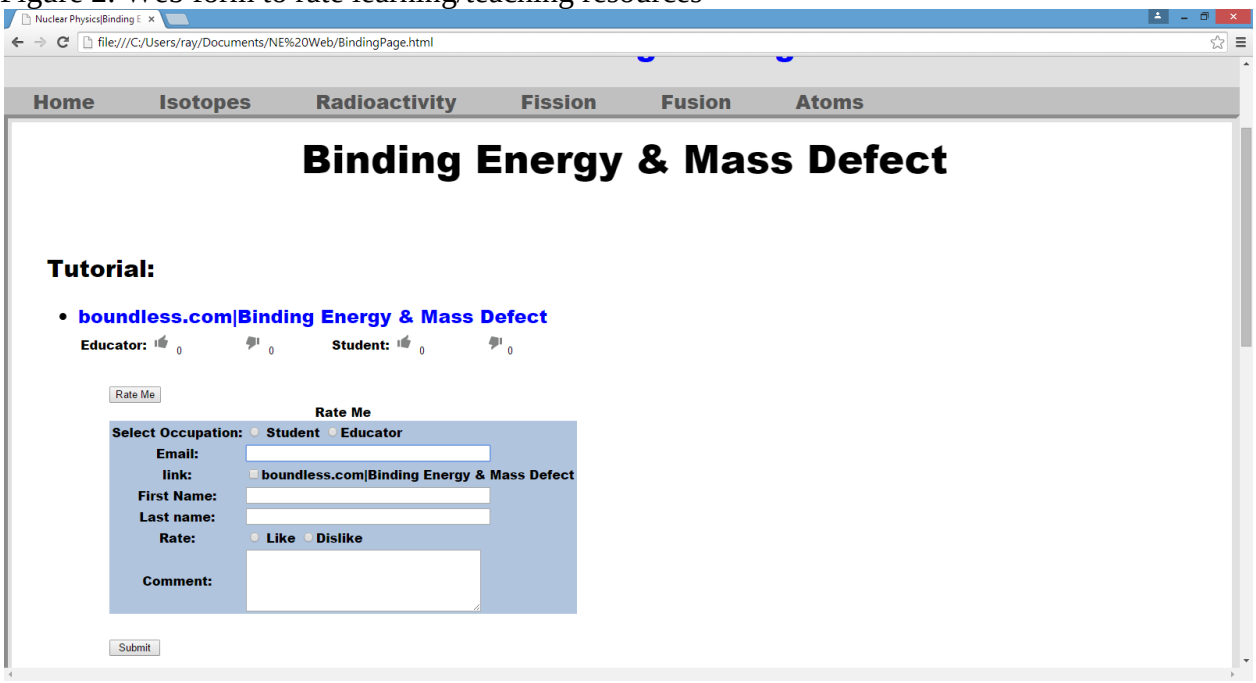
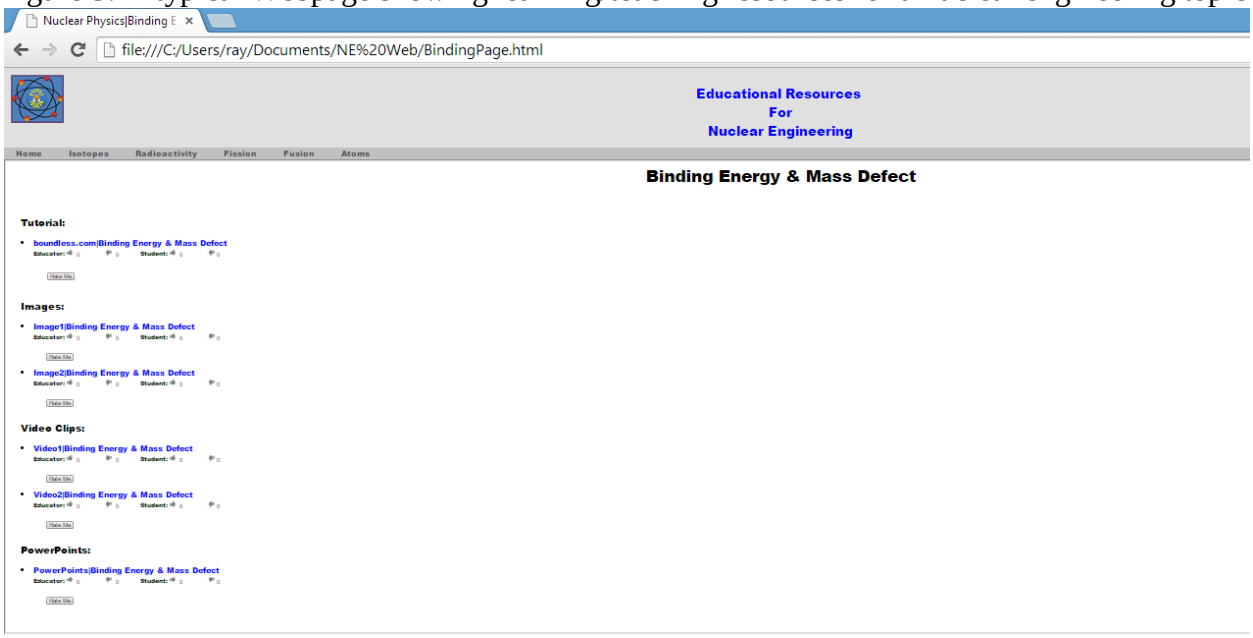


Figure 3: A typical Webpage showing learning/teaching resources for a nuclear engineering topic



Discussions

The most challenging task in carrying out this project involves the identification of useful and quality resources that appeal to both students and instructors. Currently, our system of requesting both students and faculty of nuclear science and engineering program to select these resources is not (strictly) a peer- reviewed process and the selection process relies solely on their

sound judgment. Thus, it is anticipated once the website becomes operational, it may not live to the expectation of every user. In this respect, the double-rating system could help purge resources that are not receiving favorable reviews and replace them with those suggested by the users. On the other hand, this process of continuously updating the resources could inherently be slow one, since it ultimately would depend upon the frequency of user responses.

Another challenging issue would be when some of the resources are removed from the web or become unavailable. This could present a major problem for the users. One way to address this issue would be to rely on users' comments regarding unavailable resources and make suitable replacements accordingly. Another solution would be to seek assistance of our volunteer students and faculty (at FVSU and other nuclear engineering programs) to systematically check the availability of the resources on monthly or quarterly basis. However, downloading the resources may not be a viable option because it may violate copyright once the resources are removed from the Web.

In collecting the resources, the authors have noticed that while there are a good number of learning and teaching resources for basic concepts such as atoms, binding energy, nuclear forces, radioactivity, decay processes, and radiation, very few materials are available on more advanced topics such as neutron diffusion, neutron transport theory, and reactor theory and kinetics. Thus, this work could also help identify topics that need educational resources such as short video clips, simulations, and PowerPoint presentations.

Future Work and Concluding Remarks

We plan to fully complete this project including the identification of resources and implementation of the website by fall 2015. We not only would like our own students to use the website extensively, but also sincerely hope that other interested students from all over the world would do the same. To this end, invitation letters and emails will be sent to as many nuclear engineering programs as possible to introduce our website to a wider audience after the completion of the project. In addition, the letters would invite members of the American Nuclear Society (ANS) student chapter to participate in the website review and provide feedback about selected resources. This would enhance our project by making the process of resource selection, a truly peer reviewed one.

The authors firmly believe that in order to enrich educational experiences of students in the field of nuclear engineering and health physics, educators should demand students to study and learn topics related to their field in an effective and well-organized manner. A website that centralizes relevant and quality teaching and learning resources would provide instructors with an additional tool to achieve this goal. While there are many websites such as Khan Academy that are available as a central source of learning materials to math and science students for their educational needs, such a resource is not available to nuclear engineering and health physics majors. The implementation of this website could play a positive role in helping nuclear engineering and health physics students to locate useful and relevant learning materials for their courses more proficiently. We envision our website as a Nuclear-pedia of the future!

Acknowledgement

The authors would like to gratefully acknowledge the support of Nuclear Regulatory Commission (NRC) for funding this project at FVSU. The comments, opinions, findings, and conclusions expressed in this article are those of the authors and do not necessarily reflect the views of NRC.

References

1. Said Hadjerrouit, "A Conceptual Framework for Using and Evaluating Web-Based Learning Resources in School Education," Journal of Information Technology Education, Vo. 9, 2010

2. Valerie Young, Edward Perry, Patrick Mensah, Jean-Pierre Bayard, Rassa Rassai, and Joseph Tront, "Making Use of the MERLOT Database," Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition,

3. Edward F. Gehringer, "A Database and Search Engine for Sharing Fine-Grained Course Materials over the Web," Proceedings of the 2003 American Society for Engineering Education Annual Conference & Exposition,

4. MERLOT website: www.merlot.org