

Making Use of the MERLOT Database

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Abstract

The Multimedia Educational Resource for Learning and Online Teaching (MERLOT) database allows engineering educators to use online, interactive instructional modules in their courses without investing excessive time to develop them, search for them, or screen them for suitability. MERLOT provides two categories of useful tools for new (and old) engineering educators. First, MERLOT provides links to free, public domain, online learning objects for engineering coursework in a variety of disciplines. These learning objects include course notes, diagrams, tutorial programs, demonstration and interactive applets, and even online mini-courses. Along with the link to the learning object, MERLOT provides a description of the content and, often, sample assignments demonstrating methods for incorporating it into courses. Second, MERLOT provides links to free, public domain, online pedagogical tools such as learning preferences surveys and guidance on constructing rubrics, writing course outcomes, and planning learning activities at all levels from Knowledge and Application to Synthesis and Evaluation. MERLOT has two advantages over most search engines and online teaching databases. (1) MERLOT is focused on post-secondary education. (2) MERLOT learning objects and pedagogical tools are peer-reviewed.

This paper is intended to demonstrate how to browse and search the educational resources currently available in the MERLOT database and explain how the peer review system screens educational resources for ease-of-use and technical content. It includes examples of how online learning objects can be incorporated into engineering courses, and of strategies to help engineering educators develop learning activities for their own courses that take advantage of MERLOT resources. For those who invest the time to develop online resources, MERLOT provides independent peer review to help document the value of these contributions in the promotion and tenure process. This paper encourages engineering educators to become members of the MERLOT community, add resources to the database, and act as peer-reviewers.

What is MERLOT?

The Multimedia Educational Resource for Learning and Online Teaching (MERLOT) database is essentially a catalog of on-line tools for teaching and learning. The tools, or “learning objects”, are not owned by MERLOT and do not reside on MERLOT computers. MERLOT catalogs these learning objects by subject area, provides links to them, and provides descriptions and peer reviews that can (1) help an instructor decide whether a learning object will help students achieve a particular learning objective, (2) give an instructor ideas for different ways to approach a particular learning objective, and (3) provide documentation of the contribution of a learning object to the scholarship of teaching. The MERLOT url is www.merlot.org, Figure 1.

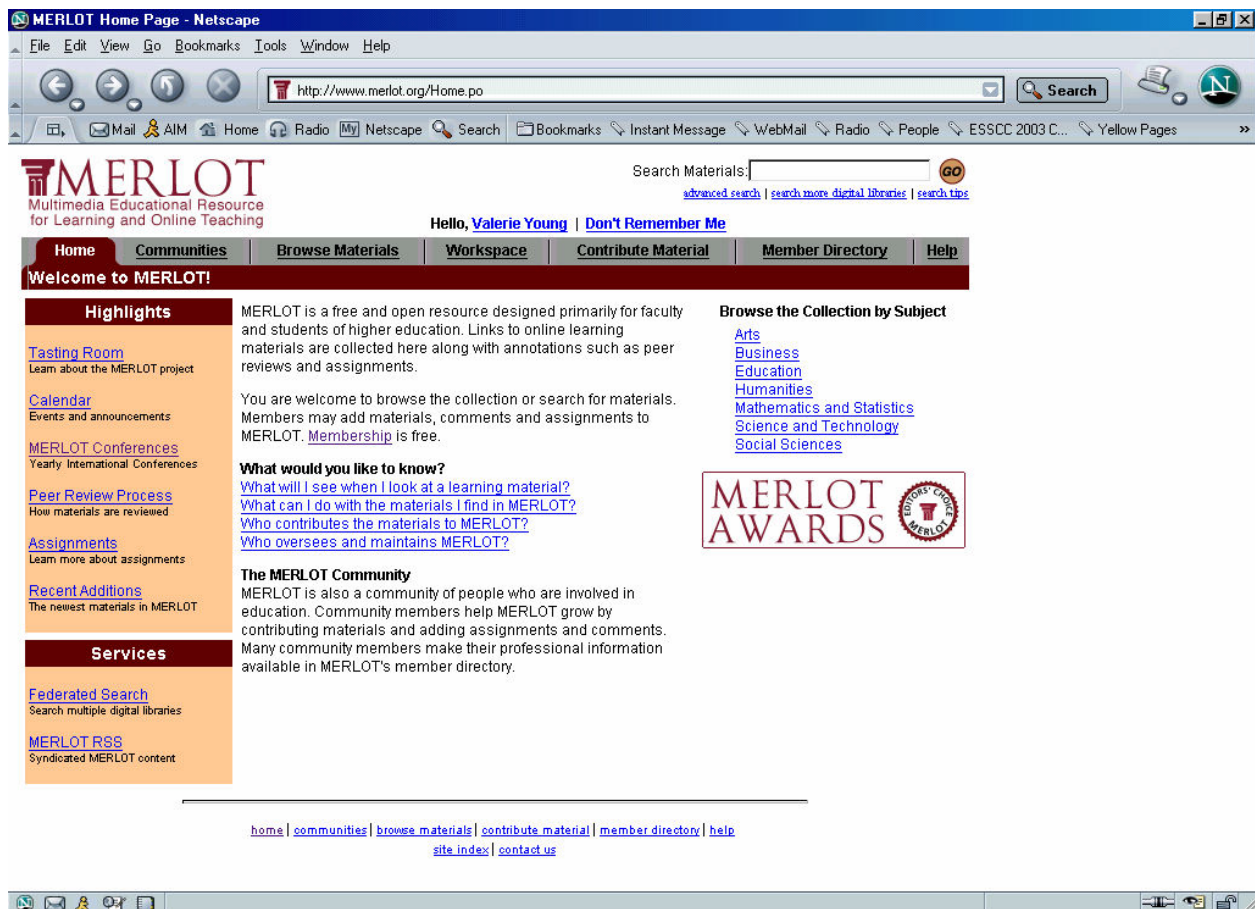


Figure 1. The MERLOT homepage

Users can browse by subject or search by key word. Pedagogical resources useful in any discipline are found under “Education”. Resources for engineering course content are found under “Science and Technology”. One goal of the engineering editorial board is to build the collection and the traffic in engineering so that engineering will become a member of the top-level subject list, not a category under Science and Technology. Anyone can browse the material in MERLOT, follow the links, and use them. Still, engineering educators are encouraged to join. Membership in MERLOT is free, and enables you to contact other members with similar interests (see Member Directory) and help build the MERLOT community. Membership does not require you to contribute or review objects or otherwise serve.

Learning objects enter MERLOT upon being added by a MERLOT member. Any member can add a learning object by clicking on “Contribute Material”. MERLOT is a catalog, not a repository. The author of a learning object retains full copyright and full control. MERLOT members are encouraged to add *any* useful online learning object, not just objects they author. When you add a learning object, you provide a brief description of the object and identify the subject area(s) under which it should be filed. The object will appear in the database immediately; peer review follows.

Each major discipline areas in MERLOT has an editorial board. (The authors of this presentation are the MERLOT Engineering Editorial Board.) Editorial Boards periodically triage new learning objects, and identify interesting or promising ones for peer review. A peer-review team consists of two educators in the discipline who rate the learning object for Content Quality, Potential Effectiveness as a Teaching Tool, and Ease of Use. The peer-review team also summarizes the learning goals and target student population for the learning object, and suggests ways in which it might be used. The MERLOT peer reviews are true reviews, separate from the “amazon.com”-style reader comments that may also appear.

MERLOT is unique because it (1) covers a wide range of disciplines, (2) is focused at the university level, and (3) includes peer review and other ancillary documentation to assist educators in using the learning objects and in obtaining credit for developing them. For example, CACHE (www.che.utexas.edu/cache/), which stands for Computer Aids for Chemical Engineering, is a not-for-profit organization whose purpose is to promote cooperation among universities, industry and government in the development and distribution of computer-related and/or technology-based educational aids for the chemical engineering profession. The CACHE collection is catalogued in the MERLOT database. However, CACHE is more a repository, and does not grow “from the grass roots” as MERLOT does. CACHE focuses on chemical engineering, while MERLOT spans a variety of disciplines. Also, links in MERLOT are regularly verified and dead links removed. The Digital Library for Earth System Education (DLESE, www.dlese.org) covers a variety of science-related disciplines, and many of the objects are reviewed, but much of the material is not at the university level. One can also uncover a variety of learning objects using a standard search engine such as “Google”. However, these will lack the peer reviews and suggested assignments that MERLOT provides.

Discipline-Specific Resources in MERLOT

Clicking on “Science and Technology” from the MERLOT homepage reveals a new page of categories. See Figure 2. The triangle with the plus-sign, such as that next to “Engineering”, indicates that subcategories are available; clicking on the triangle reveals them. Clicking on a subcategory name limits the list of learning objects to that subcategory. If you sort the listings by rating (default), the first learning objects listed are those identified by the discipline’s editorial board as particularly meritorious. You can sort by title, author, date entered, or item type instead. Types of items include case studies, virtual tours, simulations, topic notes, tutorials, film clips, assignments, anything that can be accessed via the web. Collections of items or links, such as the CACHE website or the “Physlets” collection of physics applets are also shown. You also have the option to build a personal collection.

MERLOT-catalogued resources can help you shift the emphasis in your class from teacher-instruction to student-learning. ASEE conference attendees probably know that active, student-centered classtime produces deeper learning. At the same time, the lecture truly is the easiest thing to prepare when you are teaching the course for the first time, trying to stay a couple of steps ahead of the students. Lecture notes seem to follow naturally from your own effort to learn the material you supposedly learned from your professors. When expectations for the new faculty member are very high in areas other than teaching, it is unrealistic and even unwise for most to try to make every class period in every course a model of modern pedagogy the first time through. When you have to master the material yourself before you can start designing the

activities, there isn't enough time to develop something for every class meeting. Even experienced faculty are often put off trying a greater variety of strategies by the daunting idea that they must develop from scratch something for every class meeting. When you adopt and adapt resources developed by others, it becomes feasible to go beyond lecture more often than you might have time to on your own.

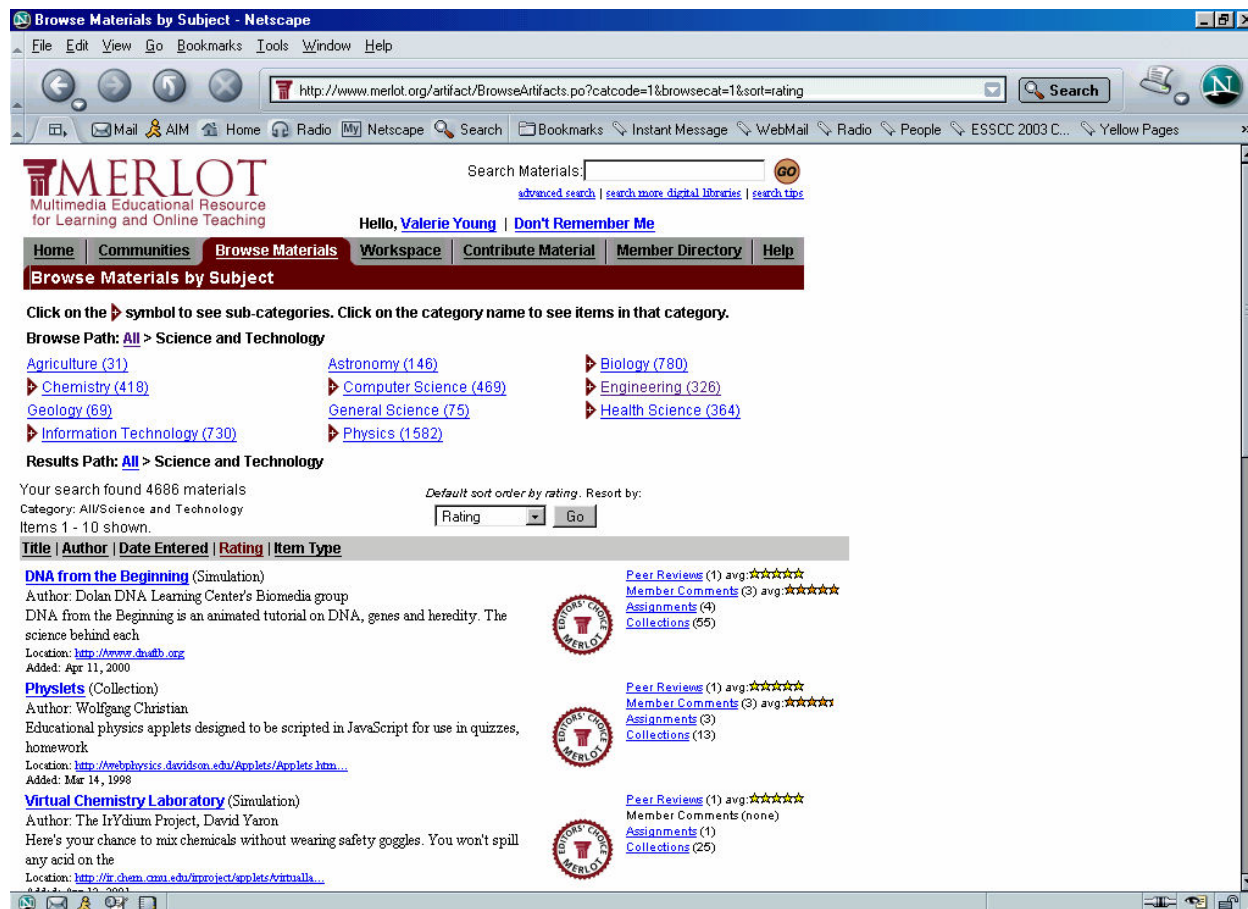


Figure 2. The Science and Technology collection

What follows are examples of how MERLOT-catalogued resources can augment your course. In general, if you want students to be able to access the material themselves, provide a link to the author's work rather than copying the work to paper or your local computer system. This avoids any question of copyright infringement. With the facilities available in many current engineering classrooms (wireless and high speed connections), faculty can use links rather than copied material during class, too. It is courteous to inform the author if you link to his work, though this bit of etiquette has often been ignored as the web has grown. Aside from courtesy, this gives the author evidence that the impact of a learning object extends beyond the single course or institution for which it was developed.

Example 1: provide links on your course homepage to calculators, table, diagrams, or other reference material. Using these tools frees students at the appropriate level from routine calculations so they can concentrate on higher-level questions. (Caution: the instructor should warn students if they will need to do such calculations without the online tools on exams, and

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give them practice doing so.) If these tools are public domain, students will refer to them long after they leave your course.

Ed Perry points his students to the “Steam Tables Calculator” by MathPad Software Corp (www.mathpad.com, or search for Steam Tables in MERLOT). This learning object is simply an online calculator that reduces the tedium involved in looking up steam properties in the conventional steam tables. It allows the instructor to assign problems that involve parametric studies (e.g. system efficiency as a function of boiler pressure) since the drudgery of steam table look-up is removed. Instead of focusing on the numbers and the calculations, the instructor can ask students to describe, verbally or in writing, how the variables are related to one another, and what the consequences of this relationship are for the design of something like a boiler. Ed Perry finds similar use for the “Compressible Aerodynamics Calculator” (www.aoe.vt.edu/aoe3114/calc.html, or search for Compressible in MERLOT) by William Devenport at Virginia Tech. This online calculator provides values for compressible flow properties that are normally found in print tables or by rather involved calculations. Included are calculators for isentropic flows through nozzles, normal shock waves, and oblique shock waves. It allows the instructor to assign problems that involve parametric studies (e.g. nozzle exit pressure vs. chamber pressure) since the tedium of table look-up or equation evaluation is removed.

Example 2: provide links on your course homepage to notes or tutorials about prerequisite (but often unmastered) material. If you give students tools to remind and reteach themselves, and encourage them to use them, then you help them develop as independent learners. Of course, the way that you direct students to these tools is important, particularly for the new engineering educator for who teaching ratings may be of particular concern. “Hmm, yes, to do this, you have to remember how to calculate the pH of a basic solution. Here, let me show you a tutorial. Try working through this; I think it will help you. After you’ve been through it, come back if you have some specific questions.” For chemical engineers encountering distillation in their senior unit operations laboratory, point them to “Distillation and VLE Explanation” by Wayne Pafko of Proctor & Gamble (www.pafko.com/history/h_distill.html, or search for Distillation in MERLOT), or “McCabe-Thiele Method” by Venkat R. Bhethanabotla of the University of Southern Florida (www.eng.usf.edu/~bhethana/McTh/McTh.html, or search for Distillation in MERLOT). For basic review of chemistry, physics, and math, consider “MSTE Lessons” from the Office of Math, Science and Technology Education at the University of Illinois – Urbana-Champaign (www.mste.uiuc.edu, or search for the name of the topic of interest in MERLOT). Among others, there are tutorials on trigonometry, Ohm’s Law and basic statistics. For balancing equations, look at “Chemical Reaction Stoichiometry” by William Smith at the University of Guelph (www.chemical-stoichiometry.net, or search for Chemical Reaction in MERLOT).

Example 3: use simulations and virtual tours as the basis for demonstrations, in-class projects, or out-of-class projects. Simulations and virtual tours let your students see and try things that are too small, too far away, too expensive, or too dangerous to experience physically. However, undergraduates will rarely think deeply about a simulation or virtual tour if they are just sent to “try it”. It is important to decide what you want students to learn from the tour or simulation, then guide them to and assess that learning objective by asking them to answer specific questions

or achieve a particular task. Require a description of the phenomenon in a technical memo, or a lab report on a virtual experiment.

The “Virtual Tour of a Steam Turbine Cogeneration Plant” by Carl Lira at Michigan State (www.chems.msu.edu/classes/321/powerplant/, or search for Steam Plant in MERLOT) is a simple site with photographs and flow diagrams for a typical steam generation plant. Sophomore chemical engineers should be able to calculate the fuel costs to run one boiler in this plant at full capacity as specified on the flow diagram, and compare costs for using different fuels.

Example 4: use tutorials as a substitute for or augmentation of lecture on a topic. You can give students a task that uses material in the tutorial, and turn them loose, either in class or out of class. Beware, however of two pitfalls if you regularly adopt tutorials instead of lecturing. (1) Your teaching evaluations may suffer if the students perceive that you aren’t actually “teaching”. (2) You may be expecting students to master too much material. Some very good tutorials contain the task as an integral part, and will augment the text and your teaching.

Joe Tront uses The Semiconductor Applet Service by Wie Chu of SUNY Buffalo (jas.eng.buffalo.edu/, or search for Semiconductor in MERLOT) in a VLSI Circuit Design class to reinforce the principles discussed in class. Students review the applets at home and perform the exercises as homework problems. Student reviews of the material rate it highly for helping them to better understand the material because of the visualization support provided in the applet. For materials engineering, “Materials Teaching Educational Resources (MATTER)”, based at the University of Liverpool (www.matter.org.uk/, or browse in Material Science and Engineering in MERLOT), is a collection of tutorials. SteelMATTER, for example, asks students to identify the most important properties for steel for particular applications (such as automobile bodies) and asks students to identify the necessary processing steps to achieve them. It provides immediate feedback and supplementary instruction at all steps of the task, as well as a broader guided study of steel making. Students can complete the tutorial at home, and submit a memo summarizing the properties and processing requirements for one of the applications.

Pedagogical Resources in MERLOT

Traditionally, graduate school has not taught future engineering faculty about such pedagogical principles as writing observable learning objectives, identifying and accommodating different learning styles, or assessment of student learning. MERLOT’s educational section can provide some assistance. Consider the “Authentic Assessment Toolbox” by Jon Mueller at North Central College (jonathan.mueller.faculty.noctrl.edu/toolbox/index.htm, or search for Authentic Assessment in MERLOT). This is a tutorial for educators in all disciplines to learn about creating tasks, rubrics and standards for measuring and improving student learning. This catalog also lists learning style surveys, tools to help you develop useful formative and summative teaching evaluations, and other pedagogical helps.

The Peer Review Advantage to Learning Object Developers

Promotion and tenure committees typically measure research “quality” in a variety of ways: presentations delivered, publications in peer-reviewed journals, grant proposals funded, comments by reviewers of proposals and publications, graduate degrees completed, reference

letters from established researchers in the field. However, in many engineering schools, measurement of teaching “quality” relies heavily or exclusively on student evaluations. The development of learning objects is something engineering faculty often engage in for personal satisfaction, and not because they expect this contribution to be recognized in the promotion and tenure process. The development of learning objects is undervalued in professional evaluations at least partially because committees are unsure how to evaluate their quality, their contribution to student learning in the author’s course or in the broader discipline community, or their potential to enhance the reputation of the author and the institution.

If you are already developing learning objects to improve your teaching, add them to the MERLOT collection. Use the peer review to document the quality of your contribution. Use the fact that others link to it or add it to their personal collections to document its impact in the discipline community. MERLOT may make it possible to get some professional credit for this professional contribution.

Joining the MERLOT Community

To join the MERLOT community, visit www.merlot.org and click on the membership link. You will be asked to fill out a short form with your contact information, discipline, and interests.

If you have developed or discovered online learning objects, click on the contribute material link and add them to MERLOT. When you use something successfully, take a few minutes to post your assignment for that object. When you find or adapt something for your own use, it takes only a couple of extra minutes to make it available to all engineering educators.

Consider writing a formal review for an object you have found and like. Contact any member of the editorial board; you can find us by following the Communities link from the MERLOT homepage. Reviewing a learning object is typically less painful than reviewing a research paper or proposal, because there is rarely a need to dig in the literature. We will assign an experienced reviewer to work with you. No need to commit to a large number of reviews; every one is a help.

MERLOT will only be valuable as a teaching and learning resource if it continues to grow by members joining, contributing material, and acting as peer reviewers. MERLOT is a new resource for the engineering education community that we would like to see expand rapidly. The MERLOT Engineering Editorial Board would be pleased to see a large number of new engineering educators benefit from and contribute to the MERLOT community.