A Tool for Online Mechanics Learning Resource Sharing

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***Abstract**: Many hours and dollars have been spent developing new resources to improve learning outcomes in engineering mechanics courses. While many of these have been developed into packaged learning systems, available for purchase by other universities, a large proportion are available free of charge for students looking to expand their study options. Over the past eighteen months, a group of engineering academics, through Australian Learning and Teaching Council funding, has been working to develop a way of guiding students towards these online engineering mechanics learning resources.*

One of the outcomes of this work is an online, database-driven directory of existing online learning resources which are free for students to use in independent study. The database guides students towards resources through a range of search criteria that resources have each been evaluated on, including: Depth of topic coverage; suitable study patterns; appropriate learner level; learning styles, etc. This paper details the development, features, and intended uses of the database. It presents a plan for researching the effect that guided access to additional online learning resources has on perceptions of learning in first year engineering mechanics courses. The authors also extend an invitation to other educators to contribute to the system and promote its use to students in their classes.

Introduction

The issue of high fail rates in first year engineering mechanics courses, is one that has troubled many over the years. On going research into this issue has set out to uncover the root causes of low pass rates. The result is not, as it was hoped, a series of key concepts or skills that were holding students back. Nor was it necessarily students' academic background, although this can have some effect

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(Thomas, Henderson, & Goldfinch, 2009). An in depth analysis of students revealed that common errors tend to vary between different institutions, while qualitative research also revealed that perceptions of problem topics are inconsistent between different lecturers and students. The issue of high fail rates then, seems to be associated with the complexity of influencing factors related to content, academic background, the classroom, or life outside the university setting. This complexity means it is nearly impossible for a lecturer or tutor to cater for all the different learning support needs of students. Many academics have tried though…

Investigating this issue, Hadgraft (2007) identified numerous online learning resources and argued that these resources should be better utilised by other engineering academics. During a review of literature surrounding student learning in engineering mechanics, Goldfinch et al (2008) found that a number of these online resources were evaluated in terms of student engagement and learning outcomes, with positive results. Development of online learning resources is also continually evolving and expanding (Prusty, Ho, & Ho, 2009). The issue then, is not of the availability of resources to support leanring, nor is it of the cost of online learning resources. The issue is how do we connect students and academics with the available resources? And how do we help students in particular, find resources that are suited to their study needs?

A Database of Resources

A list of comprehensive online mechanics learning resources is currently available through the AAEE-Scholar Wiki (Hadgraft, 2010). In addition to the more complete, online course style resources, creation of brief, topic specific learning resources has also gained some momentum (Porter, Baharun, & Algarni, 2009). A 2009 thesis study at the University of Wollongong resulted in the creation and evaluation of a set of Tablet PC based tutorial videos in vector analysis of static problems, with some positive results (Burrows, 2009). Adding many brief, single topic resources to a list of recommended resources, as is done by Hadgraft (2010), will rapidly turn the list into an unwieldy monster. As a result the effectiveness of the resource list could be impacted as the variety of options becomes daunting for students and academics alike.

To allow the inclusion of numerous small resources, a database driven approach is warranted. With this conclusion drawn, attention turned to how to set up the database. With so many different resources available, it was necessary to develop a method of evaluating and summarizing the content and format of resources. A similar online database of learning resources, merlot.org, uses a very simple set of metadata to categorise resources: general technical information, a resource summary, author details, target audience etc. Resources on this site are also organized into study discipline areas (MERLOT, 2009). Since the resource database being developed was to focus on only one area of study, the decision was made to include a greater level of detail in the resource evaluation criteria. The evaluation criteria for learnmechanics.org are described in Table 1.

Once the resource evaluation method had been established, a custom made online database was developed around the evaluation method. The result is learnmechanics.org, a free to use, searchable directory of online learning resources that focus on typical content from first and second year engineering mechanics courses. The site doesn't actually host learning resources, it has been set up to direct users to resources hosted elsewhere on web. The decision not to host resources has been made for a number of reasons. Firstly there are the obvious copyright restrictions. In some cases, even if the author wishes to have their resources hosted elsewhere, intellectual property rights held by the authors institution can restrict this. Secondly, leaving the location of the resource s the responsibility of it's original author allows the author to easily maintain control of the resources. Occasionally this will result in dead links within learnmechanics.org, however, this is a small inconvenience for the administrators of learnmechanics.org compared to the difficulties of hosting resources within the site. Thirdly, it is intended that learnmechancis.org will be maintained by a community of engineering educators with minimal funding available. By not hosting large files, term server hardware requirements are minimised, and thus, cost.

The site does require users to sign up and log in before they can start using it (Figure 1). The purpose of this is primarily so that it is possible to monitor what sorts of users are utilising the site, how many

people using it, and whether or not people visit repeatedly. How this data will be used is described later on in the paper.

Table 1 Summarised learning resource evaluation criteria

Criterion	*Purpose*
Topics covered	Basic list of topics contained in the resource to simplify searches
Depth of coverage	Very detailed resources are great for beginners, but can be tedious for more advanced students, just as topics that rely on assumed knowledge can be useless for beginners. Three levels were included for this criterion: Focus topics + detailed coverage of fundamentals; Focus topics + coverage of some fundamentals; Focus topics only.
Learning styles catered for	This criterion is based on the learning styles framework by Felder and Silverman(1988). The purpose of including this is to help academics to refer students to a variety of resources in terms of the learning styles they cater for, or for particularly motivated students to ensure diversity in the resources they select.
Type of knowledge emphasized	Some resources are developed purely for conceptual understanding, others are focused more on procedures for problem solving, while many aim for a balance between the two. Three options were considered here: Procedural knowledge, conceptual knowledge, or a combination of the two.
Suitable study patterns	This criterion identifies what study context resources are more suited to: independent study, group/peer assisted study, or lecture/tutorial materials for in class use.
Appropriate learner level	Identifies what level of competence students need to make use of the resource. Students wrestling with understanding basic concepts will be looking for different material to students who think they understand the concept and are looking to test their understanding. From this perspective the resources were classified according to five levels: pre-university, just starting the topic, practicing/reinforcing class work, revising, or advanced.
Feedback given	Feedback provided by resources tends to vary in detail, while non-interactive resources, such as video tutorials, give no feedback at all.
External review	This section identifies whether or not resources have been the subject of some form of peer review process or not. Many of the resources available have been the subject of research with associated peer reviewed publications. This can help academics decide whether or not to seek permission to include resources in their course materials, or to recommend them to students.

There are two search functions on the site. A basic search can be seen after users log in, and is intended for looking up resources that users are already aware of. For example, if a student knows the name or author of a resource recommended by a peer, they can simply search for either of these and find the resource quickly. For users looking for new resources, there is an advanced search option (Figure 2). This advanced search option allows students to just search for a particular topic area, or they refine the search with a range of criteria adapted from the evaluation criteria in table 1. Search results are listed in order of relevance, with resource name, authors, and a brief description displayed.

As an alternative to searching, all resources are displayed by default, allowing users to simply browse through the list instead.

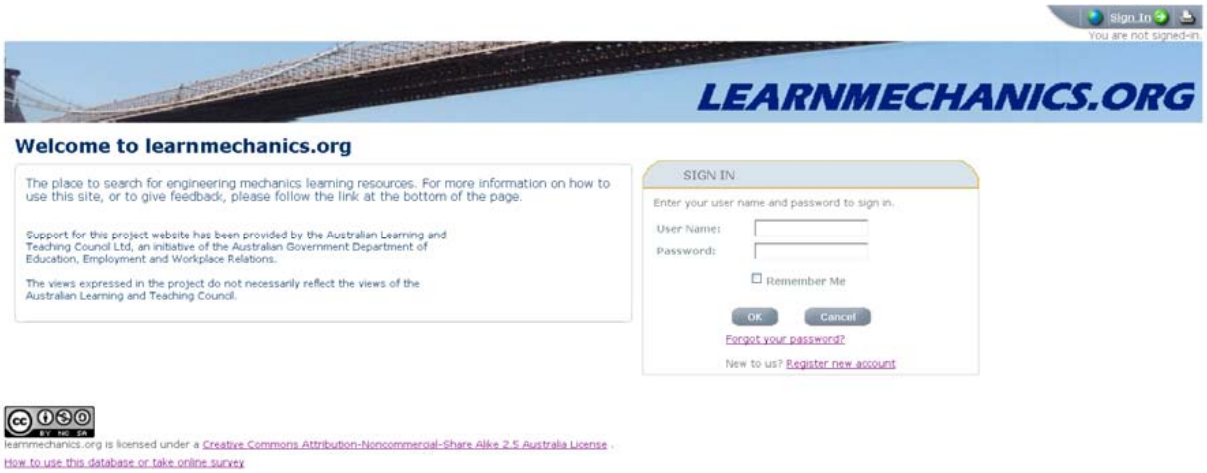

Figure 1 learnmechanics.org welcome and login screen

Figure 2 Advanced search screenshot

Selecting Resources for Inclusion

Decisions on what mechanics learning resources to include on learnmechanics.org have been made so as to encourage students to keep using the site, and avoiding including anything that may discourage them. There are three main aspects considered here:

1. Does it cost? Online learning resources have been selected for inclusion in the database in the basis that they are available for students to use in independent study free of charge. Students are unlikely to continue using the database if they are repeatedly required to pay money for resource access.
2. User friendliness. Resources that can be understood through trial and error or very brief instructions have been prioritized as these resources are likely to be more appealing to students who are going out of their way to investigate new learning options (Feiertag & Berge, 2008).
3. Duration. A number of university lecturers currently post entire lectures online. While some students may find these lectures useful, the authors are wary that few students will be willing to watch a 60 minute video clip online for both time and download limit reasons. Initially, only video resources under 10 minutes will be included.

Promoting Use of Learnmechanics.org

Learnmechanics.org is a public site so anyone wishing to utilize the site is welcome to do so. However, in the interests of gaining a greater understanding of how to promote the use of alternative learning resources to students the authors are proposing two approaches for the promotion and use of the database. A staff led approach and a student led approach. Staff led implementation will incorporate a number of formal and informal channels for academics to promote the use of alternative online learning resources to students. Subject coordinators can use learnmechanics.org to identify online learning resources relevant to the topics of study each week and recommend them to students directly as extra study activities. Reference to Learnmechanics.org will also be included in the subject outline which is distributed in the first week of session. Informally, Subject discussion spaces on eLearning will be used to promote both individual resources and the learnmechanics.org site to help students with the problems they are experiencing.

In the student lead approach, lecturers can direct students to learnmechanics.org to find relevant resources themselves. This approach requires a great deal more independence on the part of the students, and less input from academics. It also relies on informal student study networks to share online learning resources discovered through the site. It is often argued to the authors that students will not make use of this if there is no formal requirement to do so. This may be true of many and large scale usage of the site is not expected initially, however, there will still be a number of students who will utilize it. The primary purpose of the student lead implementation is for research. Evaluation methods described in the next section of this paper aim to seek out students who have and have not made use of the site and understand some of the motivational factors behind this behaviour.

Evaluation Methods

Evaluation of the database will investigate the uptake of the database by students and academics, which resources appear to be the most popular, and the ways in which students make use of alternative online learning resources. Uptake and use of the database can be monitored through the tracking functions available in the resource database. This functionality enables the authors to see how many users are active on learmechanics.org and how many different resources have been searched. The tracking also contains some demographic data such as age, gender, and whether the user is a student (undergraduate, postgraduate, or high school), tutor, lecturer, or just somebody interested in mechanics. From this data it will be possible to determine whether, for instance, undergraduate students are looking for different resources to lecturers, or if mature age students look for different resources to school leavers. Along with this information it is also possible to identify which resources are most popular overall.

A more detailed evaluation will be undertaken to look into what makes students more likely to seek alternative learning resources. Research questions include: What would encourage students to make use of this resource? Does a large array of online learning resources change students' perception of what would be useful? Does access to other resources make students more critical of how content is currently delivered within the subject? These questions will be investigated initially through recorded interview research with students during study sessions utilising learnmechanics.org. Emergent themes from this work will be fed into a larger scale quantitative survey to establish a more concrete assessment of the factors influencing students' inclination to look outside their core course materials.

Throughout this evaluation, feedback on the site itself will be compiled. Learnmechanics.org is currently very much at version one, and it is anticipated that through research and use it will be possible to make improvements and expand the sites functionality in the future.

Discussion

Management of learnmechanics.org, and the uploading of learning resource references will be undertaken initially by the authors. It is hoped that as other academics become familiar with the site and the work of like minded engineering educators around the world, interest in creating and sharing resources will grow. The intention is also to contribute to the work of Hadgraft (2010) in setting up a community of practice of engineering mechanics educators, to share experiences and good practice, organise workshops and seminars, and generally to ease the challenge of teaching this difficult subject

area. The addition of new online learning resources will be ongoing as new resources come to light. The authors would like to extend an open invitation to interested engineering educators who would like to promote the site to students, or have their learning resources added to the site.

Conclusion

Managing the complex learning needs of large first year engineering mechanics subjects is a difficult prospect. What has been presented here is a tool for finding suitable online learning resources among the many that have been created and made available for students to use. Promoting the use of alternative online learning resources to students, and even uninterested teaching staff, will be a challenge. Through further research and evaluation, the authors hope to better understand how to encourage students to be more proactive in their approach to study, and more aware of what works for them and what doesn't.

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