Utilizing web tools for engineering projects and report writing

Abd Rahman Dullah[1], Faiz Redza Ramli[1], Mohd Azman Abdullah[1], Shafizal Mat[1], Asmida Ismail[2], Shamsul Anuar Shamsudin[1,*]

[1)] Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka (UTeM), Technology Campus, 75450 Ayer Keroh, Melaka, Malaysia
[2)] Faculty of Applied Communication, Multimedia University, Jalan Ayer Keroh Lama, 75450 Bukit Beruang, Melaka, Malaysia

[*]Corresponding e-mail: shamanuar@utem.edu.my

Keywords: Mechanical; machine; design

ABSTRACT – The emergence of online learning is late to be picked up in engineering education in Malaysia. However, with the pandemic situation, engineering learning centers are forced to adapt to more online training to continue operating. This project will look into the development of our online tool based on a website that students can use to assist learning especially. There would be various equations, tables, and online calculators that they could use in learning as well as verifying their work. Hence, this would be a beneficial tool not only during this pandemic time but also after it.

1. INTRODUCTION

Mobile learning is the acquisition of knowledge, attitude, and skill by taking advantage of mobile technologies at any time and place. Mobile learning is a kind of learning that uses mobile technologies to create a learning environment [1-5] regardless of the time and place. Mobile learning is expected to increase the capacity for applied learning, especially to deliver learning. Mobile learning can improve the quality of learning activities by assisting the process of note-taking and presentation support materials, formative assessment materials, simulation, and problem-solving processes. Therefore, mobile learning is very effective and has a very significant impact on the development of education in Malaysia.

Several platforms were used to support mobile learning. The mobile learning at the Universiti Teknikal Malaysia Melaka (UTeM) is supported by the learning management system (LMS) known as ULearn that is compatible with smartphones. It allows the student to access course materials, such as lecture notes, assignments, and quizzes from the comfort of their home using computers, tablets, and smartphones and in campus Wi-Fi services plus the compatibility of smartphones used among the students.

UTeM is a TVET institution that provides formal and non-formal training to the students. A variety of methods and approaches are used to ensure effective teaching and learning activities. Currently, due to the COVID 19 pandemic, face-to-face teaching, and learning activities are restricted, and being replaced by either synchronous or asynchronous lectures is becoming a new norm. Due to the technological restraints, the lectures period at some faculty were reduced. This further reduces the level of knowledge sharing between the lecturer and the students. The acceptance of this new norm is yet to be studied.

The technical courses involve courses with many chapters to be covered and involve complex engineering problems that required lengthy calculations to be discussed. Some of the chapters serve as a prerequisite for future courses for example most of the elements in the Mechanical Design course BMCG3333 are to be applied in the Integrated Design Project BMCU3013 course. Due to that reason, selective lecture and exercises on some chapter is not a good solution at limited time. Alternatively, web-based or apps can ease and expedite students' understanding.

However, providing mobile learning platform may defeat the purpose if it is not accepted by the students. Previous studies have highlighted that the success of mobile learning implementation in universities varies and depends on many factors. These include the perceived usefulness (PU), the perceived ease of use (PEOU) [1,6,7], social influences [8], and facilitation conditions [9,10]. Hamidi and Chavoshi [1] classified the acceptance of mobile learning into four categories; pedagogical, technological, social, and individual acceptance. Therefore, it is necessary to explore the related factors that need to be considered during the development of mobile learning.

However, providing mobile learning platform may defeat the purpose if it is not accepted by the students. One of the principal elements of successful M-learning application development is user acceptance. Therefore, it is necessary to explore the related factors that need to be considered during the development of m-learning applications [7,8]. Mobile learning acceptance can be divided into four categories; pedagogical, technological, social, and individual acceptance.

Banday, Musayir and Jan [11] reported that the implementation of e-learning and computer-based engineering tools was still low in developing countries. Tawil et al. [12] studied the perceived importance of e-learning by the student of engineering mathematics which was still low then. However, by 2018, another study in Malaysia found a positive attitude towards the use of the e-learning approach in engineering education [13]. The Covid-19 pandemic has further expedited the acceptance of electronic and online teaching and learning in university studies including engineering education [14].

Engineering education, as well as real practice, could benefit tremendously from the use of online

engineering calculators. Usually, they are focused on certain topics like beam mechanics, material characteristics, Mohr's circle and principal stresses calculations, and the like. Nevertheless, there is Amesweb.info that has been most of these topics with online calculators in one website that can be used for free. Another such site is Engineersedge.com that has free and paid premium sections. Consequently, some gaps could be found that serve the needs of engineering students in Malaysia.

2. PLAN OF ACTION

The COVID-19 has shown that online learning is potentially the future in engineering education. Hence there are still many aspects that need to be improved and catered for Malaysian engineering education. Overseas sites seem to be following predominantly ASME standards with a lot of imperial units like inches in use. Hence, a localized version is needed that would help the teaching and learning of engineering more fun and easier.

The objectives of this work are as follows.

1) To investigate the acceptance of online tools in engineering education,
2) To assess the effectiveness of the current website and tools, and
3) To develop our own website that provides online tools and calculators for engineering purposes.

Implementing this work will take several phases. Phase 1 will include investigating the correlation between mobile learning and student performance in BMCG3333 Mechanical Design course and BMCU3013 Integrated Design Project (IDP) course. Other courses like Diploma Project and Engineering Design can benefit from the same portal too. This activity might consume a span of three months to complete. In this phase, the team will conduct an online survey and interviews with past and current students on the effectiveness of teaching and learning of the Mechanical Design class and IDP.

Comparison in achievement between students that use mobile learning and traditional learning will be measured in the first week of the semester. Formulation of the Mohr circle will be used as a case study for both subjects and the cognitive, affective, and psychomotor feedbacks techniques will be applied.

Consequently, the content for both courses will be reviewed based on the past Continuous Quality Improvement (CQI) practice. Next, the team will publish course modules with contents that are suitable for both courses. In the meantime, several mobile learning solutions used by other universities will be benchmarked. Phase 2 would include producing new modules that can integrate with mobile learning solutions. All formulae and contents from current modules of BMCG3333 and BMCU3013 will be gathered and they will be inserted into MS Excel spreadsheet. The new modules will be written with additional contents as indicated in Table 1 from all lecturers' past research and teaching.

CAD drawings and animations for mobile learning will be prepared using SolidWorks software. Virtual teaching on important and difficult topics will also be prepared. Web platform and apps platform will be designed and the integration of modules contents and mobile learning will be developed using *Javascript* and *Wix*.

Table 1 Module chapters.

Chapters	Topics
1	Static and Fatigue Stresses
2	Planar Kinematics – Position Analysis
3	Fasteners, Screws, and Joints
4	Gyroscopes – Applications in Robotics and Vehicles.
5	Shafts and Bearings – Design and Balancing
6	Belts, Chains, and Gears
7	Mechanical Springs

In senior year, the student will have to write a lot of term papers and project reports. Some reports are actually thesis in its format where there are chapters involved instead of sections. In the past few years, the quality of reports has become poorer especially if there are no strict guidelines or templates provided. This is unfortunate since the student was expected to have passed the English technical writing course prior to becoming seniors. Figure 1 from a recent survey supports that the majority expected extensive training on technical writing again during the advanced engineering classes they are taking.

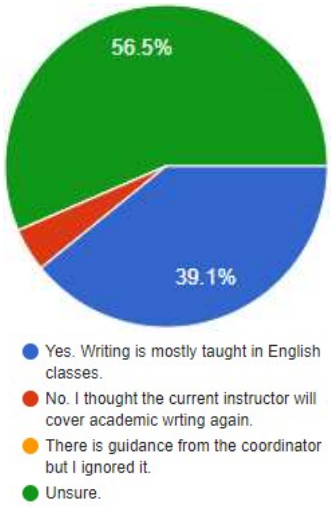

Figure 1 Students views on report writing training

Therefore, in developing the resource website, report and thesis writing samples, templates, guidance, and commonly asked solutions should be included. Currently, these are available from various sites. Consequently, our effort would provide our best suggestion links for specific details students are working on, either calculation, graphing, or writing.

3. STATE-OF-THE-ART IN ENGINEERING WEBSITES

As mentioned earlier, the concept of the portal website provides online calculators that would solve

certain variables. The basic ones that are commonly used by senior students in their analysis would include Mohr's circles, shear and bending diagrams, stress concentration factors, cross-sectional properties, as well as various material properties. These are used by working engineers too if they are designing the details of their projects.

Amesweb.info seems to host most of the items mentioned above for free. There are similar sites such as Beamguru.com, Engineersedge.com, Optimalbeam.com, and Skyciv.com. Nevertheless, these provide limited-time free access. Some have feature limitations such as units in US customary or imperial only. Figure 2 exhibits the input and output of a beam problem. General physics-related problems like dynamics can be solved using apps at omnicalculator.com.

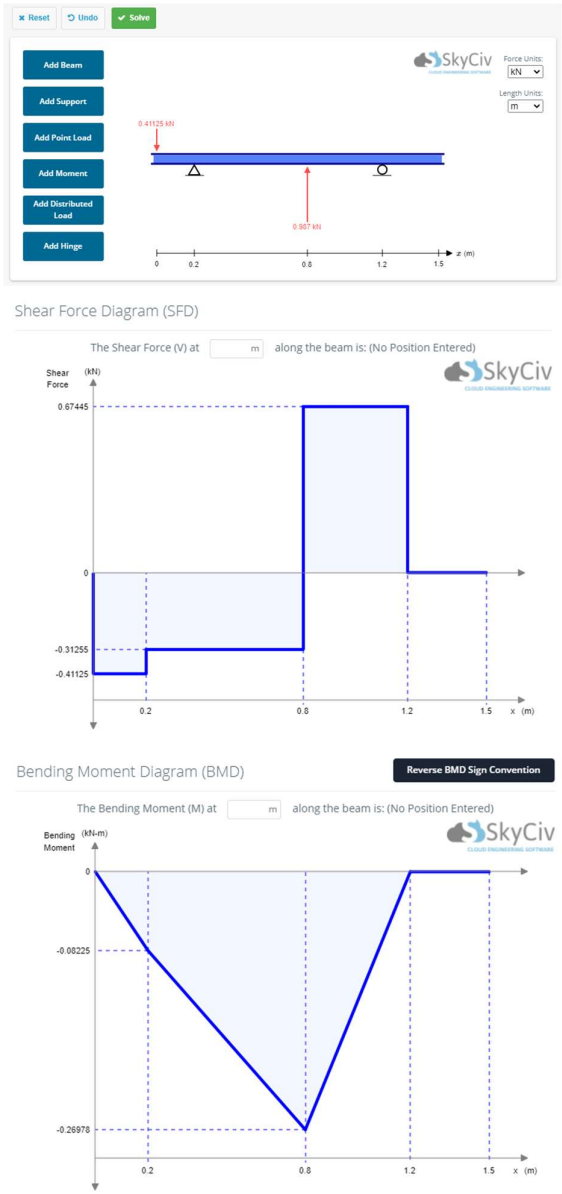

Figure 2 Pictures of beam calculator from skyciv.com.

The paid version of some of these sites can also provide the hand calculations for the values that they produce. Hence, in developing our engineering analysis site, this also needs to be included where possible, as part of the education and validation of work. Take the planar linkage kinematic problem in Figure 3 for instance. The developed system can deliver the answers for θ_3 and θ_4 but instead of just that, the system shows Equations (1) through (4) that lead to those answers as well. This way, in spare time, the users can follow the solution and verify them, which is part of the education here.

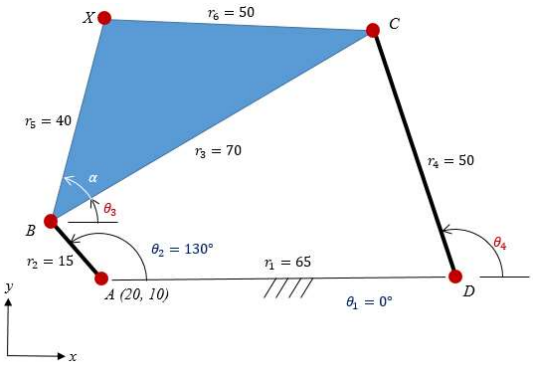

Figure 3 A planar linkage kinematic problem

$$BD = \sqrt{{r_1}^2 + {r_2}^2 - 2r_1 r_2 \cos(\theta_2 - \theta_1)} \quad (1)$$

$$\gamma = \cos^{-1}\left[\frac{{r_3}^2 + {r_4}^2 - BD^2}{2r_3 r_4}\right] \quad (2)$$

$$\theta_3 = 2\tan^{-1}\left[\frac{-r_2 \sin(\theta_2 - \theta_1) + r_4 \sin\gamma}{r_1 + r_3 - r_2 \cos(\theta_2 - \theta_1) - r_4 \cos\gamma}\right] + \theta_1 \quad (3)$$

$$\theta_4 = 2\tan^{-1}\left[\frac{r_2 \sin(\theta_2 - \theta_1) - r_3 \sin\gamma}{r_4 - r_1 + r_2 \cos(\theta_2 - \theta_1) - r_3 \cos\gamma}\right] + \theta_1 \quad (4)$$

The report and thesis writing part can be a little tricky because although the fundamentals are the same, specific settings and requirements may be different from one course to another. Hence, this part is going to include general guidelines of good technical writing, common word choices in abstract, introduction, procedure, result discussion, and conclusion. There will also be MS Word templates to choose from as well as for instructions on how to change them.

One of the parts that confuse a lot of students is the citation and reference styles. There are so many of the established styles like APA, AMA, Turabian, Chicago, and IEEE, to name a few. To make things worse, there are many in-house styles that mix some of the known styles to create new styles. There is some feature to help with this in MS Word. However, it is limited to some fixed styles only. It is hard to customize another style. Hence, this site should include online solutions such as Mendeley web and an extensive tutorial and videos on how to use it successfully. A Google Form survey in Figure 4 participated by UTeM undergraduate and graduate students shows that about 22% out of the 23 respondents are not aware of the various styles for citation and references as an element in technical writing. Even about 44% of them need to refer to some examples or guidance in order to use the styles correctly.

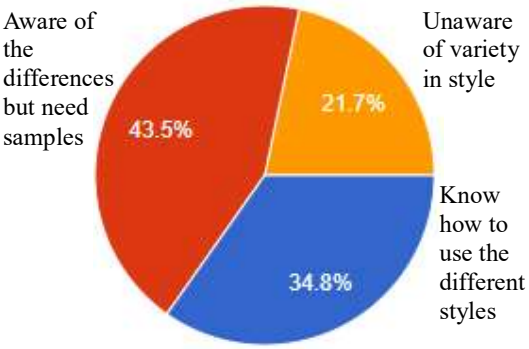

Figure 4 Student awareness on the different styles in citation and references.

Besides using MS Word, another unconventional tool can also be included in this educational website. This shall cover samples and tutorials on LaTeX (pronounced LAH-TEK or LAY-TEK), which is an open-source text preparation software. The compiler is provided by many parties, some are free, while some are paid versions. There is a desktop type that you may download, and there is also a web version that can be just as good. Usually, the output will be in PDF while the input part looks more like a programming code, unlike in MS Word. However, the software can be set the format exactly how we want it to look and it is unlikely to change unintentionally. Figure 6 shows a picture from Overleaf.com in LaTeX.

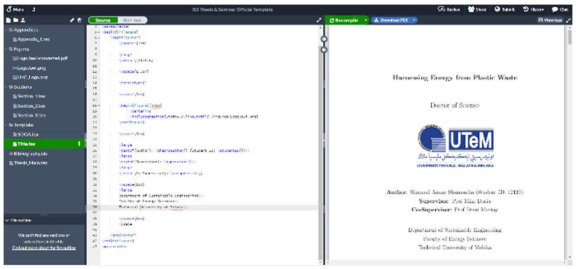

Figure 6 Using a LaTeX thesis template at overleaf.com with the PDF on the right

4. SUMMARY

In conclusion, it is very useful to have a new website that would cater to the needs for some basic engineering analysis and revision as well as for writing assistance in technical reports and thesis preparation. Moreover, the site that hosts all these features should be accessible to anybody from anywhere for free.

5. ACKNOWLEDGMENT

The authors would like to thank the management of UTeM and Multimedia University for their support.

REFERENCES

[1] Hamidi, H. & Chavoshi, A. (2018). Analysis of the essential factors for the adoption of mobile learning in higher education: A case study of students of the University of Technology, *Telematics and Informatics* https://doi.org/10.1016/j.tele.2017.09.016.

[2] Chavoshi, A., & Hamidi H. (2019). Social, individual, technological and pedagogical factors influencing mobile learning acceptance in higher education: A case from Iran, *Telematics and Informatics 38*. https://doi.org/10.1016/j.tele.2018.09.007.

[3] Yousafzai, A., Chang, V., Gani, A., & Noor, R. M. (2016). Multimedia augmented m-learning: issues, trends and open challenges. *International Journal of Information Manage*ment *36(5)*. https://doi.org/10.1016/j.ijinfomgt.2016.05.010.

[4] Yeap, J. A. L., Ramayah, T., & Soto-Acosta, P. (2016). Factors propelling the adoption of m-learning among students in higher education. *Electronic Markets 26(4)*, 323–338.

[5] Tan, G. W. H., Ooi, K. B., Leong, L. Y., & Lin, B. (2014). Predicting the drivers of behavioural intention to use mobile learning: a hybrid SEM-Neural Networks approach. *Computers in Human Behav*ior *36*. https://doi.org/10.1016/j.chb.2014.03.052.

[6] Briz-Ponce, L., Pereira, A., Carvalho, L., Juanes-Méndez, J. A., & García-Peñalvo, F. J. (2017). Learning with mobile technologies–students' behavior. *Computers in Human Behavior* https://doi.org/10.1016/j.chb.2016.05.027.

[7] Althunibat, A. (2015). Determining the factors influencing students' intention to use m-learning in Jordan higher education. *Computers in Human Behav*ior *52*, 65–71. https://doi.org/10.1016/j.chb.2015.05.046

[8] Mohammadi, H. (2015). Social and individual antecedents of m-learning adoption in Iran. *Computers in Human Behavior* https://doi.org/10.1016/j.chb.2015.03.006

[9] Al-Adwan, A. S., Al-Madadha, A., & Zvirzdinaite, Z, (2018). Modeling students' readiness to adopt mobile learning in higher education: an empirical study. *International Review of Research in Open and Distributed Learn*ing. *19(1)*. https://doi.org/10.19173/irrodl.v19i1.3256.

[10] García Botero, G., Questier, F., Cincinnato, S., He, T., & Zhu, C. (2018). Acceptance and usage of mobile assisted language learning by higher education students. *Journal of Computing in Higher Education* https://doi.org/10.1007/s12528-018-9177-1.

[11] Banday, M. T. Musavir, A., & Jan, T. R. (2014). Applications of e-Learning in engineering education: A case study. *Procedia Social and Behavioral Sciences 123*, 406 – 413.

[12] Tawil, N. M. et al. (2012). The acceptance of e-learning in engineering mathematics in enhancing engineering education. *Journal of Engineering and Applied Sciences 7(3)*, 279 – 284.

[13] Al-Rahmi, W. M. et al. (2018). Use of E-Learning by University Students in Malaysian Higher Educational Institutions: A Case in Universiti Teknologi Malaysia. *IEEE Access 6*, 14268 – 14276.

[14] Rafidi, R. (2020). Address e-learning challenges, students urge. Retrieved from https://www.nst.com.my/education/2020/06/603056/address-e-learning-challenges-students-urge

