

## Learning by Design Using MATLAB

Maysoun M. Ababneh<sup>1</sup>, Mutaz A. Ababneh<sup>2</sup>, Ali Hamouda<sup>2</sup> and AbdulRahman N. AlHarbi<sup>3</sup>

<sup>1</sup>Yarmouk University- PHD Candidate,<sup>2</sup> Interserve Learning & Employment International, <sup>3</sup>  
Madinah College of Technology

**Abstract.** This paper describes the use of Learning by Design (LbD) as an innovative approach to teaching and learning where students decide their own learning and are allowed to show what they have learned. By this approach, students can tailor their own education. The study utilizes a MATLAB – based graphical user interface (GUI). By this means, learning outcomes can be improved, teachers’ workload can be reduced, and students will be more engaged and motivated via LbD. The study describes how LbD and MATLAB transform a course from the traditional lecture-based format to a Technology Enhanced Learning (TEL) format. It also shows how Blended Learning (BL) is used in the Madinah College of Technology (MCT) in teaching binary arithmetic and logic circuits. This process starts by instructing students on how to use MATLAB along with assigning videos for them to watch and analyze. Additional discussions ranging from basic to complex topics will be provided during lab class. Furthermore, students will be allowed to practice MATLAB during the lab class. Student learning will be assessed at the end of the lab class using MATLAB. Later, assignments will be given to students via Blackboard to complete.

**Keywords:** MATLAB, Learning by Design(LbD), Technology Enhanced Learning (TEL), Student Engagement.

### 1 Introduction

There are some benefits of LbD. It ensures better management of class time where all class activities are effectively covered. In addition, it ensures more engagement on the part of students. Furthermore, by this approach students can design what they study and show what they have learned [1].

Using digital platforms in teaching computing is widening the scope of education and diversifying solutions for many computational problems. These digital platforms benefit both students and teachers. Today, the use of TEL is common in computing classes as opposed to the status two decades ago. In addition, many educational institutions strongly encourage the use of TEL which has resulted in adopting a Blended Learning approach in teaching computing. [8].

By combining traditional face to face class room with technology enhanced tools, students’ thinking skills are improved, innovative opportunities are explored and practical applications are tackled [4, 6, 7, 8]. By applying BL in the classroom setting, collaborative content can be presented to learners [3, 4, 7, 8,9,11].

This paper further explores the computing lessons being taught using the LbD approach within BL at the MCT in the kingdom of Saudi Arabia. Particularly, this paper describes how the MATLAB [10] is being used to design and teach concepts in computing.

## 2 Traditional Teaching and Learning Vs Blended Learning (Learning by Design)

In traditional teaching and learning, the teacher needs to communicate and demonstrate content to learners, while learners listen and communicate back with the teacher.

A major drawback in this approach is that Teacher Talking Time (TTT) is maximized and Student Talking Time (STT) is minimized resulting in poor student engagement in the teaching and learning process. Besides, student motivation and creativity are reduced to the minimum. Another drawback is that traditional teaching and learning lacks flexibility in terms of class time, day, and place as teachers and learners are to be present per the required schedule. Moreover, attending to the individual needs of students is limited due to the need for attending to the whole class [2].

On the other hand, using Technology Enhanced Learning including Blended Learning reduces the amount of TTT and maximizes STT. It also enhances student engagement and creativity. In addition, it overcomes the limitations of class time, day and place in that learning can take pace anytime and anywhere [2,4,7,9,11]. Attending to students' individual concerns and needs is maximized. It is worth mentioning that Blended Learning creates two types of learning environments which are physical class room and online learning [6,9,11].

Learning by Design is built around the idea of reflection in teaching and learning which enhances students' learning. This also helps teachers in their teaching and learning practice as show in Fig. 1 Kolb Learning Cycle [5]. This cycle can be used as a basis to design lessons and activities via Learning by Design.

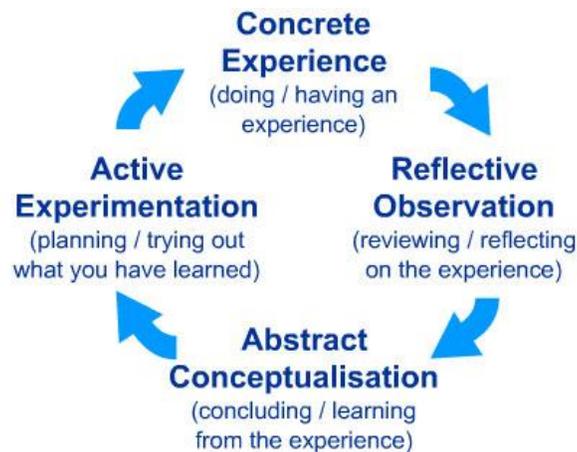


Fig. 1. Kolb Learning Cycle [5].

## 3 Methodology

This section shows how MATLAB was used in teaching concepts related to binary arithmetic and logic circuits in the Computer Technology Department at the MCT. This is done by using a set of designed examples. Compared to the traditional approach where only a few basic computing problems can be discussed and solved by students, Learning by Design enables students to work

with and solve more complicated and advanced computing problems. Learning by Design utilizes the Flipped Learning approach in teaching some computing classes where class instruction is shifted to the individual learners creating a dynamic and interactive learning environment [9].

The process starts with the teacher giving and explaining an example in the lab class. Then, he asks students to apply and implement the example. The teacher checks students' progress while doing the example and assists individual students where needed. During this process, the teacher collects and documents feedback on students' performance for assessment purposes. Immediate feedback is given to students while working on the example. Towards the end of the lab class, the teacher posts a new assignment and supplementary materials using Blackboard for students to do at home [9,11].

### 3.1 Binary Arithmetic

During lab class, an example is given by the teacher to students which is to do conversion from Octal to Hexa, Octal to Decimal and Octal to Binary. This is just a basic experiment which could be more complicated. The experiment is shown below in Fig 2, Fig 3 and Fig 4.

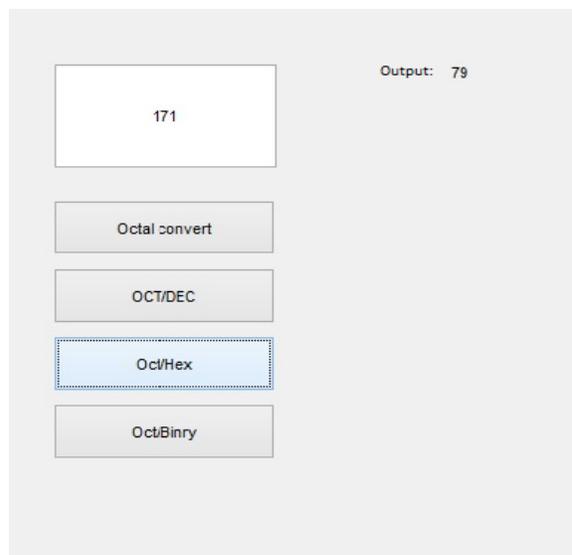


Fig. 2. Converting from Octal to Hexa.

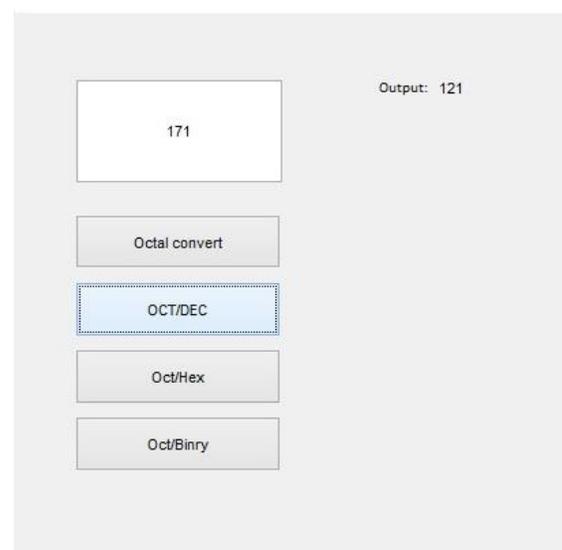
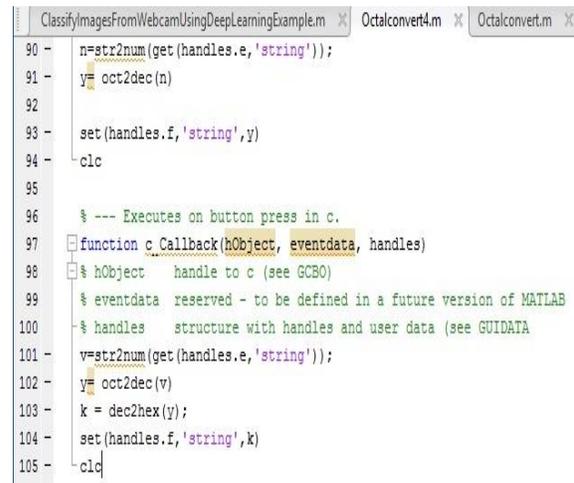


Fig. 3. Converting from Octal to Decimal.



**Fig. 4.** Converting from Octal to Binary.

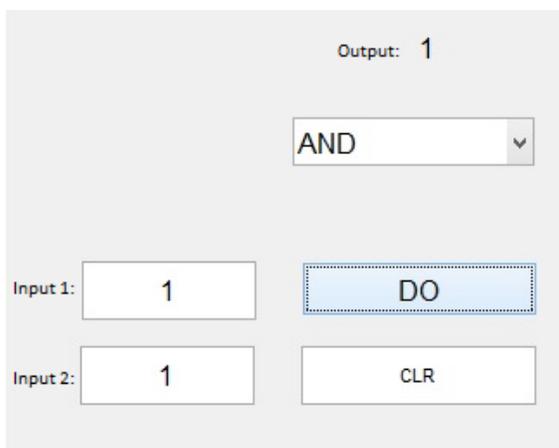


**Fig. 5.** MATLAB code to convert from Octal to Hexa

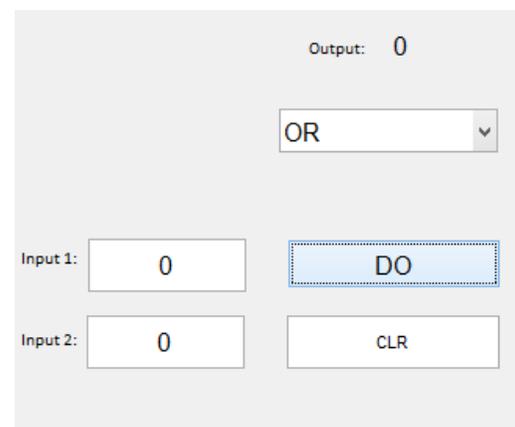
Fig 5. Shows the MATLAB code that was used to convert Octal to Hexa. However, students will learn how to implement the other conversions using other codes with the assistance of the teacher.

### 3.2 Logical Circuits

As a home assignment, the teacher posts a task on Blackboard for students to do prior to the next lab class. The assignment is to design the logic circuits: AND, OR, NAND, NOR and XOR. Fig. 6 and Fig. 7 below show the AND Gate and OR Gate with outputs using MATLAB.



**Fig. 6.** AND Gate.



**Fig.7.** OR Gate.

## 4 Conclusion

By using this approach, MATLAB together with Learning by Design, Teacher Talking Time has been minimized and students have taken more responsibility for their own learning. Moreover, face-to-face contact between the teacher and students has also been reduced. Besides, student engagement and critical thinking have been maximized. The approach of Flipped learning, which is an integral part of Blended learning, has given students ample opportunities to utilize Technology Enhanced Learning a way from the limitations of traditional teaching and learning. Furthermore, class management has become more efficient giving more time to the teacher to attend to learners' individual needs and concerns. It also has enabled the teacher to provide immediate and formative feedback to students on their progress and performance [4,6,9,11]. Overall, by this approach the quality of teaching and learning has been enhanced and students' creative thinking has been improved [5]. To sum up, Technology Enhanced Learning including Learning by Design has proved to be an effective means for knowledge transfer and sharing [5].

## 5 References

- [1] Malo, Roman, Motyčka, Arnošt. "Managing Activities in eLearning Systems". 11<sup>th</sup> International Conference of European University Information Systems. Manchester: University of Manchester, 2005,
- [2] Ashby, J. Sadera, W.A., McNary, S.W. 'Comparing student success between developmental math courses, offered online, blended, and face-to-face', Journal of Interactive Online Learning 10 (3) , 2011.
- [3] USA: John Wiley & Sons Bersin,' *The Blended Learning Book: Best Practices, Proven Methodologies, and Lessons Learned* ', J. 2004.
- [4] Bhatti, A.H., Laigo, G.R., GebreYohannes, H.M. 'Combining Active Learning Technique and Technology in Teaching Mathematics', Proceedings of the 2nd International Conference on Applied Information and Communications Technology. India: Elsevier Publications, 620-624. 2014.
- [5] Davis, C. 'Kolb Learning Cycle Tutorial - Static Version'. Retrieved from [http://www.ldu.leeds.ac.uk/ldu/sddu\\_multimedia/kolb/static\\_version.php](http://www.ldu.leeds.ac.uk/ldu/sddu_multimedia/kolb/static_version.php) ,26 May 2016.
- [6] Hasan, R., Alis, S., Hayat, 'Enhancing student's learning experience at Middle East College by using Blended Learning', Proceedings of the Science and Information Conference 2015. M. (2015).
- [7] Laigo, G.R., Bhatti, A.H., Lakshmi K.P., GebreYohannes, 'Revisiting Geometric Construction using Geogebra', Research Journal of Mathematics and Technology 5 (1), 43-51. H.M. 2016.
- [8] Laigo, G.R. and Zafra, M.A.G. 'Factors Affecting the Use of Blended Learning in Tertiary Mathematics Classes', INTED 2016 Proceedings 10<sup>th</sup> annual International Technology, Education and Development Conference, 6699-6708. 2016.
- [9] Noora Hamdan and Patrick McKnight , ' review of Flipped Learning ', Retrieved from <http://www.flippedlearning.org/> ,26 May 2016 .
- [10] The MathWorks, Inc. 2009. MATLAB 7.9.
- [11] Caulfield, Jay. "How to Design and Teach a Hybrid Course: Achieving Student-Centered Learning Through Blended Classroom",. Sterling, VA: Stylus Publishing. 2011.