

Open Education Resource: An Effective ICT Tool for Engineering Education

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Abstract: Digital Systems can be designed using Hardware Descriptive Languages. Digital System Design is one of core subject for fifth semester students of Electronics and Instrumentation Engineering, Siddaganga Institute of Technology, Tumakuru. Outcome Based Education is the main objective of curriculum. The outcome of course was, at the end of the course students were able to write code in VHDL for any given digital system, simulate on Xilinx CAD tool and Implement on Spartan 3 FPGA kit. To support the students, to enhance the skills and share their work, an Open Education Resource(OER) with name digitalsystemdesignblog at WordPress was created. This platform helps students and teaching community associated with digital system design course. The platform includes blog and pages. The blog gives brief introduction about the course. The pages are dedicated to theory, lab, question bank, students' assignment, videos and Feedback page. All of their work was shared on WordPress platform digitalsystemdesignblog. This covered the maximum examples from the course which was very helpful to students. This Open Education Resources is licensed under Creative Commons licence CC-BY-SA 4.0. The videos created in YouTube are also under Creative Commons license.

So anybody can share, redistribute and modify the work for further improvement. Creating an Open Education Resource for outcome based subject enables new blended teaching methods to be adopted in engineering education. WordPress is the one of the free resource that can be effectively utilized as platform to share the resource at global level. The survey was conducted among the students of fifth semester and they found that videos were very useful. The feedbacks reflected that website can improved with subjective and objective quizzes.

Keywords: Question Bank, OER, Digital System Design, VHDL, Creative Commons License, videos.

1. Introduction

An Outcome Based Education (OBE) will have course outcomes and program educational objectives (Donald Heer et al., 2003). National Board of Accreditation (NBA) has defined Program Outcomes (PO) that has to be met by all programmes in educational institutes. The Course Outcomes (CO) have to match with POs defined by NBA. The OBE brings the systematic teaching learning experience at higher education (Wang Lixun 1, 2010). To meet POs defined by NBA, curriculum has to undergo a lot of changes and should have systematic approach in teaching learning methods. This helps to evaluate institutions based on students' learning. At the end of the course the student will be able to take up any challenges. The OBE is primary concern especially in engineering institutions (A. Masni-Azian and A.

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Rahimah, 2014). The OBE implementation is regarded as performance driven activity. There are two types of COs mapping with POs. One is direct method and other one is segregated method. The direct method is one where CO attainment directly implies PO attainment. In the segregated method each component assessment is mapped to respective CO and POs. The segregated method was most effective as indicated in Table-5 for CO-PO attainment based on segregated measurement. The evaluation will be done mainly on marks obtained by the students. Unlike previous method where each CO need not necessarily have to match the POs, here the subject coordinator has to ensure that the curriculum modified so that the all COs should match the POs. COs of particular subject has to match some of the POs mentioned by the NBA. The programme as whole has to map to all POS. The OBE can be effectively achieved with interactive teaching learning methods (Nesimi Ertugrul, 1998). To have interactive teaching along with the traditional teaching we have to adopt laboratory methods in engineering programmes like electrical, electronics and computer sciences. Practical knowledge of students is increased, which is main aim of OBE. This helps students to solve complex engineering real life problems. The interactive teaching learning can be achieved using learner centric approach, OBE (Shrinivas A. Patil and Saurabh R. Prasad, 2016). The learner centric can be blended learning along with chalk and board method. The new innovative method can be flipped class room activity (M. Sirigiri and S. D. Rajan, 2015). In flipped activity students will be provided with ready material. The ready material may be videos on particular topic, power point presentation or text book chapter. The student has to go through the provided material and come to class. In class room teacher will conduct Think Pair Share (TPS) activity. Student has to individually think about given problem. Then pair with the partner and try to solve the given problem. Share phase is for doubt clarification and exchange of ideas. The use ICT tools also will improve teaching learning methods. The ICT tool can be Gmail, Whats app, videos. The content creation can be through Power Point Presentations (PPT). The PPT can be distributed among the students. The same can be accessed through flipped class room activity. The videos can be created using Screencast-O-Matic software. The videos can be used to share information at global level. There are many open education resources like GitHub, Spoken tutorial, Drupal, Moodlecloud, WordPress and many more. WordPress is user friendly and can be easily implemented.

WordPress is used OER for Digital System Design course. The reasons to choose wordpress over other ICT tools are as shown in Table 1.

Table 1. Comparison of wordpress over other ICT tools

Sl.No	wordpress	Other ICT tools
1	User friendly and does not need any user name and password access only website name is sufficient and can be accessed by anybody around the globe.	Moodle - Need to provide user name and password to access. The enrolled persons can only access particular account.
2	Ease of use and requirement of less technical knowledge to customize wordpress website makes it more popular. Wordpress is upgraded very frequently	Drupal –less themes are available in Drupal. To customize Drupal we need to depend on designer. Drupal is not cost effective
3	Videos, PDFs, word document, and PPTs can be uploaded uploaded on wordpress.	spoken tutorial - Videos with audio narration are uploaded through spoken tutorial

The Digital System Design is the core subject for fifth semester students of Electronics and Instrumentation department at Siddaganga Institute of Technology, Tumakuru. The OBE is followed in the Institute. The Course Objectives have to map with the POs defined by NBA. The redefined COs are very effective. The same can be observed in Table 2. The redefined COs enables the student to have practical knowledge of how digital systems work. The curriculum is redesigned to suit the OBE. In modified curriculum the student will be able to write code for any digital circuit, simulate the same using Xilinx CAD tool and implement on FPGA kit. The outcome is strong programming concept. With strong programming concept student can take up the projects based on VHDL programming.

Table 2. Comparison of earlier CO s with OBE based CO s

Sl.No	Earlier version of CO s	Revised CO s mapping with POs for OBE
1	Design and analyze Arithmetic and Logical circuits using HDL.	Select appropriate coding style to write VHDL code and implement basic combinational circuits to design digital system component using Xylinx tool.
2	Design and analyze Sequential circuits and Memory devices using HDL.	Apply the knowledge of basic mathematics to implement arithmetic operations using VHDL using Xylinx tool.

3	Design and analyze Finite State Machine as control unit for processing.	Use Xilinx tool to implement digital system components on Spartan-3 FPGA.
4	Understand FPGA architecture for efficient Digital system design.	Select appropriate coding style to write VHDL code and implement Finite State Machine as control unit using Xilinx tool.
5	Design digital systems on FPGA for embedded applications.	Select appropriate coding style to write VHDL code and implement data path components to design digital system component Xilinx tool.

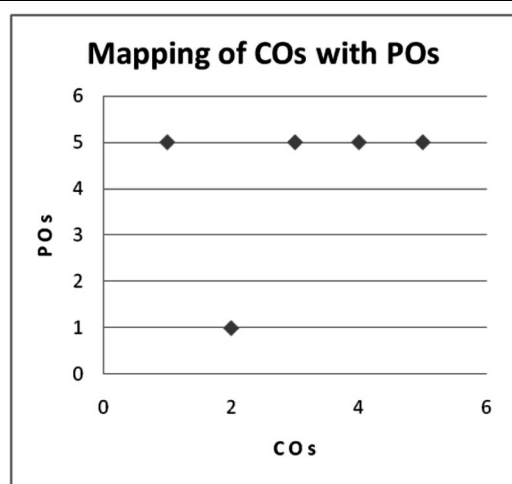


Fig. 1. Mapping of CO s with PO s

Digital circuits can be designed using various descriptions like dataflow, behavioral and structural. VHDL code will be written by selecting any one of the appropriate description. The same should be analyzed and implemented using modern tools. Total of 5 Cos has been defined for digital system design. CO 1,3,4,5 mapped directly with PO 5. The PO5 specifically used to map the subjects which use modern tools, select and apply appropriate techniques. The CO2 mapped directly with PO 1 as shown in Fig 1. Digital System Design cannot map to all the POs. All the subjects, Labs and projects should collectively satisfy the 12 POs (9). The OBE is mainly based on students' performance. So there is need to inculcate new teaching learning methods. The new methods can be blended with traditional methods like chalk and board. All the concepts solely can be taught with neither modern techniques nor traditional methods only. So blended learning is very important. Creating OER will help to adapt to new techniques. The new technique can be creating PPTs, videos, Flipped classroom

activity and many more. OER is nothing but sharing information through digital media. This will help many people who are in financial crisis to have library enormous collection of books. This brings in collaboration of people of same field. Information exchange, resource sharing is main idea behind OER. IIT Bombay conducts FDP on Use of ICT in Education for Online and Blended Learning. This FDP helps to learn creation of videos using screen cast and how to publish videos on YouTube with Creative Commons license. Concept of Flipped activity, OER creation and team collaboration are main objectives of this FDP. After completion of this FDP, the OER for subject Digital System Design was created. The URL of OER is <https://digitalsystemdesignblog.wordpress.com>. The OER is licensed under Creative Commons CC-BY-SA 4.0. So the contents can be reused, modified and distributed. The students and faculties are finding the OER very effective and useful.

2. Key features of OER

The open education resource can be video, PPT, website, whatsapp, email and many more. The OER should be available to all globally. Many educational institutes are not having library with wide range of books. High investment is needed. If we can make resources easily available on internet as open education resource, it will benefit larger section.

A. Videos with Creative Commons

Creating videos is one of the ways to create educational resource. Videos can be created using screen cast. First PPTs are prepared on particular concept. The resource should be free from plagiarism. Once PPTs are prepared, using Screencast-O-Matic software for windows platform, record the audio along with explanation for PPT content. We can upload the same video in YouTube. In YouTube videos can be uploaded with two types of licenses. One is standard YouTube license the other one is Creative Commons license. When a video is uploaded with standard YouTube license, the video cannot be reused without permission. If we create video with Creative Commons license the video can be copied, remix and redistributed. If we creating video as open resource, it should be created with Creative Commons license. As part of creating OER, videos on basics of digital electronics are created. The video on basic gates is created with URL [The video on universal gates was created with the URL](#)

<https://www.youtube.com/watch?v=jRwi6h7Cq44&feature=youtu.be> . The video on Demorgan theorem and Boolean algebra was created with URL <https://www.youtube.com/watch?v=3HbGsMKRQP I&feat.ure=youtu.be>. Multiplexer with URL <https://www.youtube.com/watch?v=mQJOoTkJNs &feature=youtu.be> . The videos can be used for flipped activity in the class room. The videos can be provided to students. The students will watch the videos at home. The same concept can be discussed in class room with Think-Pair-Share (TPS) activity. First information transmission occurs and then assimilation in class room. In think phase students are asked to think individually about the concept. In pair phase, each one should pair with neighbouring student. In share phase all ideas are shared in class room by each pair. Share phase is mainly for clarification and conclusion. The videos are part of innovative teaching method. Visual communication is more effective than audio communication. Digital System design is having Lab associated with theory. In lab VHDL code is written for digital circuits. The code is synthesized and simulated on Xilinx ISE 14.7. The synthesized code is implemented on Spartan 3 FPGA. The video for “how to get started with Xyninx ISE 14.7 and implement on spart 3 FPGA” is uploaded on on YouTube. The URL for the video is https://www.youtube.com/watch?v=J_KvoTIVefw&feature=youtu.be . This video will help anybody who want to get started with Xilinx tool for simulation of digital circuits. Students found it very useful. The steps to create and publish video on YouTube website is as shown in Fig. 2.

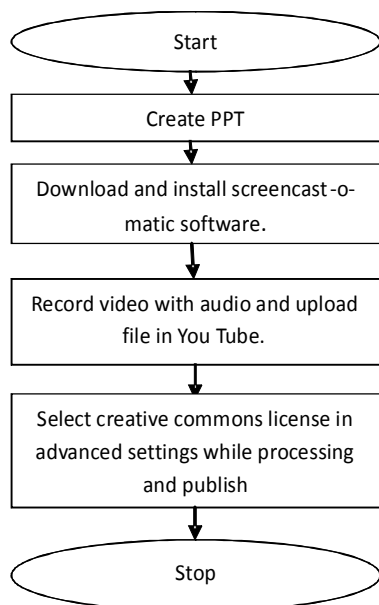


Fig. 2. Flowchart for creating video on YouTube

A. OER creation on WordPress

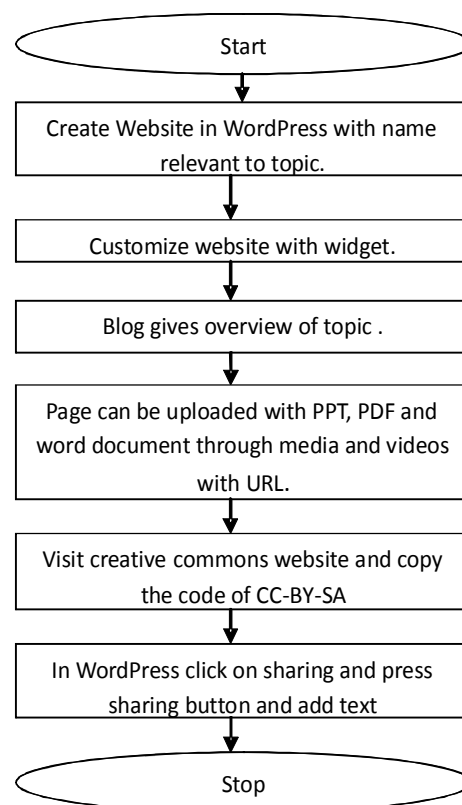


Fig.3. Flowchart for creation of WordPress website

The WordPress is a free open source. There are many other open sources like Scilab, GitHub, Moodle, Drupal and Spoken Tutorial. The URL of Digital System Design is <https://digitalsystemdesignblog.wordpress.com/>. This is the platform where all contents related to Digital System Design subject are uploaded. Everything related to theory and lab is uploaded. This OER is having one blog and many pages. The blog with name Digital System Design describes about key features of Digital System Design course. Separate pages are created as Digital System Design (theory), Digital System Design Lab, Question Bank, and Videos on basics of digital circuits, About Me page and Assignments Submitted. There is Feedback form also. Digital System Design (theory) page is uploaded with PPTs and word documents. It consists of examples of dataflow, structural and behavioural description. Digital System Design lab consists of syllabus, video on how to get started with Xilinx ISE, Manual and programs with simulated results. Question bank page has been uploaded with previous year question papers and model question paper.

Videos on basics of digital circuits are uploaded in the separate page. This is just to have recap of digital electronics. The VHDL code is written for digital circuits which students have studied in third semester. Each student is assigned separate question. Each one of them have to write VHDL code, simulate on Xilinx ISE and word document for the same should be submitted. All the word documents submitted by students are uploaded in page Assignments Submitted. As all examples cannot be covered in class, information can be shared this way. This will also help to achieve OBE. The students are involved in improving Digital System Design OER. Now these resources can be used by anybody. People who explore the website can give feedback. This helps in improving the OER. The WordPress website creation is shown in Fig.3.

A. Email

Email is also considered as one of the OER. Creating Google group is best example of OER. With this, resource can be shared with larger section of people. Each class is asked to create one Google Groups id. Any resource sharing will be done through group email id. The students submitted their assignments through email id. All assignments were later uploaded to WordPress. This is also one type of information transformation.

B. PPTs, PDFs and word documents

The PPTs, PDFs and word documents are also considered as one of the OERs. The PPTs and PDFs on particular can be directly uploaded on internet. Where people can download and use them. The PPTs were created on topics like Dataflow description and Structural description. Word documents of all program examples were created. The manual and question papers are in PDF format. All documents are uploaded on <https://digitalsystemdesignblog.wordpress.com/>. Creating particular website as OER is the best method for information transmission. The content sharing in website by all type of documents can be analysed through pie chart as shown in Fig 2. The website is having 63% word documents, 13% PDFs, 7% PPTs and 17% videos. The percentage of resource used for website creation was mentioned in students' survey. Feedback was taken about which type of survey they found more useful.

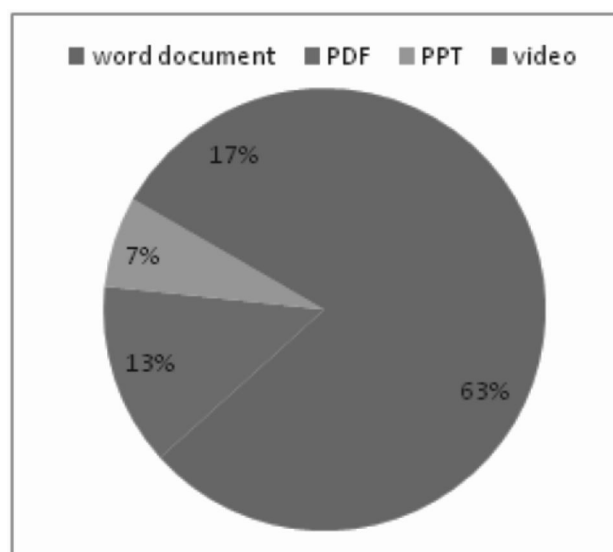


Fig. 2 percentage of resource type in Digital System Design OER

3. Survey and results

The URL was provided to faculties after the creation of OER on Digital System Design. Everyone was asked to visit the website <https://digitalsystemdesignblog.wordpress.com>. They gave feedback through Feedback page provided in website. All feedbacks were analysed. 70% of them found it very useful. The survey was conducted in class for students with simple questions like was it effective, how to improve website and which type of resource used in OER was most effective. The survey showed that videos are more effective, especially video on “how to get started with Xilinx ISE 14.7”. Feedback was given to include more videos. The Page on Digital System Design Lab was very much appreciated. Rest found that the website can be further improved with modifications. Suggestions were given to add quizzes.

4. Conclusion

The OBE demands new innovative teaching learning methods. The OER is created for information transmission. The OER for the course Digital System Design was created. The students were asked to simulate and implement different examples. The outcome was, each one of them could practically test how digital systems can be implemented. This helped to achieve OBE. The documents submitted by the students were uploaded in the OER <https://digitalsystemdesignblog.wordpress.com>. Now the content can be accessed through the website. Videos created on basics of digital electronics were

helpful to recall concepts studied earlier. The videos were helpful for conducting flipped activity in class room. The video on “How to get started with Xilinx ISE 14.7” was helpful in lab session. As OER is licensed under Creative Commons, the contents can be remixed and distributed. It will help students and faculty who are associated with Digital System Design all over the world. Survey conducted among students showed that videos are very effective. The website can be further improved with more contents. The subjective and objective quizzes can be added using Moodle cloud. The URL of MoodleCloud can be included in WordPress. The quizzes will help the student to test and improve their knowledge. The OER can be further improved with more resources like videos.

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