A Flipped Course Delivery: A Practitioner Approach with a Case study

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ABSTRACT: *Flipped course is used in well-developed educational institutions and technologically developed countries. It is quite experimental in nature for resource restricted educational Institutions and developing countries. In this paper such cases are considered, where faculties make use of free resources available for conducting flipped courses. Traditionally courses are taught to the students using black board. Nowadays teachers have started using power point presentations for their teaching. Teachers cannot completely depend on black board teaching to demonstrate the applications and implementations of a course. In addition to the conceptual teaching, the students should be actively involved and motivated to make the course more effective. To make students to get involved in learning about concepts of a course, the authors have designed and conducted different case studies. The methodology of delivering course and assessment methods are refined year after year using qualitative and quantitative measurements. Comparison of the outcomes is done by the authors with respect to students' performance year after year. This helps in refining the course content, course delivery and assessment methods. In this paper, authors discuss the different course delivery methodologies, they are practicing with continuous refinements. The authors suggest different learning activities, assessment methods and their outcome analysis in this paper.*

1. Introduction

1.1 Traditional Course Design

In traditional courses, most of the students are inactive in class. Making the students get involved in active learning is a typical task which has to be planned properly. Active learning happen in traditional classes accidently which are not scheduled priory. In traditional classes, there are no interesting technologies used for student interaction. Curriculum designers organize the design of courses which are needed for a student to get familiar with a particular professional course. The courses are to be taught across the semesters of the years of the programme conduction. Students have theoretical exams for their assessments to grade their performance.

1.2 Modern Curriculum Design

Learning of a course help the students for their all round growth of knowledge. Curriculum designers should design the syllabi

of different courses in a constructive way. Thus the students grow in their knowledge of conceptual and experimental skills. So they can design the courses from junior years to senior years in a pipelined or stream lined structure. Fundamentals courses of a Programme can be taught in the junior year. Then the intermediary courses can be taught to students in the intermediary years of the Programme. Then the advanced courses can be covered and taught to students in senior years. So the students will have thorough knowledge of courses as they learn the concepts in stages throughout their complete programme [1]. Teachers have many ways to communicate with the students such as the websites, online forms, etc. There are new methods which are the findings of educational research to conduct different teaching delivery and assessments. In this paper, the authors consider few of the delivery methods for a course and assessments using modern methodologies. These methods surely improve the interest for the students in learning a course and get assessed.

2. Case study: Flipped Compiler Design Course for Engineering Students
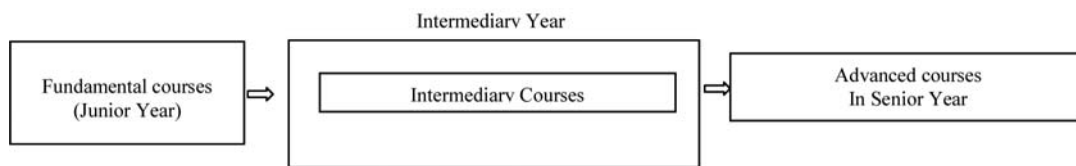

Figure 1. Moduels of Course coverage in Junior years till coverage of a Advanced Course in senior year

In this paper, authors consider the Curriculum designed for Computer science and engineering students. In first year, students study Fundamentals of Computing in which they learn C programming developing, compilation and execution. In second year, students study basics of Data structures, Algorithms, Discrete mathematics, Theory of computation, Microprocessor, Computer organization and Data communication. These are the important courses, students learn to become a Computer Science and Engineer.

In Third year, the students learn compiler design. Before that, they have learnt the basics of compiler in Theory of Computation subject and the data structures. These courses are needed to be learnt for designing compilers. So students can understand about the stack usage easily in compiler operations. About algorithms students have learnt in Analysis of Algorithms course. This course helps the students for designing their compiler phases in an optimal way.

Microprocessors and Computer Organization courses help the students to study and learn about the Computers in detail. With the knowledge of the usages of system software students learn the purpose of translators. Students learn about translators
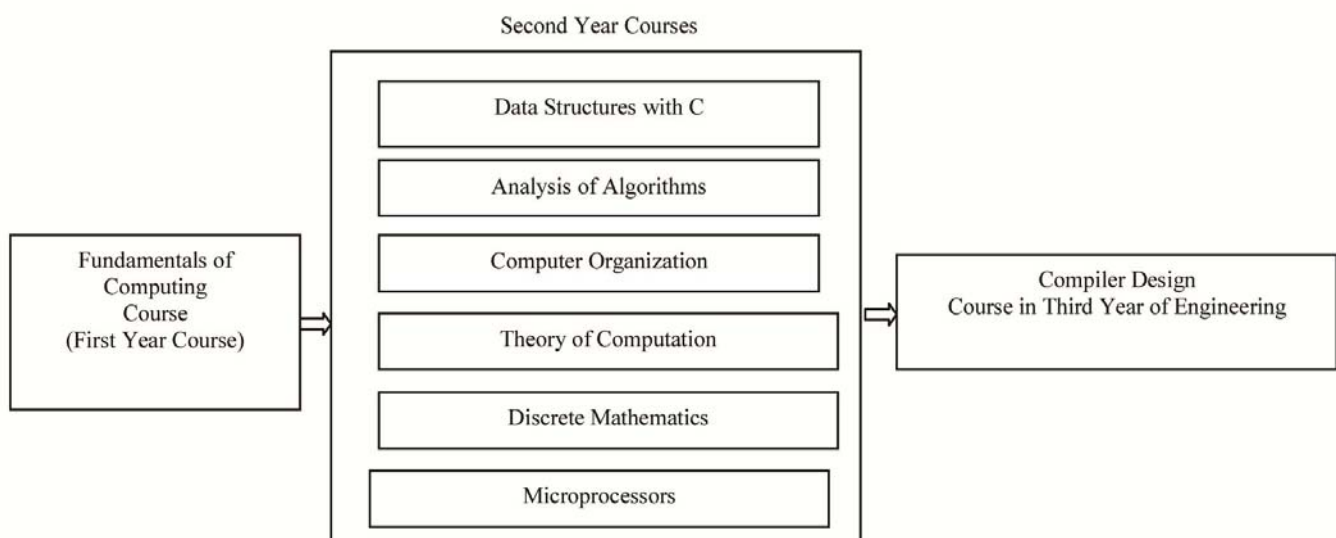

Figure 2. Case study: Moduels of Course coverage in different years of Engineering till Compiler Design Course is taught

and their working nature for each computer architecture. Students correlate machine architecture knowledge with the translators like assembler and compiler. As students learn microprocessor they can able to code for a machine using assembly language program. This which help the teacher to link to compiler code generation phase as code generator phase generated assembly language code.

Instead of teaching the students in traditional ways with black board, the authors use quiz component. This quiz conduction is used to make students to prepare for the course concepts. The authors have conducted the quiz as additional assessment component in their first attempt to deliver the course. Students show interest to prepare for the assessment of online quizzes more than the regular descriptive theory tests. So authors have motivated to add more active learning strategies in their courses. For this authors have refined the active component in the next year. For that authors have selected a strategy to implement the course concepts in an experimental ways using tools. That also yields a fruitful performance improvement in the students' interest and motivation. Students show interest in collaborative learning of course contents in group activities by sharing their knowledge.

3. Overview of course Structure

3.1 Refining a Course in an Autonomous Institution

The objective is to flip the course delivery and assessment methods from the traditional methods of course conduction. Initially when the authors institutions have moved to autonomous institution status, they have introduced the tutorial component only for problem oriented subjects. This tutorial is additional component and varying from traditional university curriculum delivery methods of courses. So the students get involved in problem solving during the tutorial sessions and additional faculties will be there to help students in solving problems. Students have discussion with their peers during tutorial session and solve the problems in collaborative way too. Authors have introduced quiz component to improve their learning activity, so that they come prepared for quiz. Then the authors have used practical assignments to improve their practical skills to implement conceptual knowledge. This year authors have refined the course conduction thus the students involve actively in technical paper writing skills related to courses.
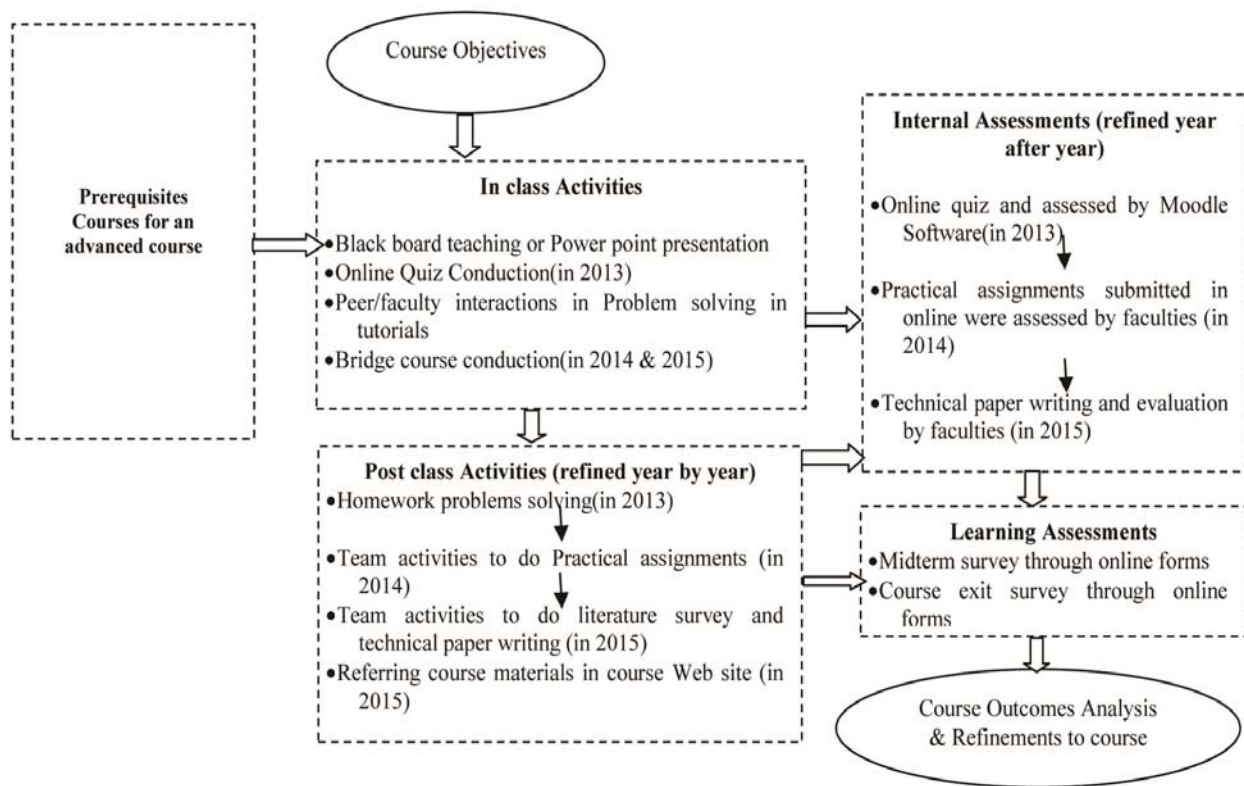

Figure 3. Structure of a Course with Year wise refinements

3.2 Course Objectives

The authors want to standardize the course delivery methods in an outcome based education scenario. For which they have to determine the course objectives which are needed to be achieved by efficient course delivery, learning and assessment methods. This has to be done very much prior to the beginning of a course. So the teacher can plan and schedule the things accordingly. In this paper, authors consider the following course objectives which are set for compiler design course.

Compiler Design course will help students to achieve the following objectives:

• Present fundamental concepts and techniques for compiler design and understand the scanning process of compiler

• Identify the methods and strategies for parsing techniques.

• Show the syntax directed translation schemes of compilers

• Devise intermediate code generation schemes

• Optimize the code for efficient utilization of CPU

3.3 Course Outcomes

To measure the course objectives attainment, the course designer should specify the outcomes needed to be measured for a course. This has to be specified before the beginning of the course. In this paper, authors have defined certain course outcomes which have to be met at the end of the compiler design course.

At the end of the compiler design course students should be able to:

• Identify the phases of a complier and explain and perform the lexical analysis process of compiler

• Create various types of parsing tables for syntax analyzer phase of a compiler

• Devise and perform syntax-directed translation schemes for compiler

• Formulate intermediate code generation schemes for compiler

• Reorganize code for obtaining an effective code generation.

4. Learning Activities for Flipped Course

4.1 Quiz Activity

Traditionally teachers conduct quiz orally to students by dividing them into groups and grade them. In some cases, it can also be conducted by making students to write answers in answer sheet. Faculty evaluate the answers of quiz later and assign the grades to students accordingly. For the preparation of quiz, students need to prepare for the conceptual as well as problematic lessons of the course as home work. This improves the active involvement of students in understanding the concepts outside the class. As part of the flipped course conduction in this paper, authors attach quiz component which is different from traditional method of quiz conduction. The Authors have conducted online quiz using Moodle Tool. Previously, the authors have used quiz component with courses like computer organizations through multiple choice questions [19].

4.2 Using Moodle Software for Quiz Conduction

As traditional methods of quiz conduction are time consuming, the faculty should look for softwares such as Moodle for the evaluation of quiz. Hence in this case study, the authors find Moodle software to be more effective in terms of time. Teachers find reducing malpractices such as copying and other things. Because the questions are not same for all the students as the software has the option of assigning questions randomly. Further this quiz component result in effective and proper evaluation of students with regard to various courses offered.

4.3 Conduction of Bridge Course to Teach Tools

For the courses consists of experimental nature, the authors suggest the faculty that they should teach students with demon

stration of related tools. This help students to simulate the concepts learnt in a course [18]. Teaching the tools during the regular class consume student's time and deviation from regular course conduction. Instead bridge course conduction make students learn the tools or simulators. This help them experiment their conceptual learning of a course. Bridge course can be conducted during vacation or during the weekend or special classes [15]. In this case study, the authors want students to improve in their creative skills. In compiler design course, students solve the problems related to compiler phases. The authors have refined the learning method by replacing quiz component of course with practical assignments. This helps to involve students in active learning of compiler design tools. Using the tools students design compiler phases and learn compiler design using hands-on training. Students learn to work with the tools through the bridge course. Bridge course have been conducted for 2 days during 2 weekends.

4.4 Group Activities and Online Submissions

Teachers should involve students in active learning and make them use the technology. For that teachers can make the students to perform activities in groups [8]. Transferring the assignment questions and the solutions can be done through online over the internet communications between the students and teacher [17]. In this case study, the authors teach Lex and Yacc tools to students. They teach the way of coding to generate compiler phases using the tools. At the end of bridge course the authors give few assignment questions. Students should perform and submit the assignments in group of 2 [10] before dead line. So students actively get involved in the bridge course and complete the assignment in the stipulated time [11].

1) Sample of Practical Assignment Questions

The authors define the problems to be solved by students using Lex and Yacc tools. Students get supplied with the sample input to be given as well as the output to be yielded from their programming solutions. With reference to that students develop program solutions using the tools as the outcome of bridge course. The sample practical assignments problem definitions are stated below. Students are provided with the sample input and output to validate their program execution to avoid ambiguity in their solution.

Problem Definition 1:

Write a Yacc program to accept a statement and do error detection. Check for valid arithmetic expressions in input C program. Report the errors in the statements to user.

Sample Input 1:

```
A = a + b +(f+6)/(f*j)
```

Output Expected for sample input 1:

```
    Valid arithmetic expression
```

Sample Input 2:

```
    A = a + b +(f+g-8))
```

Output Expected for sample input 2:

```
    Invalid arithmetic expression
```

Problem Definition 2:

Write a Lex program to accept a C program and do error detection & correction.

i) Check for un-terminated string constant in input C program. i.e A string constant is beginning with double quotes and extended for more than one line. Intimate the error line numbers and the corrective actions to user.

ii) Check for valid arithmetic expressions in input C program. Report errors in the statements to user.

Sample Input 1:

```
#include<stdio.h>

#include<conio.h>
```

```
void main()

{

int a;

char c[10] = ”msrit”;

a = a + b;

}
```

Output Expected for sample input 1:

```
Valid string

Valid arithmetic expression
```

Sample Input 2:

```
#include<stdio.h>

#include<conio.h>

#include<string.h>

void main()

{

int a;

char c[10] = ”msrit”;

a = a +/b+ h;

strcpy (c, ”Bangalore”);

}
```

Output Expected for Sample Input 2:

Invalid arithmetic expression in line number 8 : + and / used adjacently.

Corrective action required: remove either + or / appropriately.

Invalid String in line number 9: " is opened but not closed.

Corrective action required: close the input string

4.5 Assessment of Group Activities
1) Using Online Forms
Assignment questions for group activities can be put in the website or it can be sent to the group mails of students. Teacher can make use of resources like google forms to accept the submissions from students. This resource is freely available, so faculty can use it for flipped course conduction in terms of assessment submissions [5].

For the bridge course assignment in this case study, the authors create online forms and send the links to students. Students submit their program solutions online along with their team details for assessing them. The authors evaluate the students' code which get submitted through online forms. Then the authors assign the marks and send to their group mails. This reduces the consumption of paper for contacting and notifying students about their progress. The authors find this method as environment friendly[2].

In Figure 4. online form to submit the Practical assignments is given. When it is submitted it will be in the responses of the

google form, so faculty can assess it and send the grades along with remarks. In Fig.5. The responses submitted by students are shown below.

4.6 Online Course Website for Course

Developing Educational Institutions can launch their website using freely available website service providers. Teaching faculties can use Google sites or Wix, etc., so faculty can put their notifications, notes, questions on the website and students can refer to them whenever they want [5].

Figure 4. Case study : Online Form to Submit the Assignment

As part of this case study, this year the authors launch course website using free website providers. This is useful for guiding students online whenever faculty are away [2]. The authors make important notifications, course reference materials, tutorial problems, assessment methods through the website. In Figure.6, week wise updating of course reference materials are shown section wise. In Figure.7. Web page of weekly tutorial problems is shown. Previous year semester end examination question papers are put up for students' reference in web page as shown in Figure 8.

Timestamp	USN	Names	Code	Marks	Remarks
2/19/2014 23:32:53	1ms12cs400,1ms12cs415	Ashwini.R.H,	**********************	10	
2/20/2014 5:31:23	1MS11CS126,1MS11CS113	Varun H M, Suhas	%{	10	
2/20/2014 6:11:33	1MS11CS110,1MS11CS120	SPURTHI, SWATHI	%{	10	
2/20/2014 9:10:18	1ms11cs109,1ms11cs134	sonu kalwar,vinit	lab 4:-	10	
2/20/2014 9:34:48	1ms11cs123	ujwal kiran	%{	10	
2/20/2014 16:17:19	1ms11cs108,1ms12cs402	sonali,lavanya	%{		
2/20/2014 17:19:18	1ms11cs137,1ms11cs138	zeeshan	%{	10	
2/20/2014 21:42:51	1ms11cs132,1ms11cs136	vinaykumar.m,yash	lab task 4:	10	
2/20/2014 21:49:57	1MS11CS139,1MS11CS141	SHRUTHI J	%{	10	
2/20/2014 21:54:14	1MS12CS402, 1MS11CS108	LAVANYA ,	lab4 lex pgm	10	
2/20/2014 21:55:28	1MS11CS143,1MS11CS145	Shreya	%{	10	
2/20/2014 22:02:47	1MS12CS405,1MS12CS410	mark	#include<stdio.h>	10	
2/20/2014 22:15:54	1MS11CS121, 1MS11CS147	SYED NOUMAN	%{	10	
2/20/2014 22:27:00	1MS11CS107,1MS11CS136	SNEHA G	%{	10	
2/21/2014 1:47:20	1MS11CS151	Akanksha Singh	%{	10	
2/20/2014 23:16:10	1ms12cs409,1ms12cs411	Nataraj T N,	%{	10	
2/20/2014 23:27:39	1ms11cs142,1ms11cs144	harsh	%{	10	
2/21/2014 1:52:03	1MS11CS140 , 1MS11CS146	KS MONICA ,	%{	10	
2/21/2014 8:11:26	1MS11CS150, 1MS11CS148	Ayush Jain, Rahul	Lex Program - Lab	10	
2/21/2014 9:35:14	1MS11CS115	Sunilkumar	%{	10	
2/21/2014 18:46:58	1ms11cs105,1ms11cs135	Vivin, Sidharth	%{	10	
2/22/2014 9:02:44	1ms11cs112,1ms11cs128	sudarshan rai,vijay	%{	10	
3/3/2014 5:15:13	1ms11cs127 ,1ms11cs133	Veeresh Nete	program 1 :	0	only lex pgm have to be
3/2/2014 23:25:07	1MS11CS150, 1MS11CS148	Ayush Jain, Rahul	1st question	0	only lex code is needed
3/4/2014 4:57:40	1MS11CS110,1MS11CS120	SPURTHI HEGDE ,	program 1	0	only lex code is needed
3/4/2014 7:11:11	1MS12CS405,1MS12CS410	Mark	y51.l	0	only lex code is needed
3/5/2014 1:45:06	1ms12cs400,1ms12cs415	Ashwini.R.H,Theias	GRAMMER 1:	0	only lex code is needed

Figure 5. Online form submissions(Excel sheet) created automatically from student responses using Google form

4.7 Using Free/Limited resources available online for Course Delivery and Assessment methods

Moodle is a software through which, faculty can conduct online quizzes, assignment submissions, project document submissions, etc.,. Moodle is an open source. Faculties can design their course websites to be in touch with students through

Figure 6. Case study : Course website - Web page to view course reference materials week wise

Figure 7. Course web site - Web page to view tutorial problems week wise

online using free website providers. They can upload the study materials and notifications to students in web pages. Faculties can use online forms like google docs to create forms and collect surveys from students. Using google sites, wix web sites templates, etc., people can create their websites and launch. Even shared drives can be created through drives like google drives and those repository files can be shared among students.

4.8 Refinement in course learning activity

Course delivery and assessment methods are refined based on the feedbacks, surveys, performance of students in assessments. Based on the analysis of these data, course designer and deliverer modify the course contents and the assessment strategies. For this new strategies are needed to improve the active learning involvement of students [4][12][10].
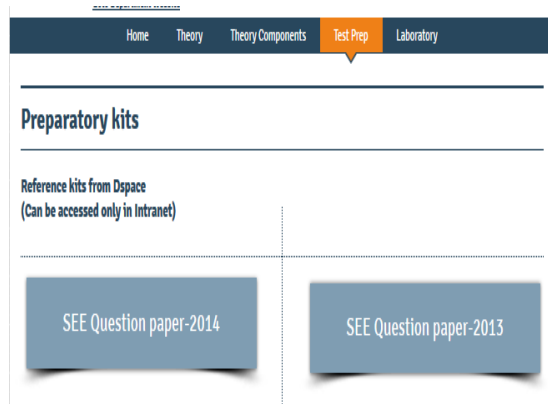
Figure 8. Course web site – Web page to view previous year question papers

1) Technical paper writing

For the advanced courses in senior year, faculty can ask students to do literature study over the existing systems related to particular topic of a course. Based on that the students can be instructed to write technical papers and present for professional societies. This promote the students skills to become a researcher and creator. In this case study, after two refinement stages in the past two years, this year the authors introduce technical paper writing. It involves literature survey and writing technical paper on Compiler design phases and related topics. Students are new to technical papers writing. So the authors make repositories of papers and share to students through shared drives which are accessible online.

2) Repository of Journal papers through Shared drive Online

Faculty can create repository of journal papers which she/he wants to share for students. Students download according to the specializations and put in the shared drive online. For this free shared drives services can be used online over the internet. Teaching faculties can make use of shared drive facility available with Google. This reduce the expenses in conducting flipped courses in developing educational institutions. In this case study, the authors create the repository of technical research papers. Repository consists of different categories like lexical analyser, parser, semantic analyser, intermediate code generator, code optimizer and code generator. The authors' institutions have purchased online journals which is available in digital library. The authors have created the repository out of the digital library. So student can easily refer these repositories to do their literature survey and write technical papers related to compiler design. They need to present in conferences and publish in journals. After getting the review comments and acceptance notifications they need to show the proofs to faculty for assessment. This component is been assessed as part of their continuous internal assessment [16].

5. Assessment Results and Analysis of CIE Assessment

CIE theory exams can be conducted in traditional way, to evaluate the conceptual and problem solving ability of students. Questions can be formed and categorized using revised blooms taxonomy. In Fig.9. CIE question paper analysis is shown as per blooms taxonomy. It depicts that 17% of the questions are making the students to create solutions and write. Another 17% of questions are to make them to remember and write the concepts and 19% of the questions to evaluate the concepts learnt. 14% of questions are making them to analyze and write. Of the remaining 13% for checking the understanding and 20% of the questions are for making students to apply the knowledge to answer the questions.

Curriculum designers and teaching faculties can measure and analyze the course delivery methods by collecting the feedbacks and surveys as well as from the performance assessment results. By comparing them year wise [9], the flipped course objectives attainments can be drawn against the course outcomes. This has to be mentioned prior to the beginning of the course delivery. For this case study, the authors do the statistical analysis of all students' performance in the continuous internal evaluation (CIE) tests. The CIE tests were conducted for 30 marks. Three CIE tests were conducted in equal distribution across the semester of 6 month duration. The authors have compared the performance of present year students with previous year students. In Table I, the students CIE-descriptive question answering marks were analyzed statistically. Deviation of marks is very less for students of 2014 compared to that of 2013 batch students.

In Table 2, comparison of students marks test wise as well as year wise are shown compared to the 2013 batch student. The standard deviation of students' marks get reduced for all tests of 2014 batch students. Mean values of test1 and test2 marks are more in 2014 year compared to 2013 with active learning methods, such as practical assignments. In test 3, the students of 2013 have done better and 2014 students have not performed well. The reason for this is practical assignments are not given from the course outcomes mapped to test3. Further 2013 students have studied for the quiz prior to the test3. This has helped them to perform better in test3 and mean is higher than 2014 students.
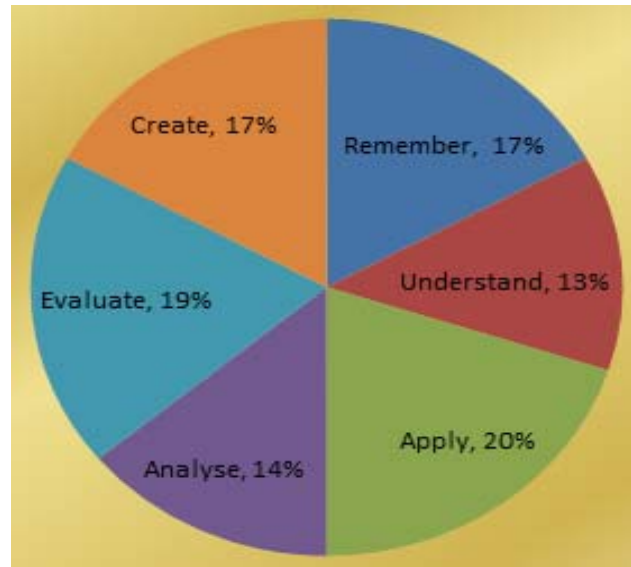

Figure 9. Case study Analysis :Blooms taxonomy of questions CIE question papers in 2013 for Compiler design course assessment

Year	Mean	Std Dev	Min	Max
2014	20	5.81	5	30
2013	21	6.72	2	30

Table 1. Case study: Statistical Analysis of CIE –Desriptive question and answering Test marks

Year	InternalAssessmentNumber	Mean	Std Dev	Min	Max
2014	Test1	20.51	5.58	2	30
	Test2	21.1	6.00	1	30
	Test3	15.64	7.11	2	30
2013	Test1	16.89	6.85	1	30
	Test2	16.01	7.16	1	30
	Test3	23.72	7.54	2.5	30

Table 2. Case study: Statistical Analysis of CIE –Desriptive question and answering Test marks

5.1 Analysis of Quiz Assessment (2013) & Practical Assignment Assessment (2014)
Quiz conduction has been done through Moodle software. Students get the questions in different order with options. The questions and options are jumbled up by software automatically. Students appear for quiz online individually. Finally the assessment of quiz has been taken from Moodle software in excel format. Assessment marks get added to their theory

Continuous Internal Evaluation (CIE) marks. Through Quiz, faculty can able to assess students remembering, understanding, analyzing and applying skills. Students collaborative skills are not involved in quiz as well as faculty cannot assess creative skill of students. This can be overcome by practical assignments. Students get involved collaboratively in practical assignments as they do assignments in group and they use their creative skills. Students learn in shared mode along with remembering, understanding, analyzing and applying skills.

Year	Mean	Std Dev	Min	Max
2013	14.3	3.02	3	19
2014	19.48	1.50	11	20

Table 3. Statistical Analysis of Active learning assessment marks

The authors compare the quiz marks with that of practical assignment marks of different years [9][14]. They observe that the standard deviation of students' marks in 2014 is lesser than the year 2013.

5.2 Semester End Examination Assessment Analysis

Statistical analysis of Semester End Examination marks helps the curriculum designer to determine the effectiveness of flipped course conduction and assessment methods. The statistical information can be compared across the different years [14][3].

Statistical analysis of different course delivery and various assessment methods are done for refinement [7].This will surely help the faculty to know whether the new methods have improved the performance of students or not. In table IV, statistical analysis of Semester End Examination marks conducted for this case study are shown. These are taken of compiler design course students of year 2013 and 2014. The S grade represents students have scored between 90 to 100 marks, A grade represents 80 to 89 marks, B grade represents 70-79 marks, C grade represents 60-69 marks, D grade 50-59 marks, E grade represents 40-49 marks and F grade represents Fail grade. The authors compare the percentage of students who scored F grade in 2014 with 2013.

Year →	2013	2014
Grade	Percentage of students	Percentage of Students
S	1.27	2.60
A	36.94	26.62
B	36.31	47.40
C	12.10	11.69
D	5.10	5.19
E	4.46	3.25
F	3.82	3.25

Table 4. Case study : Statistical analysis of Semester End Examination- Descriptive question and answer

Similarly E grades, C grades are reduced in year 2014 compared to year 2013. There is a negligible decrease of 0.09% for D grades in 2014 and B grades also have increased in 2014. There is 10% decrease in A grade for 2014 and B grade scorers have increased by 11% compared to the year 2013. S grade scorers also increased by 1.4% in year 2014. Hence the authors identify that they should put in more effort to increase A grade scorers. For that they should introduce more active learning strategies in their course.

5.3 Statistical Analysis of students attaining the Course outcomes in CIE

The authors desire to measure the course outcomes and analyse them. For that they map the questions asked in the CIE
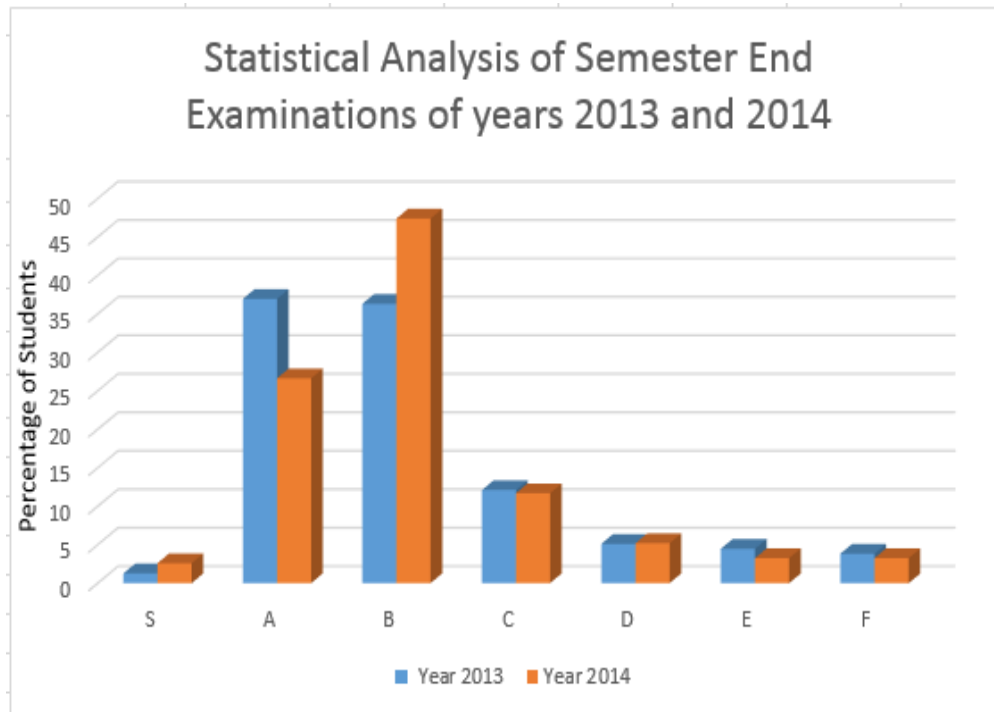
Figure 10. Case study: Student Grade distribution in Semester End Examination in years 2013 and Year 2014

assessment to the course outcomes (CO). Then they compared them year wise [20]. In table 5, the statistical analysis is shown for the years 2013 and 2014. It shows the student's average marks scored in each questions. Questions get mapped to the course outcomes and with that percentage of course outcome attainment is calculated [6].

Year →	2013	2014
Course outcomes	Percentage of attainment	Percentage of attainment
CO1	60.01%	73%
CO2	63.29%	83%
CO3	65.57%	80%
CO4	78.27%	73%
CO5	75.93%	60%

Table 5. Analysis of Course outcome attainments- with respect to Students percentage of marks scored questions wise

In 2014 the students have performed well in their CIE assessments. The authors observed that students learning outcomes are attained better for the course outcomes 1, 2, 3. Because the practical assignments are related to the topics CO1, CO2 and CO3. Hence the authors plan to refine the practical assignments related to CO4 and CO5, so that students actively learn CO4 and CO5 to enhance attainment level.

5.4 Analysis of Student Feedback during 2014
The teaching faculty can measure delivery methods and assessment methods using the surveys and feedback. Faculty can analyse the data to extract the effectiveness of their delivery and assessment strategies used during the course conduction [1]. For this case study, the authors have collected students' feedback in 2014 using online forms and the responses are analysed [13].

Feedback Questionnaires	Mid Term Survey		Course Exit Survey	
	Agree	Disagree	Agree	Disagree
Lectures clear/well organized and presented at a reasonable pace	98%	2%	100%	0%
Class sessions increase the understanding of the course	95.9%	4.1%	100%	0%
Problems worked out in the classroom help to understand and solve questions on their own	95.9%	4.1%	100%	0%
Grading scheme clearly outlined and reasonable/fair	91.8%	8.2%	100%	0%
Assignment procedures clearly explained by the teacher	89.8%	10.2%	100%	0%
Attainment level of CO1	100%	0%	100%	0%
Attainment level of CO2	100%	0%	100%	0%
Attainment level of CO3	95.9	4.1%	100%	0%
Attainment level of CO4	-	-	100%	0%
Attainment level of CO5	-	-	92.3	7.7%

Table 6. Feedback analysis of students-2014

Table 6 shows the midterm survey of students' feedbacks.

Midterm survey helps to

- Improve the lectures and delivery methods for improving understanding
- Refine problems solved in tutorials to improve the problem solving skills
- Improve the grading schemes
- Refine the instructions and guidelines
- Refine assignments

So in course exit survey the feedback get improved to 100% in most of the feedback statements asked to students through online forms [6].

6. Discussion

Teachers want their students to learn the course thoroughly. For this active involvement of students is required through active learning.

Active learning methodologies discussed in this paper

- Online quiz conduction using computers

- Homework assignments
- Online submission forms
- Online technical paper submission in shared drive
- Group activities in collaborative manner

The above mentioned activities are experimented, analysed and compared for their effectiveness. For this case study, in 2014 the authors have introduced the practical assignments. This help students get involved in designing compiler phases using lex and yacc tools. This help the students to learn to work with compiler phases. This created an opportunity to experiment the theory of compiler design course.

In 2013 students actively learnt compiler design concepts using their preparation for quiz. This helped them to prepare for conceptual knowledge test and individual participation. But in 2014 students got an opportunity to work as a team using tools. The authors assisted them by conducting additional bridge course to fill the gap of compiler theory and the practical. For that the faculty have used lex and yacc. Students have done collaborative work to develop programming solutions [12][8].

The authors measure [3] the course outcomes attained using the grade scored by students. They use surveys to collect student feedback about the course outcomes attainment levels. This help the authors, to know how much understanding students have about the course. This helps to refine the delivery methods and the assessment methods.

This year 2015, the authors have created course website. This is useful to communicate to students for the ongoing compiler design course. The website provide the weekly reference materials and tutorial problems to be solved. This will help the students to update themselves with respect to course materials. This year, the authors have asked students to write technical paper on compiler design. This make the students involve in compiler research study better. This helps the students to understand the basic concepts and improve their grades in CIE and in Semester End Examinations.

7. Conclusion

In this paper, the authors suggests useful strategies to deliver the flipped course effectively. For that the authors suggests freely available resources over the internet such as Moodle software, Google online forms, Google web sites, wix websites, etc. This encourage students involvement in active learning of practical assignments related to theory than quizzes. Further, the authors analyse that the practical assignments help students to learn the compiler design theory better. They observe that the practical assignments help students to improve in their grades in the assessments. With this the authors conclude that having limited resources cannot restrict flipped course conduction, Teaching faculties can use freely available internet resources to provide better course delivery and assessment online. Faculty can host course references and assessments through freely available online resources.

References

[1] Anupama Prashar. (2015). Assessing the Flipped Classroom in Operations Management: A Pilot Study, *Journal of Education for Business,* 90 (3), 126-138,

[2] Engidaw, Berhanu. (2014). Teacher trainers' and trainees' perceptions, practices and constraints to active learning methods: The case of English Department in Bahir Dar University, *Educational Research and Reviews*, 9 (20), 981-990, 23 October,

[3]Johnson, D., Steven, R., Aragon., Najmuddin Shaik., Palma-Rivas, Nilda. (2001). Comparative analysis of Learner satisfaction and learning outcomes in online and face to face learning environments, *Scott Journal of Interactive Learning Research*, 11 (1), 29-49.

[4] El-adaway. I, Pierrakos. O., Truax. D. (2015). Sustainable Construction Education Using Problem-Based Learning and Service Learning Pedagogies, *Journal of Professional Issues in Engineering Education and Practice*, 141 (1), January.

[5] Heinrich, Eva. (2014). Towards using relevant collegial contexts for academic development, Active Learning in Higher Education, November, 15 (3), 215-230

[6] Kim, J., Herrmann. (2013). The impact of cooperative learning on student engagement: Results from an intervention, Active Learning in Higher Education November .

[7] Tikly, Leon. (2015). What works, for whom, and in what circumstances? Towards a critical realist understanding of learning in international and comparative education, *International Journal of Educational Development,* 40, January, 237-249

[8] Springer, Leonard., Stanne, Mary Elizabeth., Donovan, Samuel, S. (1997). Effects of Small-Group Learning on Undergraduates in Science, Mathematics, Engineering, and Technology: A Meta-Analysis, Research Monograph No. 11, National Institute for Science Education, University of Wisconsin-Madison, December .

[9] Lopatto. D. (2007). Undergraduate Research Experiences Support Science Career Decisions and Active Learning , CBE Life Sciences Education, 6 (4), 297–306.

[10] Loren, Intolubbe-Chmil., Carol, Anne Spreen., Swap, Robert, J. (2012). Transformative learning: Participant perspectives on international experiential education, *Journal of Research in International Education*, August; 11 (2), 165-180.

[11] Margaret, M., Dubeck., Amber Gove. (2015). The early grade reading assessment (EGRA): Its theoretical foundation, purpose, and limitations, *International Journal of Educational Development,* 40, January, 315–322.

[12] Magni, Massimo., Paolino, Chiara., Cappetta, Rossella., Proserpio, Luigi. (2013). Diving Too Deep: How Cognitive Absorption and Group Learning Behavior Affect Individual Learning, Academy of management learning and education, March , 12 (1), 51-69.

[13] Cavalli, Matthew., Neubert, Jeremiah J., McNally, Dustin., Jacklitch-Kuiken, Debbie. (2014). Comparison of Student Performance and Perceptions Across Multiple Course Delivery Modes, 121st ASEE Annual conference & Exposition,June.

[14] Prince, Michael. (2004). Does Active Learning Work? A Review of the Research, *Journal of Engineering Education*, July.

[15] Hu, Qinran., Li, Fangxing., Chen, Chien-fei. (2015). A Smart Home Test Bed for Undergraduate Education to Bridge the Curriculum Gap From Traditional Power Systems to Modernized Smart Grids, *Education, IEEE Transactions on*, 58 (1) 32-38, February.

[16] Rosemary, C., Reilly, Sidney, N. , Mitchell. (2010). The Clash of the Paradigms: Tracking, Cooperative Learning, and the Demolition of the Zone of Proximal Development , *The Alberta Journal of Educational Research,* 56 (4) Winter , 419-435.

[17] Sousa, L., Antao, S., Germano, J. (2013). A Lab Project on the Design and Implementation of Programmable and Configurable Embedded Systems, *Education, IEEE Transactions on*, 6 (3), 322-328, August.

[18] Koulouri, Theodora., Lauria, Stanislao., Macredie, Robert, D . (2015). Teaching Introductory Programming: A Quantitative Evaluation of Different Approaches, *ACM Transactions on Computing Education* (TOCE), 14 (4), February .

[19] Jungiæ, Veselin., Kaur, Harpreet., Mulholland, Jamie., Xin, Cindy. (2015). On flipping the classroom in large first year calculus courses, *International Journal of Mathematical Education in Science and Technology*, 46 (4), 508-520.

[20] Weili Cui., Jones, W. E., Klotzkin, D., Myers, G. L., Wagoner, S., White, B. (2015). Realization of a Comprehensive Multidisciplinary Microfabrication Education Program at Binghamton University, Education, IEEE Transactions on, 58 (1), 25, 31, February.