7.2.1 Best Practices

Best practices I: Industry powered laboratory

I (a):Automotive Learning Factory

1. Title of the Practice

Automotive Learning Factory

2. Objectives of the Practice

To create opportunity for students to experience hands on training on various automotive components, its design, working, analysis and manufacturing.

3. The Context

Automotive Learning Factory was established in the year 2018 by the Department of Mechanical Engineering for the students to gain hands on experience and training in the field of automotive engineering. Ashok Leyland 222 Viking BS4 - SCR Chassis has been used to demonstrate mechanical fundamentals to the students by conducting various experiments. Several mini projects have been developed under this lab on Automotive Electronics done by the Mechanical Engineering students thereby focussing on Interdisciplinary activities. Automotive Learning Factory has received a BMW Twin Power Turbo Engine and 8 Speed Steptronic transmission under BMW SkillNxt programme sponsored by BMW India. Moreover, there will be a MoU to be signed with Toyota Kirloskar Motor to develop a NMAMIT-Toyota Centre of Excellence focussing on student training, internships and projects.

4. The Practice

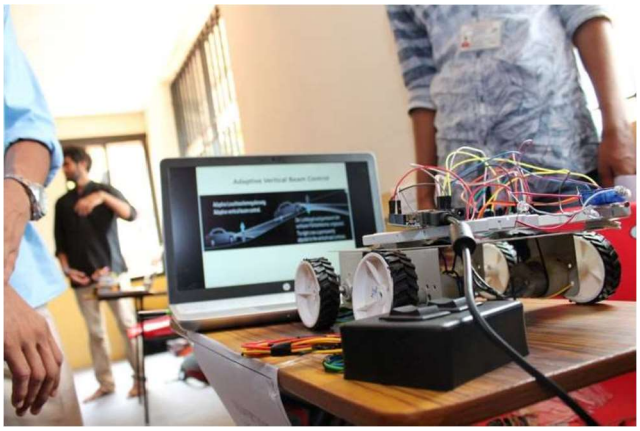
The primary focus of Automotive Learning Factory is to teach every single aspect that's been used in the Automotive Industry right from hand sketching, clay modelling, 3D modelling using software, analysis and finally 3D printing of the parts. Keeping in mind the demand for Electric Vehicles, this factory has also an Automotive Electronics Lab teaching Mechanical Engineering students to focus on multi-disciplinary activities.

5. Evidence of Success

This factory motivates the students to undertake projects related to latest advances in automotive technology. This factory also promotes students to publish their work in reputed journals/conferences. Till date, one paper is already published on a mini project and faculty members are continuously motivating and guiding students to come up with new technology projects related to automotive engineering. Students of VI semester have to compulsorily undergo active learning lab in this factory where they are taught to hand sketch, model and fabricate a component using 3D printer.

6. Problems Encountered and Resources Required

Students are not getting enough time apart from their regular curriculum to come and work in this factory. As of now, a request is given to the management to procure Automotive Electronics components for the lab so that equal focus can be given on Mechanical as well as Electronics stream.



I (b) : Active learning Mechatronics NMAMIT-FESTO Centre for Technology Automation

1. **Title of the Practice**

   Active learning Mechatronics NMAMIT-FESTO Centre for Automation Technology

2. **Objectives of the Practice**

   To impart practical experience on automation technology to the students.

3. **The Context**

   Mechatronic course will give theoretical knowledge to the students. However, current scenario requires industry ready engineers. However to gain the practical exposure on latest automation technology and to learn fundamental concepts effectively, active learning in mechatronics lab is introduced.

4. **The Practice**

   Active learning on mechatronics has been set-up as a part of Memorandum of Understanding between NMAM Institute of Technology and Festo India Private Ltd. (FIPL). This lab currently has mobile workstation for pneumatics unit (double sided). It has basic pneumatic training kit along with add-on basic electro pneumatic and Programmable Logic Controller (PLC) Training kit. Active learning lab mainly consists of industrial problems for which

pneumatic, electro pneumatic and PLC circuits are designed and executed on the training kit as well as in the Fluid sim simulation software by the students.

5. Evidence of Success

The practical exposure to the students on automation technology has resulted in improvement in student learning. The concepts are clear to the students and they are implementing automation techniques in their project work. The students have given positive feedback and their opinions are - that majority of the students were of the view that the active learning lab was useful in enhancing their knowledge with practical exposure. They suggested the active learning mechatronics lab should be made as a regular lab with credit benefits and increase the pneumatic kit along with provision for computers to do simulation.

6. Problems Encountered and Resources Required

It was felt that fully fledged Fluidsim simulation lab is essential for simulating and verifying the experiments in active learning mechatronics lab.

I (c) :NMAMIT-Fronius Center For Welding Technology

1. Title of the Practice

NMAMIT-Fronius Center For Welding Technology

2. Objectives of the Practice

To provide skill development training, consultation and research facilities to promote international standard welding practices among the students, faculty members and nearby industries.

3. The Context

NMAMIT-FRONIUS Center for Welding Technology (CWT), NMAMIT, Nitte started in 2018, in collaboration with Indian welding society (IWS) and M/s. Fronius India Pvt. Ltd is actively involved in the research and training of students and faculty members in welding. In the due course of time, the center has carried out several skill training programs benefiting ITI and B.Tech students, teaching faculties and industry personnel. CWT conducted an in-house training to officials of Mangalore chemicals and Fertilizers (MCF) on Maintenance in 2018. Organized a faculty development program in April 2019 on "Research opportunities in welding". Several hands-on trainings on latest welding machines was given to Mechanical Engineering students of nearby Engineering colleges. In August 2019, conducted a vocational training on welding for rural students. CWT is conducting several perpetual skill training programs for the UG and PG students.

4. The Practice

The center has latest world class welding and testing facilities under one roof to carry out research, impart training and for consultancy services. The center is hosting and managing Indian Welding Society IWS of the region to get connected with the industry and to provide consultancy services. The center is also running a student chapter of Indian Welding Society (IWS) to update students with latest developments in the welding and related areas. Further students would use the facilities at center for various learning activities under a supervision of a faculty mentor

5. Evidence of Success

In this short span of 3 years, the CWT has observed several milestones in the area of research as well. A student project on "TIG welding of aluminium alloys with pulsating wire feeder" won second prize in the IMTEX Machine and Tool Expo 2020, Bangalore. Further, CWT has supported more than 20 student projects, conducted more than 10 workshops and skill training programs, provided consultancy services to more than 07 MSME's and is currently hosting 03 government funded research projects of faculty members

6. Problems Encountered and Resources Required

Finding the human resource with right expertise to provide consultation services to the industry and to impart skill training at various level is a challenge. However, since the technology is evolving quickly, its rapid adoption becomes a challenge as it requires capital investment and skill human resource.

I (d): NVIDIA Server for AI/DL

1. Title of the Practice

NVIDIA Server for AI/DL

2. Objectives of the Practice

To enable students and faculty to carry out research and experiments in the domain of Artificial Intelligence/Machine Learning/Deep Learning concepts.

3. The Context

Deep Learning server was procured in the year 2018, which has the following configuration:

1. 1 no x Supermicro 1U Rack Server Chassis with 1600W Redundant Platinum Level (94%) Power Supply
2. 1x Intel Xeon E5-2609V4 8C 1.7GHz 20M 6.4GT/s
128GB (8 no x 16GB) DDR4 ECC Reg. 2400MHz DIMM
3. 2 no x NVIDIA Tesla P100 GPU – 12GB
4. 2 no x Seagate Enterprise Class 1TB 2.5" 6Gb/s 7.2K RPM SATA HDD

The server is formatted and reconfigured to the latest versions of Operating System and tools

1) Operating System Ubuntu 18.04 LTS
2) Nvidia Driver: 450.51.05
3) CUDA Tools: 11.0
4) Docker: 19.03.12
5) Latest tensorflow libraries.

The server can be accessed even outside the home network and is available for usage round the clock.

4. The Practice

The server is accessible to all students and faculty of the Institution. When a request is made by the students/faculty for the access to the server, they will be given with a username and password for the server access. The server enables the user to conduct experiments using various datasets. The executions on the server will be faster than the conventional computer.

5. Evidence of Success

Every year most of the CS/IS students request an access to the server for their final year projects on ML/AI/DL. Faculty researchers also use the server for completing their research work. Procurement of the server has enabled the students/faculty to explore more on Deep learning models which also resulted in the introduction of DL/AI subjects in the curriculum.

6. Problems Encountered and Resources Required

Usage of the server has to be expanded to other departments. Currently majority of the server usage is by the CS/IS students. Increase in the usage of the server among other branches is to be achieved.

I (e): Testing of soil for Agricultural purpose

1. Title ofthe Practice

Testing of soil for Agricultural purpose

2. Objectives of the Practice

To create opportunity for students to learn about the fertility composition of agricultural soil and suggest suitable additions to improve agricultural yield, effective use of fertilizers; problem-solving skills, analytical skills, soil management skills etc, all from a practical view point.

3. The Context

It provides training on Understanding and operating the PUSA STFR Kit to determine the Soil reaction (pH), Electrical Conductivity (EC), Organic carbon (OC), Phosphorous (P), Potassium (K), Manganese (Mn), Iron (Fe), Sulphur (S), Zinc (Zn), Boron (B), Copper (Cu) and Nitrogen (N) parameters and Lime and Gypsum requirements.

Soil testing lab (STL) started in 2020, is a mini consulting project component in the Civil Engineering/Biotechnology program. STL is a social outreach program of the institute to connect with the local farmers and strengthen Society-academia collaboration. In this project, a team of 3-4 students are required to work with farmers or a civic body (Panchayat) on a technical issue. Each team is mentored by a faculty member. Through this, the students would see the worth of what they learn as applicable to down-to-earth practical situations.

4. The Practice

The farmers typically make use of the services of the lab to solve an issue for which it has been unable to allocate appropriate resources. The students would work with the farmer in the respective organization and scope the issue in consultation with the faculty mentor. Further, using various consulting frameworks, or through empirical means, students would do research and come up with actionable solutions.

5. Evidence of Success

This opportunity helps the local farmers in getting consulting. Since this is the 2nd year operation for STL, the institute has delivered about five consulting projects with local farmers.

6. Problems Encountered and Resources Required

Finding the right solution to the farmer multiple problems is a challenge. The main problem is in sampling. If sampling is not done in a specified way the result may lead to inappropriate conclusion which may create imbalance in ecosystem.

I (f) :Texas Instruments Center of Excellence

1. Title ofthe Practice

Texas Instruments Center ofExcellence

2. Objectives of the Practice

To create opportunities for students to learn about microcontrollers and interfacing sensors, actuators and other modules to create innovative project prototypes.

3. The Context

Texas Instruments Center of Excellence lab is offered by TI university program under Texas Instruments and is established in NMAMIT in 2019. It is a program to facilitate the student to build concept technological prototypes. The program provides laboratory facilities for the undergraduate and postgraduate students.

4. The Practice

The Texas Instruments Center of Excellence lab resources are utilized to carry out the project at different levels. The hardware and software resources available in the lab are used to offer training and workshops. Internet of

things (IoT) prototypes are built to test and validate different communication protocols.

5. Evidence of Success

Department of Electronics and Communication Engineering, NMAMIT, Nitte, in association with STEPS Knowledge Services Pvt. Ltd., authorized Partner for Texas Instruments University Program organized six days hands-on workshop on "Embedded System & Wireless Sensor Network for Internet of Things(IoT)" from 6 - 11 January 2020. The Resource person for this event was Mr. V.S. Ramesh, Director and Mr. Rajeev Guptha, Assistant Engineer from STEPS Knowledge Services Pvt. Ltd.

This workshop included the training on following topics

1. IoT and its Applications.
2. The architecture of TI CC3200 which is a wireless microcontroller programmable to wireless (Wi-Fi standard) connectivity.
3. Cloud Application using the MQTT Protocol.
4. HTTP Protocol: Thing speak cloud experiment.
5. Wireless Sensor Network.
6. System design approach for Robotics which used MSP432 microcontroller to program the Robotic kits.

It was structured to meet the needs of the participants to get a very good exposure of Internet enabled systems and their applications.

During the workshop, participants were made to implement the following projects using Robotics Kit.

- Line Follower
- Cloud controlled Robots
- Swarm Robots
- Cobots

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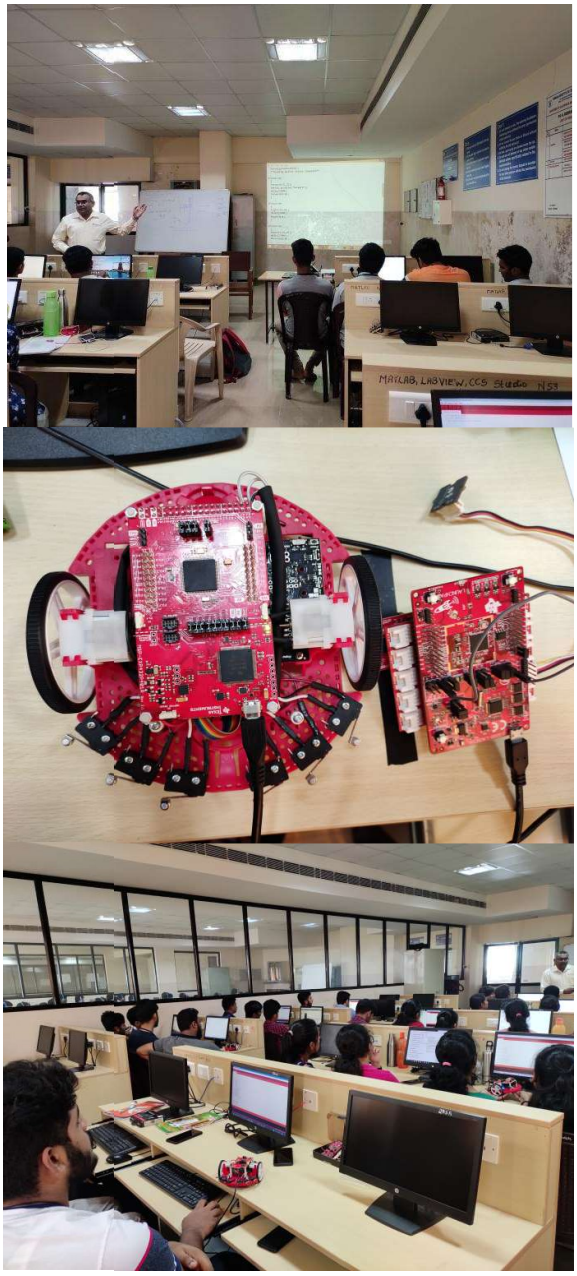
6. Problems Encountered and Resources Required

The IoT modules are to be upgraded.



Best Practices II: Project Based Learning

II (a): Project Based Learning in Biocomputing with SAS Lab

1. Title of the Practice

Project Based Learning in Biocomputing with SAS Lab

2. Objectives of the Practice

Biotechnology engineering students as a study group, a case of implementing a SAS programming practical course through peer interaction blended with a project-based learning approach is presented. The general hypothesis that non-circuit branch students such as biotechnology students dislike programming courses is not true when such courses are structurally taught making best use of ICT and pedagogical techniques. SAS programming is one of the core requirements in Clinical Data Management systems and most of the

companies prefer to hire candidates having sound knowledge of programming in SAS.

3. The Context

The successful implementation of a programming course for non-circuit branches should address two specific areas *viz*. its commercial use (industry) and ease of use or programming. The ease of use referred to here is to make the course more learner centric and reduce the student hesitancy towards programming languages. This is possible by making use of a suitable mix of pedagogical techniques such as peer interaction, ICT, group learning and regular evaluation through objective type questions. Once the student is well acquainted with this programming language, it will be easier for the student to go forward in learning it in depth. Here, it is very important to fix the breadth and depth of the course to overcome the student hesitancy which can be expanded at an advanced learning level.

4. The Practice

SAS ODA is a cloud-based software and operates through many of the major web browsers and on any of the operating systems. Google Chrome web browser (v90) was used for all the web-based activities. The user needs to register and create a profile in the SAS ODA login or registration page (https://welcome.oda.sas.com/login).

Users can register as Faculty or a Student. This course was administered using a blended modes of teaching – learning approaches. These approaches include providing self-learning material, video tutorials, and group project. All the activities were controlled through Moodle 3.1 server (hosted on the Institute server) accessible via intranet as well as internet. A sample of activity page for Lab-7 is shown in Fig. 1. Alternatively, course content delivery could also be done via Google Classroom.

The reading materials to learn the code description and components of software was provided through Moodle. The program files for execution were provided as 3 tiers for each set of codes. The first-tier program file was completely pre-written, and student had to just execute the same. This enables the student to understand what each part of the code performs. The second-tier program was a partially written code which student need to complete and then execute. This second program enables the student to use the concept learnt from program 1 and extend the same. The third-tier program was just a question describing the output required. In this third case, student need to write the complete code necessary to execute the program. Different data sets required to execute these programs were given to the students.

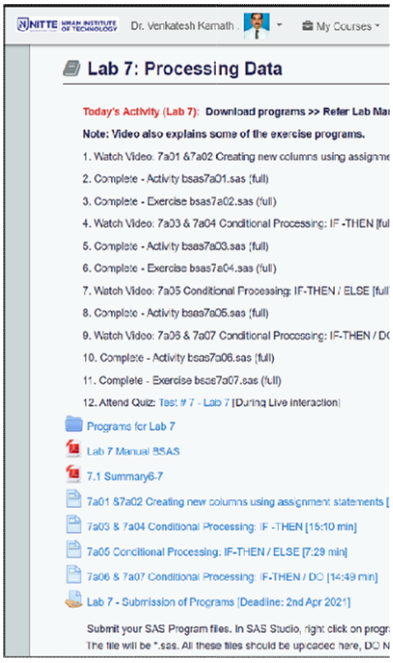


Fig. 1. A sample of activity page for Lab-7

Video tutorials, prepared by the author were provided through the Moodle course page (YouTube link to these videos: https://youtube.com/playlist?list=PLrqvoPRYv-C3ov2nr6mylSO_AKU0VRECD). Some of the videos available in SAS Resources webpage were used for Statistical Analysis and Survival analysis. These tutorials were intended to help the students to understand the tier-1 programs as described previously. In these video lectures, key components such as cognitive load, elements to promote active learning and elements that impact engagement were incorporated

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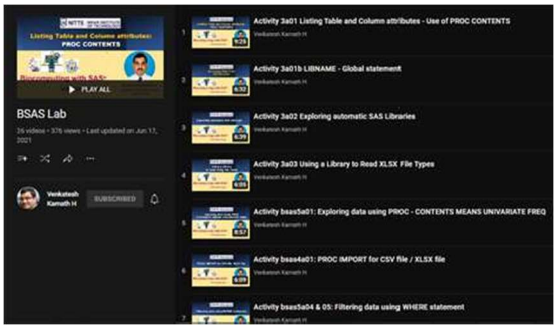

Fig. 2. YouTube Channel for BSAS Lab Tutorial videos

Based on the cumulative scores obtained by the students in w ekly quizzes, four quartiles of students were created. These quartiles refer to Q1 (top 25%) – fast learners,Q2 (upper middle 25%) – above average learners, Q3 (lower middle 25%) – below average learners and Q4 (bottom 25%) – slow learners. The project group was composed of one student each from each of these four quartiles. Students were given freedom to make their own grou s adhering to this composition rule. The students belonging to Q1 category were made the team leaders. The datasheet to work on and a reference problem statement was provided to the teams. Each team had to come up with problem statement that include data description, statistical analysis plan (SAP) or analytics requirements and mock shells. Teams were permitted to modify or include new datasets as per requirement. This exercise helps in understanding real world problems where SAP and Mock Shells are defined by the authorities and teams need to work on it. This activity hypothesizes the enhancement of following skills: teamwork, knowing the depth of a problem statement and realities, understanding the use of codes in a better way, learn to use SAS documentation and SAS communities for help, reviewing of codes and comments, by making use of codes that were not taught in the curriculum (beyond the curriculum). Support and suggestions were given by the faculty instructor at every stage of project execution. Student teams had to present their project work and make necessary changes as required before final submission.

5. Evidence of Success

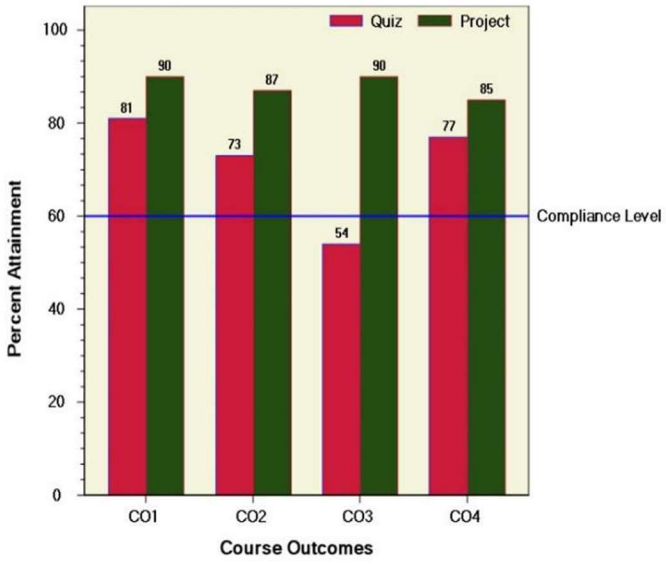

Fig. 3. Percentage attainment of course outcomes through test items weekly quiz and group project work. The attainment is compared with compliance level of 60%. Improvement is observed for CO3 after adapting peer learning activity through group project is introduced. This graph is plotted using SAS Studio.

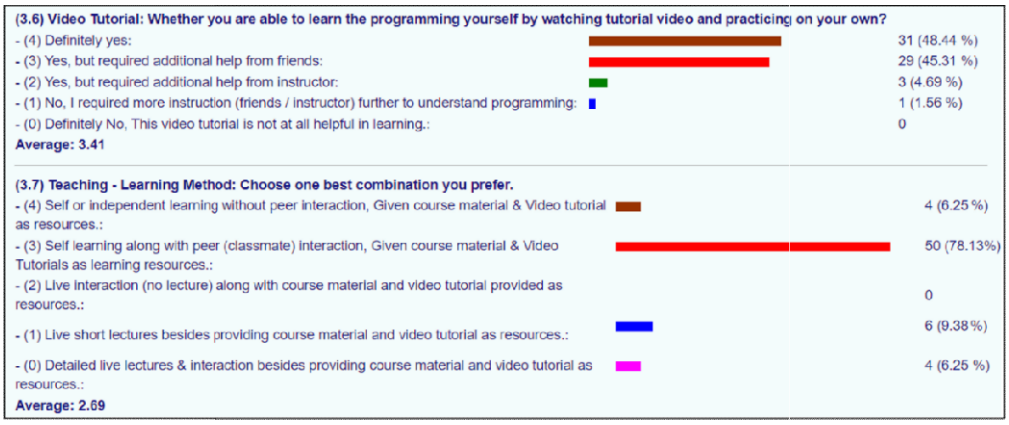

Fig. 4. Response recorded in Moodle feedback report for queries related to self-learning, peer interaction and combinations to execute weekly programming activities.

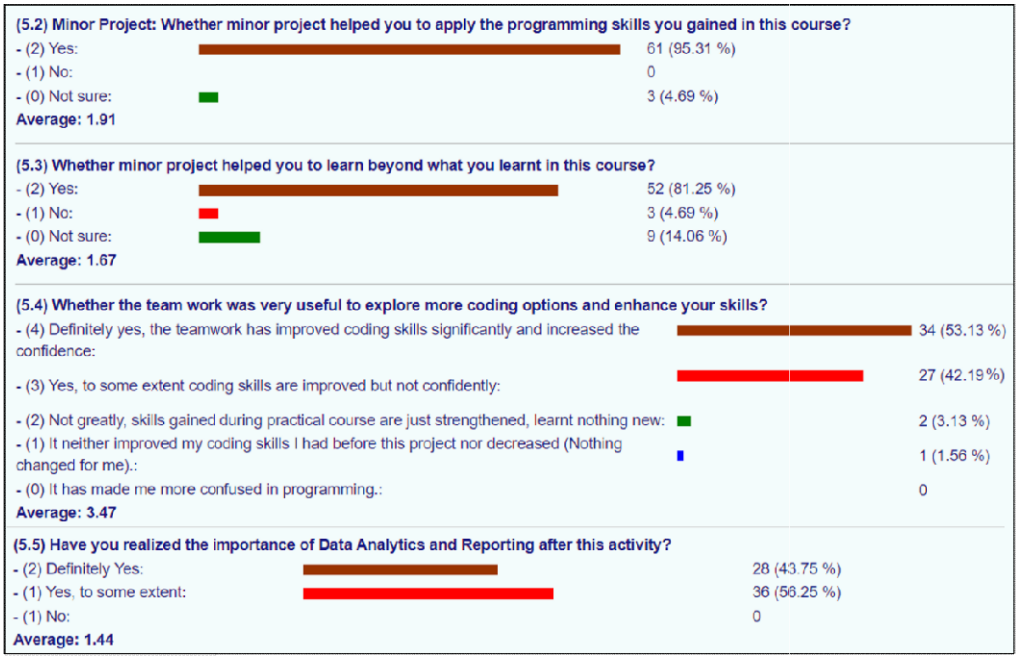

Fig. 5. Response report from moodle to feedback queries related to effectiveness of group project work on deeper learning of SAS programming The outcome of this is published by the course coordinator in web of science indexed journal

Venkatesh Kamath H. Statistical Analysis Software (SAS) Programming Course to Enhance Computing and Coding Skills of Biotechnology Graduates: A Case Study on Learner Centric Approach. International Journal of Educational Sciences, vol. 34 (1-3), September 2021, pp 79–92. [DOI: https://doi.org/10.31901/24566322.2021/34.1-3.1213, ISSN(P): 0975-1122, Indexed: Web of Sci. (ESCI).

6. Problems Encountered and Resources Required

- Requires preliminary knowledge in operating MS Excel or Spreadsheet,
- Requires internet to operate the software,
- Student can learn the software at free of cost but cannot use it for any commercial purpose,
- Requires basic knowledge in statistics.

To implement this practice, either Moodle LMS or Google classroom can be used. Videos can be shared through YouTube

7. Notes

The resources prepared can be used by the students at any time in future as they are available to them in the form of softcopy. They can take advantage of it even after their graduation.

II (b): Problem Based Learning in IoT

1. Title of the Practice

Based Learning in IoT

2. Objectives of the Practice

Project Based Learning (PBL) is a teaching methodology that enables the students to learn by conducting experiments and working on real-time projects. The projects are implemented in teams by the students with continues mentoring from the faculty member. Teams should present the work to faculty at regular intervals during the team meeting, these meetings are also a process of evaluation. It is observed that this method enhances the skill of project development, team work, ability to carry out additional studies based on the need of the project.

3. The Context

The concept of Project Based Learning (PBL) was implemented through the mini projects as a part of some of the subjects. Some of the courses that has a mini project component are Web programming, Internet of Things, Big data, Cloud Computing, Machine learning, Database management system, Computer Graphics. These subjects are spread over 5th, 6th and 7th semesters of CSE.

The project is given with 40% weightage in the internal evaluation of the course. Students are informed to commence with the project work from the mid of the semester. The project has to be related to the theme of the subject. Students are encouraged to select the project topics that address the real world issues from the surrounding or address some research problem

4. The Practice

Internet of Things (IoT) subject is taken as case study for the demonstration of the PBL. The subject was offered as elective for the 6^{th} semester students of Computer Science and Engineering (CSE) branch. The subject deals will the theory and practice of using the IoT concepts and demonstrates its application to the real world problems. The course contents include an introduction to the hardware sensors, Arduino programming concepts, board structures of Arduino and Raspberry Pi, basics of python libraries for raspberry Pi. The concepts that are discussed in the course are to be demonstrated using a mini project. Additional study is also required to carry out the project.

PBL was applied in this course by giving more importance to mini projects that address the real word problem. Theory concept that are studied are applied to the mini project.

5. Evidence of Success

Some of the faculty members at NMAM Institute of Technology, Nitte has made an attempt to introduce project based learning in the courses being taught by them in the engineering curriculum. A survey is conducted among the students and faculty of computer science and information science branches to know the effectiveness of implementation. From the survey results, it can be observed that the PBL will help the students to gain sound knowledge in the subject, to get and exposure to the problem solving skills and team work. It can also be observed that, the process needs more investment of time from student and faculty side. Mentoring by the faculty on regular basis is expected by the students, giving additional inputs will be an added advantage. Individual evaluations are to be carried out for the work at regular intervals. It is observed that, students expect regular team meeting whenever they complete a major stage and inputs from the faculty to proceed further. Students prefer to select the problem statement them self. From the results

of the survey, it can be observed that, the students are happy with the methods adapted by the faculty. It is also suggested to bring some changes in the process in order to make the process more effective.

Conducting a regular team meeting will result in good outcome in terms of project completion. As the number of students in the class increases, it is a challenging task for the faculty to have the meetings. If the classes are in online mode, following up of the work with the students is challenging. Properly designed rubrics will help in the correct evaluation of learning outcome. Institutions are also having the challenge of providing adequate resources for all the teams. Faculty are expected to have a clear knowledge of PBL to carry out the implementation effectively. Sufficient amount of device and other equipment are required in the institution for carrying out of the projects.

6. Problems Encountered and Resources Required

- It is observed that, regular team meeting will result in good outcome in terms of project completion. As the number of students in the class increases, it is a challenging task for the faculty to have regular interactions with the student teams and the process expects a lot of investment of the time and effort from faculty side.
- If the classes are in online mode, following up of the work with the students is challenging. Motivating the students to do innovative and reducing the plagiarized content is a tedious task for the faculty. A well-defined rubric will help in the correct evaluation of learning outcome.
- Institution is having the challenge of providing adequate resources for all the teams. Faculty are expected to have a clear knowledge of PBL to carry out the implementation effectively. Sufficient amount of device and other equipment are required in the institution for carrying out of the projects.