Improving Student Outcome through Flexibility in Teaching and Evaluation Methods

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Abstract: As engineering education is becoming easily accessible, many students from diversified background are getting enrolled i.e., from different regions/states where their educational policies adopted during their school education is different. Bringing these diversified students to cope up, build their higher order skills to analyse and inculcate creativity, flexibility in teaching and evaluation is required. Although many institutions are given autonomy to design their courses and curriculum, when it comes to implement in classroom teaching, still the conventional mode of teaching and evaluation dominates the educational system. The outcome of autonomous learning was evaluated through a detailed survey taken from 265 students for python programming course and its outcomes are compared with conventional practices. While using conventional practice, students were not able to analyse and devise solutions to problems independently. They were not able to transform and apply the learnt concepts for real time applications and their learning outcome was found to be 52%. This mode of teaching has enhanced the higher order thinking skills, creativity, imagination, problem solving and conceptual understanding of our students. This paper realizes the advantages of autonomous courses by evaluating the results received from various evaluation surveys for 'Python Programming' autonomous course with students and teachers.

Keywords: Autonomy education, Sustainability, higher order skills, Student outcomes, Assessment Methods.

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1. Introduction

Currently, lot of innovations are brought in the field of engineering education and autonomy mode of teaching courses has promoted students' knowledge towards experiential learning compared to conventional practices (Tong Zhang et al., 2020). This mode gives the teacher the freedom to exercise his/her experiences to improve the students' understanding, thinking and creative levels so as to enhance their outcomes. This mode of teaching provides conceptual, practical and real time exposure to the student community (Vekic et al., 2020). The adaptation of diverse instruction strategies like classroom lecturing, guided learning, industry evaluations, practical implementation, exploratory demonstrations, open book assessment and project evaluation integrated with online tools creates an inimitable learning path for each learner and takes the teaching/learning process to the next level by creating awareness to students on concept understanding and its implementation (UNESCO, 2015).

The autonomy in engineering education is gaining its popularity due to its added benefits to both the teaching and student community (Panel et al., 2020). Recently, a lot of researches have been incorporated to demonstrate on how these modes of active learning improve student competence in their domain (Cebrián et al., 2015). Contrasting the conventional teaching-learning approach wherein many students lose interest due to over emphasis on memorizing rather than learning and applying concepts, field surveys, practical/industry exposures and other interactive modes help the students in gaining higher order skills expected from an engineer (Pérez et al., 2018). This paper describes the student outcome improvement by analysing the course survey on "Python programming" course handled both through conventional and autonomy mode. The rest of the paper is organized as follows. The first section describes the related works on student outcome improvement and the role of autonomy on outcome improvement. Section 3 describes the overall methodology implemented for the "Python Programming" course which is followed by Section 4 which demonstrates on the student outcome, result analysis and the improvement gained through a case study. Finally, Section 5 concludes the work.

2. Related Works

IT sectors demand students skilled in innovative thinking and capable of coping with the technological growth. In-order to inculcate these skills, students has to be educated with high order thinking skills (Onah et al., 2017). Hence, the educational methodologies have to be transformed to experiential and participative mode, so as to ensure that there are no longer passive participants (Price, 2015). In order to achieve the above goal, the faculty members are empowered to exercise flexibility in mode of teaching and evaluation (MacLeod et al., 2018). A faculty can choose, non-conventional assignment, typical quizzes, experiment based evaluation, research article based evaluation, evaluation by industry expert, conduct open book test, organize student seminar, promote peer evaluation,

model/design development and project based evaluation. This can help the students to understand the concept clearly, analyse/solve complicated problems and guide them towards self-governed and lifelong learning (Kinshuk et al., 2016). This work considers a UG level course on "Python Programming" for assessing the student outcome. Each course outcome of student attainment was evaluated based on rubric metric.

3. Evaluation Methods and Implementation

In-order to assess the student outcome by comparing the conventional mode of education with progressive methodology adopted by effect of autonomy in teaching and evaluation, six methodologies were identified to address most categories of the students namely, assignment, quizzes, mini project, research paper analysis, industry expert evaluation and open book evaluation are adopted as depicted in Fig. 1.

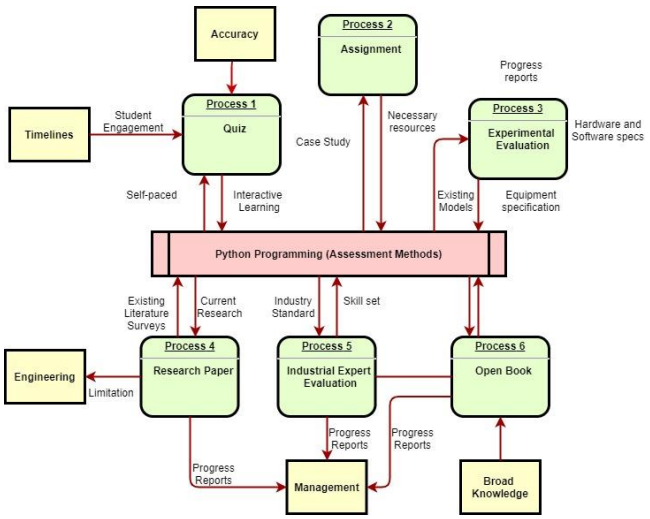

Fig. 1 Assessment Methods for Python Programming Course

A. Quiz Based Evaluation

The students were trained with lots of learning resources and they were provided easy access to the course related materials by creating a repository of e-contents. Most of the materials were taken off the web and prepared inclusively for better learning. Simple periodic evaluation was conducted in the form of multiple choice, fill ups and true/false questions. Since, python programming course is a foundation course for all computer science first year engineering students, the deeper understanding of the course is essential as it may also affect the outcome of the subsequent courses. Students were given provisions for representation of question and answer feedback. The comprehensive way of adopting quiz based evaluation is a greater challenge especially with the programming language like Python programming. The questions were made to address the basic concepts behind the programming language and also it provides the opportunity for the students to increase the decision making capabilities. Fewer questions were also asked to test the programming capability of the student. The questions were taken in the proportion of 1:2:3 (i.e. 17% of questions were tough only students with through knowledge can answer such questions and 33% of questions were related to the programming fundamentals and 50% of questions addresses the contents of the class room teaching).

B. Open Book Evaluation

This evaluation enables the student to analyse or apply their knowledge and their learnt concepts under real time problem scenario. This is a time constrained evaluation mode where the students were asked to carry their text books or any other printed materials to the examination hall. This evaluation strategy enables the student to review on various sources for finding the answers and apply integrated results from different contents they have reviewed. This makes them deeply probe in to the material and complements a learner centric approach in engineering education. The questions given for the assessment is based on cognitive levels which are just beyond the concept visualization, reasoning and problem solving. The method exhibits the level of problem solving in the real time working scenario. The questions are created in such a way that, more emphasis is given for error free programming for the existing problem, rather than going for an imaginary problem.

C. Assignment Based Evaluation

Students were assessed through two different modes of assignment evaluation which includes traditional assignment procedure (direct method) and negotiated assignments. In the direct mode, students were given assignments on the case study of their learnt concepts and the rubrics for awarding marks is informed to students. The students were asked to submit the same within a specific deadline and they were evaluated based on the rubrics and their assignment scores are displayed in the portal. In negotiated assignment mode, students were given flexibility in selecting their assignments and an initial lecture was conducted to demonstrate on the instructions to follow while submitting the assignments. They were also asked to make up an oral presentation and class discussion on their assignment. In this mode of evaluation, students were trained to adopt and search solutions based on the global scenario, say a real time solutions done in the case study. The evaluation method for the assignment is transparent. The methodology increases the self-learning capability of the students, where student find palpable solution for the problem by themselves.

D. Industrial Expert Evaluation

This mode evaluates the students' ability based on the industry requirements. Though many colleges organize frequent guest lectures, workshops and field visits to industry for their students, the learning need not actually take place what is expected. An evaluation by the industry expert helped the students better understand their

preparedness to meet the expectations from the industry. Accordingly a final evaluation was done by the industry expert in our premises to assess the understanding, analysing and creative skills of our students.

E. Research Paper Writing

In this mode of assessment, students are organized as small groups and they were asked to plan, design and give the Software requirements specification (SRS) of their plan on addressing a real time problem. Students were asked to make a literature survey to gather different sources of information related to their selected domain or area of interest. Then, they were asked to prepare a presentation based on their identified objectives which will be checked by the evaluation team for its feasibility. The learners are given guidance to modify the existing work or to create new ones. The students were asked to focus on real time problems with live experiences to create an authentic learning experience. Their detailed design on the project is evaluated by the review team and the students are guided to implement their proposed work. The students are asked to transform their implemented project into research paper.

F. Experimental Evaluation

A list of practical exercises are prepared and verified by the evaluation committee and the students were made to create their own programs by applying the concepts learnt in their classroom experience. This mode of experimental learning enables the students to apply the syntax and semantics. This enhances the problem solving skills of the student and helps them to solve real world problems effectively. Students were made to do their practical and they were evaluated on rubrics assigned for each exercise.

4. Results and Discussion

The outcome of this course on python programming was evaluated through a detailed survey taken from 265 students and also a comparison was made using conventional practices. Students who underwent conventional mode of learning were not able to analyse and devise solutions to problems independently. They were not able to transform and apply the learnt concepts for real time applications and their learning outcome was found to be 52% (i.e. the percentage of students whose satisfactory level is more than 60%). The conventional teaching methodology was upgraded through autonomy based teaching for the above course based on the feedback received from different stakeholders like students, parents, teachers and industry personals. This change has evolved and reshaped the learning process by making the students more skilled professionals than learners. The evaluation was done every week, and a survey on the time spent by students in each activities of the subject is monitored.

A. Comparison of mark percentage in various Assessment methods

The attainment of each assessment method was evaluated on a 5 point scale by using different set rubrics for each assessment. Periodic quizzes were done in every week through moodle platform and other interactive quiz tools to link the concept learning with understanding and analysing levels. Open book assessment was conducted at the end of course completion and students were given assessment to test the cognitive skills which are just beyond the concept visualization, reasoning and problem solving. Students perceptions were assessed through assessment tasks like evaluations, peer reviews, online evaluations, participative and experimental learning. The percentage of mark attained with each evaluation is depicted in Fig. 2.

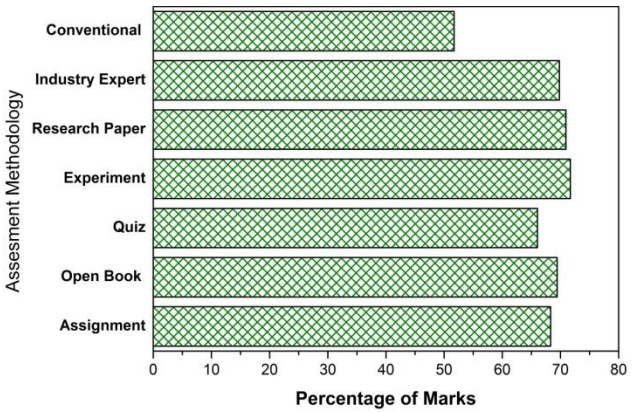

Fig. 2. Percentage of marks on various assessment methods

The course outcome was evaluated by analysing 265 students in 6 different assessment modes. In assignment evaluation, among the 265 students 86 students were in exemplary and 95 students in accomplished level with a total of 181 students with an overall score of 68.3%. In open book assessment, 90 students were in exemplary and 94 students in accomplished level with a total of 184 students with an overall score of 69.43%.In quiz and experiment based learning, attainment was 175 and 190 students with an overall score of 66.04% and 71.70 respectively. Research paper writing category, 188 students attained at exemplary/accomplished level with an overall score of 70.94%and in industry expert evaluation 185 students attained at exemplary/accomplished level with an overall score of 69.81 respectively whereas the conventional mode of teaching/learning process achieved only 51.69% which was evaluated from previous semester results. Figure 3 represent the deviations in mark for all the evaluations by calculating the standard deviation of the scores. This is depicted through an error bar as follows.

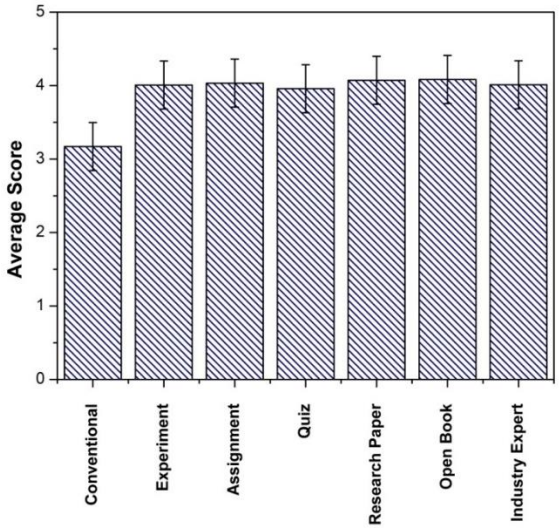

Fig. 3: Variation in mark for different assessments

B. Distribution of marks in each assessment method

The mark distribution in each category was evaluated through continuous assessments, checkpoints and the comparison graph is depicted in Figure 4. The comparison was done on 265 samples on each assessment method and the range of students in each category was evaluated on rubrics score. In the conventional mode 125 slow learners were identified and most of the fast learners i.e. 73 students were in the moderate category in achieved level. But, this autonomy mode has made the fast learners to exemplary level and has transformed slow learners from beginners to developing category. The number of students achieved in each range of marks is depicted in Figure 4.

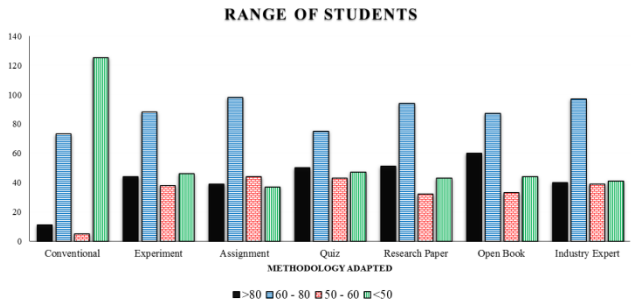

Fig.4. Mark distribution using various assessment methods

5. Conclusions

This effectiveness and the impact of deploying autonomy in engineering education towards improvement of student outcomes have been described in this paper. Although, this mode of assessment is time consuming and complex for both the faculty members and students, its learning effectiveness and outcome acquired outperforms the conventional teaching/learning practices. Based on the analysis results, at an overall 138/265 students were found to be in exemplary in different levels and they have attained the course outcomes. Also, 39 slow learners have transformed to the developing level and they are able to achieve and reform themselves based on industrial perspective. Hence, this mode of autonomy in teaching and evaluation was found to have much impact on improving the competence of students has enhanced the higher order thinking skills, creativity, imagination, problem solving and conceptual understanding in them.

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