

Creating a Learner Centric Environment Through POGIL

Our experience in engineering and management education in India

Sandhya Kode

EnhanceEdu

International Institute of Information Technology

Hyderabad, India

skodev@iiit.ac.in

Jyotsna Cherukuri

VNR Vignana Jyothi Institute of Engineering and

Technology

Hyderabad, India

jyotsna_c@vnrvjiet.in

Abstract—Engineering education in India is primarily through lectures and little emphasis is on student involvement. To enhance the skills of the students/learners they need to be involved in the learning process. This paper describes the use of Process Oriented Guided Inquiry Learning (POGIL) in an engineering and management college in Andhra Pradesh, India. Though POGIL has been developed and validated extensively over the last 15 years in the US, it is quite new in the Indian scenario and in Engineering and Management education. The authors share the process steps followed in introducing POGIL in the classroom and highlight the changes that they observed in the students and the teachers after introducing POGIL. The authors observed increased classroom interaction and improved grades in students. These positive findings encourage the authors to further use POGIL in engineering and management and spread POGIL to other colleges.

Keywords: POGIL; guided inquiry learning; student centric learning; process skills; team based learning; blended learning

I. INTRODUCTION

According to Pancham and others, the quality in education is evolving at a quick rate [1]. There is need for us to shift from the traditional teacher-centric approach, largely a broadcast model of learning, to a learner-centric approach to enable students to acquire the new 21st century knowledge and skills [1]. To allow students to move towards competence, they must be actively engaged in the learning process [2]. Rather than simply studying subjects, students should be solving real world problems, producing original writing, completing scientific research projects, dialoguing with others on important issues and constructing physical objects as models could be some approaches [3]. According to Newby et al, a teacher should transform from knowledge transmitter to that of learning facilitator, knowledge guide, knowledge navigator and co-learner with the student [4]. Once such a rich and interesting environment is provided, and add to this a supportive teacher, students will be more responsible for their own learning. They will search for, find, assimilate and share the knowledge with others.

In this context, POGIL (Process Oriented Guided Inquiry Learning) has emerged as an effective learning technique in higher education at school as well as undergraduate college levels globally. This approach helps in stimulating their creativity and drives them in integrating research into their learning experience [5].

Our main objective was to design POGIL activities for engineering and management disciplines, as there were very few activities in these domains. We then wanted to measure the effectiveness of this approach compared to traditional approaches to teaching and learning. As this process entailed huge effort, an elaborate roadmap of implementation at

Vignana Jyothi Institutions was drawn up expanded from the POGIL India roadmap [6].

II. BACKGROUND

POGIL has been used extensively in the US in domains like Chemistry, and also in Materials Science and Engineering [7] and Computer Science [8]. POGIL employs the guided inquiry approach to develop students' understanding in a three-stage manner: exploration, concept invention/formation and application [9].

In the exploration phase students attempt to explain or understand the material that is presented by proposing, questioning and testing hypotheses. The second phase involves concept invention or concept formation. Once the concept is identified and understood, it is reinforced and extended in the application phase. In the application phase, learners use the new knowledge in solving exercises, problems and even research situations.

One of the principles that characterize POGIL as a teaching strategy and philosophy is the explicit emphasis on the development of process skills (Fig 1) such as critical thinking, teamwork, information processing, problem solving, oral and written communication, all of which are important components of the student learning process[10].

A POGIL classroom consists of a number of students working in small groups with individual roles, on specially designed guided inquiry materials. In the POGIL class room, a teacher is not the expert provider of knowledge, but rather guides students in the process of learning, in developing skills, and in developing their own understanding. Involving the whole class in discussion increases motivation and performance and provides them with opportunities to develop communication and thinking skills [11].

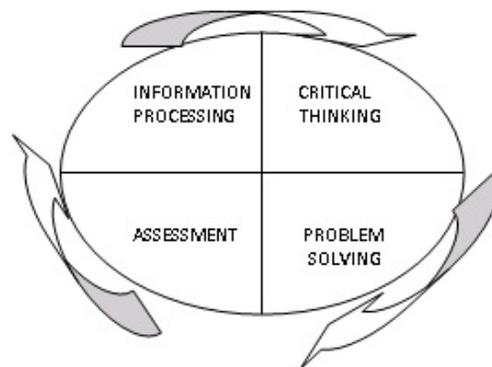


Figure 1. Process skills to be inculcated in students

One of the values of POGIL is the process of assessment, which is done by SII [12]. SII stands for Strengths, Improvements and Insights. It gives specific, detailed and constructive feedback. The SII process provides feedback to an instructor focused on improving classroom facilitation skills, to students learning how to work together in a group, to an author designing a new POGIL activity and to many other audiences.

III. METHOD & WORK DONE

POGIL as a teaching and learning tool was introduced at Vignana Jyothi Institutions - VNR Vignana Jyothi Institute of Engineering and Technology (VNR VJIET) and Vignana Jyothi Institute of Management (VJIM) in Hyderabad, India to enable the faculty to offer effective learner-centric classroom pedagogy.

VNR VJIET is an NBA and NAAC accredited and autonomous engineering college with 4000+ students that is aiming at education excellence and targeting to be a deemed university. VJIM is a Management school offering a 2 year post graduate diploma in management.

To begin with, the authors attended a POGIL facilitator training in South Carolina, USA, followed by 3 weeks of shadowing professors who used POGIL in their classrooms, in Philadelphia area, USA. Later, Intro to POGIL-a one day workshop, was organized for 107 faculty members of VNR VJIET and VJIM from different engineering and management disciplines. This was followed by a number of in-house POGIL workshops (refer Figure 2) scheduled as per the roadmap. These workshops helped the faculty to enhance their motivation, enthusiasm, confidence and creativity along with higher levels of critical thinking and also instill the spirit of working in a team.

To enrich the faculty in crafting POGIL activities and in facilitation, a three-day international workshop REIMAGINE STEM*(Reviving Education by Implementing Active and Guided Inquiry Experiences in Science, Technology, Engineering and Math+Management) was held in VNR VJIET campus [13, 14]. A pre-workshop schedule was chalked out as a preparation for the 3-day international workshop which included informal review of activities designed by the faculty, a template for designing POGIL activities and strategies for implementing POGIL in the classroom. The international workshop facilitated by POGIL US team and the authors, exposed the participants from different domains to Beginning/ Intermediate Classroom Facilitation and Advanced Classroom Facilitation, as well as Intermediate and Advanced Writing of POGIL activities. The discussion on DCV (Direct, Convergent and Divergent) questions as part of structured activities laid down a platform for writing of POGIL activities and was very helpful in generating ideas catering to various learning styles especially kinesthetic learners. This elaborate process was required to ensure that proper POGIL activities are designed in subjects so they can actually be used effectively in the classroom.

The outcome of the workshop was to help the faculty in identifying threshold areas in their domains, designing activities and finally implementing the same in their classrooms. The faculty members took part with great enthusiasm in all sessions and showed great interest in learning and designing POGIL activities, a few of which are outlined in Figure 3. They understood their strengths and weaknesses clearly in a group and imbibed the intricacies of generating curiosity and interest in their students.

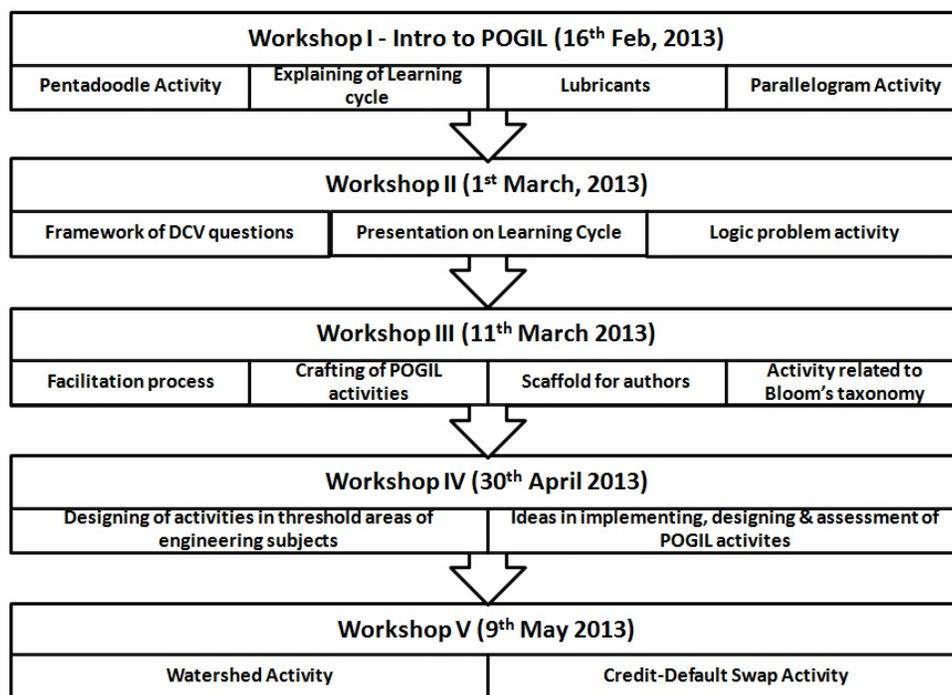


Figure 2: In-house POGIL workshop activities

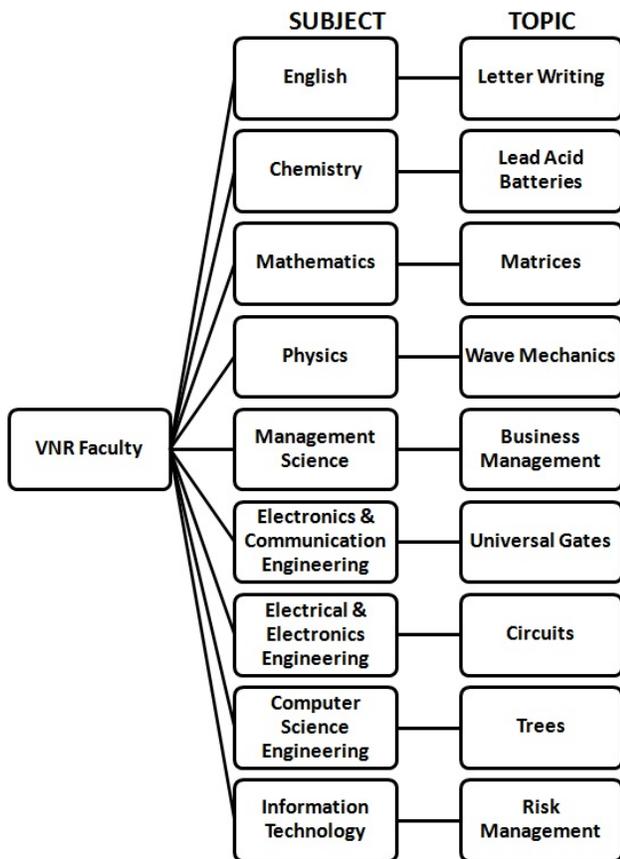


Figure 3: Threshold topics for which POGIL activities have been designed

IV. RESULTS & OBSERVATIONS

For Engineering:

In VNR VJMET, where teachers used POGIL in the classroom, over 80% of them developed at least one POGIL activity. We studied the impact of using POGIL in the classroom for one particular subject, Engineering Chemistry. This is a required subject for all first year students of engineering (total 540 students taught). Before POGIL was used in the classroom, faculty conducted the classes through lectures only. A comparison of lecture based approach used in the academic year 2011-12 and lecture+POGIL approach used in the academic year 2012-13 was performed for the 540 engineering students of first year. The students were taught by the same four faculty members of engineering chemistry. Our observations showed a marked decline in the number of failures from 54 (2011-12) to 26 (2012-13) and a significant increase in the number of students securing above 90% marks (see Figure 4).

From a student survey, we gathered that the methodology helped students in acquiring better concept understanding and improving their critical thinking. Teaching through POGIL created a large impact on the process of learning among students and improved their learning and analytical skills. Students felt that POGIL helped in making learning easy and fun. They liked working in teams as it helped

instill confidence. They liked the participative approach and were motivated to learn.

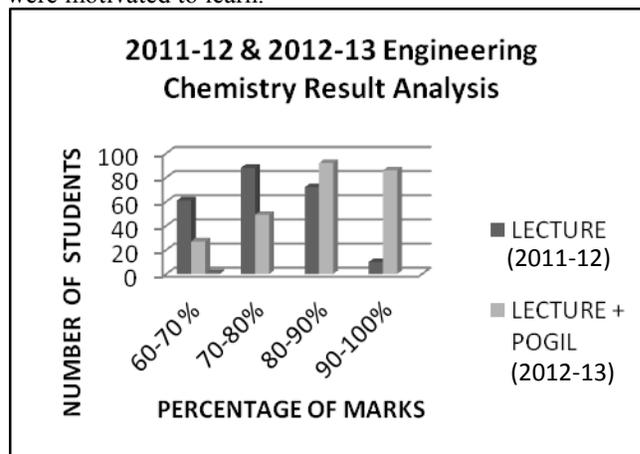


Figure 4: Result Analysis of a lecture and lecture + POGIL based classrooms findings

For Management:

At Vignana Jyothi Institute of Management (VJIM), POGIL was implemented as one of the pedagogies for student learning. A one month reverse orientation program was conducted to reorient and reinforce students, who had completed their first year, with basic concepts to prepare them for the next academic year. In this program POGIL was incorporated along with the Socratic Method as a teaching methodology for 209 students in a single auditorium style classroom, proving that POGIL can be implemented for a large group of students. It was observed that POGIL played a vital role in the delivery of a curriculum and facilitated preparation of learning objectives as per the Bloom's Taxonomy and allowed for customization of rubrics in student assessment. Inter-disciplinary concepts, Case Studies and Caselets were introduced and discussed through POGIL in management education.

Any new pedagogy when introduced will not be effective for continuity unless feedback on the pedagogy is collected and analyzed for productive learning giving scope for improvement. Hence a questionnaire was prepared for the same and administered to the students after the completion of the Marketing module during the reverse orientation program. Based on the frequencies and cross tabulations of the feedback data, **97% of the students agree that due to POGIL method of teaching they could learn and understand the concepts of the Marketing subject with clarity and better than the regular classroom teaching.** 100% of students in the 'B' CGPA category, 98% students in the 'A' CGPA category and 95% in the 'D' CGPA category agree to the same. Based on Chi-Square test, it was concluded that this opinion of students is independent of their CGPA scored in the first year.

After introduction to POGIL followed by several POGIL activity sessions and deliberations amongst the authors they found that POGIL can be equally applied to Social Sciences [14]. Having seen the benefits of POGIL, VJIM is planning to implement it for different trimesters in the future academic years.

V. CONCLUSION

POGIL, a learner-centric teaching method helps in achieving learning with a lot of ease and fun in a friendly environment of their peers. The work thus far at VNR VJIET, the engineering college and VJIM, the management school has met with good initial success. We have had very positive experiences of having improved student grades and process skills in a first year engineering course with 540 students. In the Marketing reverse orientation, 97% students agreed that POGIL was better than classroom teaching in understanding marketing concepts. POGIL helped to create high levels of critical thinking and problem solving and also helped in conceptual clarity, student engagement, communication through cooperation and reflection. Working in teams made students imbibe qualities like patience, valuing other's thoughts, better listening and improved creative thinking. This inquiry-based team environment energizes students and provides instructors with instant and constant feedback about what their students understand and misunderstand. The teachers are enjoying their new roles as facilitators and are exploring innovative ways of designing POGIL-like activities and creating a learner centric environment in engineering and management disciplines.

VII. FUTURE WORK

We expect to increase the number of faculty actively designing POGIL activities for engineering disciplines and collaborate with other institutes and POGIL India efforts.

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