

POGIL - A New Dimension in Higher Education

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Abstract : Education is the light that shows the right direction and helps to achieve ones goal. A good and innovative teaching helps to produce knowledge rather than simply reproducing knowledge. A paradigm shift from teacher centered instruction to learner centric instruction will direct a student towards real time innovation. Hence, a new dimension in higher education called POGIL, an activity based learning has been designed to empower the students with conceptual knowledge. This team based learning enhances the thinking skills among students and has both personal and academic benefits. From the feedback obtained from both the students and the teachers after successful implementation of POGIL, it was confirmed that this learning technique improved their communication skills, listening skills, problem solving skills and gave an in depth knowledge of the subject.

Key words: POGIL, teacher centered, learner centric, activity based learning.

1. Introduction

Innovation in any field is the key to so many global problems. In traditional methods of teaching students are considered as empty minds in which teacher fills the concepts adopting a suitable teaching methodology. But gone are the days where student is passive and teacher is active. The human mind has limitations on the rate and amount of new information it can accurately assimilate and comprehend, any strategy that attempts to transfer knowledge more or less directly from teacher to student-"teaching by telling" is ineffective for many if not most students [1]. To meet the changing education scenario a good teaching may be designed to affect maximum learning [2]. A lecture class no longer entails simply a scripted delivery of information (no matter how well done) but it may also include a variety of active learning techniques that truly engage students in learning [3]. The purpose of education should not be just making them graduate, but should be designed in a way to enrich with thinking capabilities, problem solving skills and conceptual knowledge. To move students towards competence, they must be actively engaged in the learning process, involve in research projects and try to find solutions to the real world problems.

A learner centric program always enables students to focus on true learning giving priority to concept building and individual development. There are varieties of teaching learning techniques to motivate and elevate the student standards so as to meet the global challenges [4]. One such technique is POGIL

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(Process Oriented Guided Inquiry Learning) a new dimension in higher education [5]. POGIL is a student-centric instructional approach that develops critical thinking, effective communication and team work. This way of learning helps to trigger the minds and helps students learn in a better way when they are actively engaged in thinking both in the classroom and in the laboratory [6]. It is an activity based learning which focuses on core concepts and encourages a deep understanding of the topic with higher order thinking skills. It helps students learn to analyze and draw conclusions on a core concept.

The main objectives of POGIL:

POGIL, an activity based, student/learner centric technique aims at developing team work, process skills, and engages students in learning and thinking. It improves attitudes towards science and technology giving a perfect platform for pursuing research.

In a POGIL classroom teacher is not the expert provider of knowledge, but guides the students in the process of learning in developing skills and better understanding.

2. Methodology

POGIL methodology was developed upon notions of independent learning and individual development. This method empowers students to take responsibility for their own learning and fosters the possibility of deeper learning across a range of different areas. This particular style of teaching allows students to challenge their own knowledge and skill levels to reach their goals.

A POGIL mode of teaching and learning can be implemented while introducing a particular unit, a difficult topic, and some threshold areas where a deep conceptual knowledge is required. It can also be used when lecture mode is not efficient and for reviewing or checking for proper understanding. The whole lot of the prescribed syllabus need not be taught in a POGIL style. There are four main phases in POGIL, as shown in fig 1.

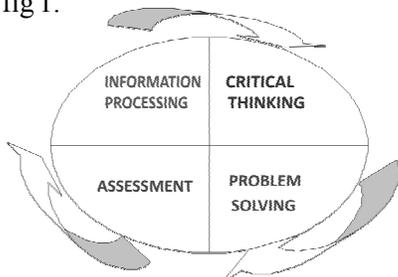


Fig 1: Phases of POGIL

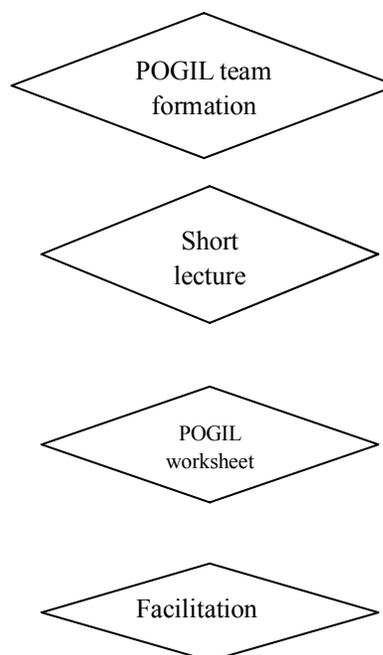
Characteristics of POGIL activities

The POGIL activities are designed as learning tools and not as assessment devices. The main characteristics of POGIL activities are:

1. Activities should be designed for use of a self-managed team with teacher as a facilitator of learning rather than source of information.
2. The material should guide students through an exploration to construct, deepen, refine and understand the content.
3. Application and development of at least one of the targeted process skills is embedded in the structure of a POGIL activity.
4. Students are expected to work collaboratively and draw conclusions by analyzing information and discussions.

How does POGIL pedagogy work?

A POGIL class consists of students working in small groups on specially designed guided inquiry materials. These materials supply students with data or information to interpret, followed by guided inquiry questions designed to lead them towards a valid conclusion. The working of POGIL can be depicted in the following flowchart.



A typical POGIL team comprises of four members-a manager, recorder, spokesperson (presenter) and reflector (strategic analyst). This inquiry based team environment energizes students with their roles assigned as, Manager- manages the group, Recorder-records the group discussion, Presenter- presents the conclusions of the discussions, Reflector- observes and comments on group dynamics. After the roles are assigned a short lecture on the topic is given and a POGIL work sheet is distributed. The instructor facilitates the interaction within the group and students learn by constructing knowledge.

During the POGIL activity, instructor or the facilitator monitors the progress of the groups and guides them to the solution without giving the answer directly. The role of the instructor-as-facilitator is to help students understand that they already possess the background and the reasoning skills necessary to develop new concepts and solve unfamiliar problems [7]. Involving all the students in the activity provides them the opportunity to develop their skills. Presenter from various groups may be asked to share their team member's responses about the activity. A POGIL activity often takes more time than a lecture based teaching but since it is an outcome based learning it can be implemented at any level of education with higher efficiency.

Structuring of POGIL and POGIL-like Ideas

The Journey of POGIL India started at IIIT Hyderabad in 2012. The inspiration drawn at IIIT paved the way in the opening of a new chapter of POGIL (India) at Valluripalli Nageswara Rao Vignana Jyothi Institute of Engineering & Technology (VNRVJIET). A number of ideas were implemented in the classroom and in the laboratory in executing POGIL.

□ Fundamental concepts of each unit may be introduced not through POGIL activities but through POGIL-like activities namely discovery learning, guided enquiry etc.

□ A review session shall be conducted as a POGIL activity for each of the five units in the (autonomous) syllabus, ideally at the end of every "even week", i.e. Weeks #2, #4, #6, and so on, until the end of the syllabus/semester.

□ An interim POGIL activity shall be assigned to students as homework at the end of every "odd week", i.e. Weeks #1, #3, #5, and so on, until the end of the

syllabus/semester, when approximately one half of the content in each unit is completed

□ POGIL approaches can also be used for developing laboratory experiments [8]. Lab experiments can be designed as per the POGIL frame work and can be implemented. For few experiments activity can be done before and for others after the experiments. Both the ways have their own benefits.

□ Students will show great enthusiasm to participate in the group activity and may explore themselves by making charts and models to present the activity during report out.

□ A POGIL like activity may be implemented in which frequently asked questions, analytical questions, knowledge based questions i.e DCV (Direct, Convergent & Divergent) questions from each unit may be framed as per Blooms Taxonomy and can be given to the student groups in the classroom. After the discussion they will come up with the answers. This helps the students fare well in the exams and may reduce the failure percentage.

□ A Guided enquiry may be done in the classroom in which after the explanation of the concept students can be asked to frame questions. This helps the students to understand better and to recollect the points discussed during the class.

Chemistry learning can be made easy and effective by implementing active learning methods[9] [10]. To bring successful learning in chemistry, POGIL is implemented in Engineering Chemistry course with Guided Inquiry learning activities for the Ist year B.Tech students at VNRVJIET.

3. Results And Discussions

The students experiencing a POGIL approach in class reported significantly higher improvements in their process skills compared with those students whose classes were taught in a lecture format. [11]

To understand the effectiveness of POGIL, results obtained in Engineering Chemistry course is compared with and without implementing POGIL in the classes. The comparative analysis is shown in Table 1.

Table 1. Comparative result analysis of Engineering Chemistry course with and without implementation of POGIL in 2013-14 and 2014-15 years

WITHOUT POGIL (2013-14)			WITH POGIL (2014-15)		
Marks range	Number of students in the range	% of students in the range	Marks range	Number of students in the range	% of students in the range
<=40	19	6%	<=40	6	2%
41-50	43	15%	41-50	10	3%
51-60	61	20%	51-60	13	4%
61-70	84	28%	61-70	31	11%
71-80	61	20%	71-80	61	20%
81-90	30	10%	81-90	100	34%
91-100	2	1%	91-100	79	26%
Total	300	100%	Total	300	100%

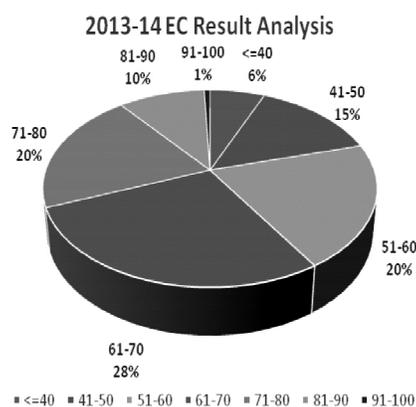


Fig 2. Result analysis without POGIL

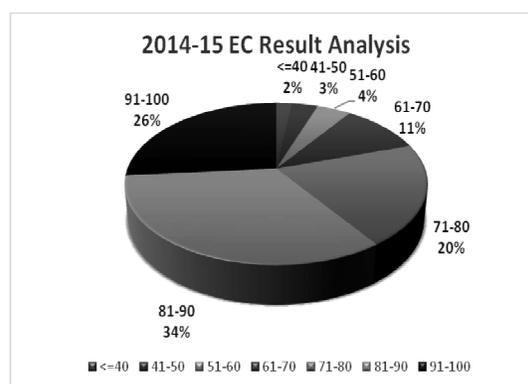


Fig 3. Result analysis with POGIL

From Fig 2 and Fig 3 it is observed that number of students securing above 90 percent increased enormously from a nominal number of 2 to 79 by implementing POGIL. Also the number of students in the range of 81 to 90 increased greatly from 30 to 100 after successful implementation of POGIL. The number of failures also decreased from 19 to 6. On the whole it can be summarized that POGIL style of learning increased conceptual learning in students

which resulted in helping them to acquire good scores.

Rewards of the POGIL pedagogy: The most important advantage of POGIL is improvement of student-student and student-instructor interaction. POGIL sessions received profound response from both the students and teachers because it has enormous benefits of which some are mentioned below.

PERSONAL BENEFITS	ACADEMIC BENEFITS
1. Team spirit enhancing sharing of Knowledge.	1. Improves concept building
2. Develops communication skills	2. In-depth knowledge
3. Grow responsible in different roles	3. Inductive learning
4. Clarity of thought	4. Student centered learning
5. Listening skills will be improved	5. Help to explore the subject
6. Improves performance in the exams raising confidence levels	6. Fosters research
7. Time management	7. Helps to relate to the real world situation

Survey on POGIL Implementation

After the successful implementation of POGIL activities in classroom and laboratories, an opinion poll on implementation of POGIL was conducted both for teachers and students (Table 2, Figure.4) About 900 students from I year B.Tech and 100 teachers who were trained in POGIL were involved in the survey.

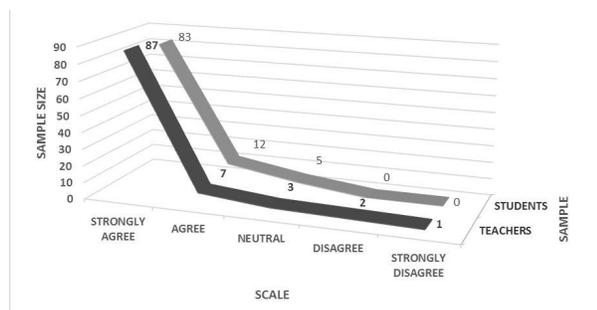


Fig.4 Opinion Poll on POGIL implementation

Scale	Faculty	Students
STRONGLY AGREE	87 %	83 %
AGREE	7 %	12 %
NEUTRAL	3 %	5 %
DISAGREE	2 %	0 %
STRONGLY DISAGREE	1 %	0 %

From the survey data obtained it is observed that 87% of faculty and 83% of the students opted strongly for POGIL type of learning. 7% of the faculty and 12% of the students agreed for the implementation of POGIL in classroom and laboratories. About 3% of the faculty and 5% of the students under survey remained neutral towards POGIL style of teaching, while only 3% of the faculty disagreed for POGIL implementation (as of designing the activities for some vague concepts). Hence from the opinion poll conducted it is established that POGIL phenomenon helps in reaching outcome based education.

The feedback received from students and the teachers towards implementation of POGIL is summarized as follows:

5. Feedback of the students:

The POGIL methodology received an overwhelming response from the I-Year B.Tech students after the successful implementation of POGIL in classroom and laboratory. POGIL method helps in learning with lot of ease and fun in a friendly atmosphere and makes the topic easy to understand and learn. It helps to gain, in depth knowledge in the subject and enhances high levels of critical thinking and problem solving capacity. Working in team makes the students imbibe the qualities like compatibility, patience, valuing others thoughts etc. The students are happy to be a part of such an activity based learning which sharpened their listening and communication skills and drove them towards creative thinking. POGIL sessions instilled confidence, enthusiasm and motivation in the students. It inculcates research culture in students, improves competence in report writing, presentation and time management. It also helps in proper understanding of experiments in laboratories.

6. Feedback from teachers:

Adopting POGIL in the classroom and designing activities was a challenge to the teachers that raised their spirits. They were happy to play a different role of a "Facilitator" that helped them in creating a passion for teaching. A number of team based activities done during the sessions helped the faculty to enhance their motivation, enthusiasm and confidence in handling the sessions & creativity in designing the activities. Through a series of workshops and seminars on this kind of activity based learning they imbibed the intricacies of generating curiosity & interest in the students. The teachers expressed that team activities would improve the competence in report writing, presentation skills, managing of time and would instill the spirit of working together. They felt assigning different roles to the students would help them master the concepts. They felt that this style of teaching and learning would work wonders with kinesthetic learners.

7. Future scope of the work

Though POGIL initially started with chemistry, it can be implemented in all the subjects and at all levels of education. It is best suited to engineering education in various disciplines as it provides a deep conceptual understanding required for pursuing independent research. POGIL can be implemented for both classroom teaching and laboratory.

8. Conclusions:

Teacher-centered instructional methods i.e traditional lecture methods have repeatedly been found inferior to instruction that involves active learning, in which students solve problems, answer questions, formulate questions of their own, discuss, explain, debate, or brainstorm during class. The POGIL methodology is in line with Edgar Dales Learning cone which supports "Tell me and I'll forget, show me and I may remember, involve me and I'll understand." [12]. 70% of learning happens when the students participate in a discussion and 90% takes place when they present and simulate the real experience. This is a cooperative learning, in which students work in teams on problems and projects under conditions that assure both positive interdependence and individual accountability. [13] This conclusion applies whether the assessment measure is short-term mastery, long-term retention, or depth of understanding of course material, acquisition of critical thinking or creative problem-solving skills, formation of positive attitudes toward the subject being taught, or level of confidence in knowledge or skills [14]. To conclude, POGIL a concept based student centric learning is more helpful for the student to understand the subject thoroughly in less time through discussions.

Acknowledgements: The author profoundly thanks the POGIL project, USA for providing a novel methodology in teaching and learning process. The author also thanks the management and Principal of VNRVJIET for creating a congenial atmosphere for implementing this technique and popularizing it.

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