How the inclusion of the POGIL method in high school chemistry classrooms impacts students' affective learning: A study from the perspective of the students enrolled in both traditional method and POGIL method classrooms.

Abstract

On the national level, several factors have recently combined to cause a re-evaluation of the instructional methods used for introductory science courses.
Many teachers and other educators have expressed a concern regarding the lack of student interest in many of the traditional chemistry courses. Students are having difficulty understanding and applying concepts, finding relevance, transferring knowledge within and across disciplines, identifying and applying the skills needed for future success in college.
This research introduces the POGIL as the new teaching strategy and suggests the combination of this selected pedagogy with traditional methods of teaching
Cooperative learning method; such as the POGIL, a student-centered learning environment, is now better understood and more widely used, I think, should go hand in hand with the faculty-centered learning environment, the traditional method of teaching

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Education 536: The teaching and learning of chemistry
Dr. Juli Ealy and Professor James Ealy
2008 April 23

How the inclusion of the POGIL method in high school chemistry classrooms impacts students' affective learning: A study from the perspective of the students enrolled in both traditional method and POGIL method classrooms.

Introduction

The Teaching of introductory courses in any subject presents many challenges. The most important being the installment of deep conceptual understanding of the content in the students that enables them to retain what they've learned and apply it to other aspects of their education. Novice students may find stoichiometry problems conceptually challenging, but after practice these become routine algorithmic exercises. Thus, whether a student finds a question to be challenging or not depends on the **knowledge** and **level of experience** of that student (JCE online CQs, 2-3).

In this research, the depth of knowledge equates type and level of knowledge as well as seeking connections among various pieces of information or applying the newly learned information to everyday life phenomena (Granville & Dika, 2002 p. 909)

I am concerned in bridging the gap or to reconcile traditional method of teaching with the POGIL method to fifteen or sixteen year old ten/eleventh grade high school students.

Fundamental teaching of chemistry is required for students being introduced to the POGIL method for the first time. This pedagogy is more affective with students having prior experience with chemistry.

Because none of the students had formal chemistry instruction prior to grade nine, and because interest and self-concept are defined as affects that are closely related to the specific chemistry instruction, I assumed that students have not

developed chemistry – specific situational interests or chemistry – specific self-concept prior to the start of the instruction.

Keywords

Affective Learning: students sense of confidence, accomplishment and engagement.

POGIL: Process oriented guided inquiry learning.

Conceptual understanding: ability to apply learned scientific concepts.

Conceptual Understanding

The learning of chemistry concepts is more than a cognitive process. Students' interests and attitudes toward science as well as their academic self-perception may play important roles in developing a meaningful understanding of scientific concepts. Understanding that goes beyond rote memorization is a necessity.

In the context of this study, conceptual understanding is interpreted as the student's ability to apply learned scientific concepts and the ability to recognize new information as something different from one's current understanding and believe, for example, the converting between moles and number of particles and the meaning of the word mole. ** Additionally, conceptual understanding covers the ability to identify inconsistencies, to seek connections among diverse pieces of information, to construct explanation and to reconcile knowledge conflicts.

Conceptual understanding assesses student understanding of the underlying ideas behind a phenomena. It requires students to explain why something occurs, adapt

an explanation to new situations, test the transfer of knowledge and causes students to visualize a system and use it to reach a conclusion.

Traditional method of teaching

'Chalk and talk' is the predominant teaching style in the traditional teaching approach**.** Conceptual understanding through traditional lecturing enables students to understand the underlying fundamentals of chemical phenomena. It allows students to apply these fundamentals, adapting them to different problems.

Traditional teaching of fundamental concepts is also related to participation. It develops a classroom climate that takes students' participation seriously throughout the course (e.g., responding to student questions and inviting him/her to voice a concern) and not only when it is convenient for the teacher. This classroom climate has many benefits, including the improvement of social skills.

Middle East colleges and universities have been undergoing reform over the last twenty years. However the teaching methods have not changed sufficiently to satisfy the requirements of the education system reform. A traditional teaching approach still dominates. Teachers give formal lectures to transmit knowledge. Students receive it passively and are expected to reproduce it accurately in examinations.

In western society, there are some new trends and changes in education including a movement from a 'teaching-center approach' to a 'student-centered approach', and a recognition that, wherever possible, students must be active participants in the learning process in order to promote deep level processing of knowledge. (Hendry, Cumming, Lyon and Gordon 2001)

A research study on student knowledge retention showed that students usually retain 10% of what they read; 26% of what they hear; 30 % of what they see; 50% of what they can see and hear; 70%of what they say; 90% of something they say while they are doing a task (Lagowski 1990). So the traditional approach to teaching science must be improved. I plan to introduce the POGIL method of teaching as a strategy to improve the traditional teaching approach and increase teaching quality. However this strategy is not a replacement for the traditional teaching approach. I believe that it is not right to abandon the traditional teaching approach. The traditional teaching approach can be adapted, modified and improved by integrating a range of contemporary teaching approaches.

Improving traditional method of teaching chemistry

The traditional teaching approach requires fewer teachers and teaches more students. So it is necessary to improve the traditional teaching approach step-by-step. The main goals of the improvements enable students;

- to master chemistry principles and technology more deeply, using chemistry knowledge;
- to analyze and solve chemistry-related problems;
- and to develop the ability of independent thinking.

As educators we need to help students become proficient in chemistry aspects. We need to identify what progresses students have made and facilitate future development. We need to identify misconceptions that students have and be able to ask critical questions that process the understanding behind the false knowledge and force students to correct the misconception. Concept questions are useful in this regard. They can be used to probe the mental models

students have constructed to represent their understanding of chemistry (Stonybrook 1997 p. 15).

Using student-centered teaching

All students are different because each has a unique experience of the world. Giving the same piece of information to all students at the same time may only work for those whose schema can assimilate it (king 2004). Not all students are at the same level of understanding at the same time. This kind of teaching approach mostly leads to a surface level learning and over-dependence on the lecturers.

Student-centered teaching is based on the hypothesis that students benefit by being given the freedom to study and search for solution based on their personal interests (Hendry et al. 2001). Students are allowed to discuss and work together on the problem, to explore different paths for solution. The responsibility for learning is with the students (King 2004). **In order to overcome some shortcomings of traditional teaching approaches such as spoon-feeding and over-dependence on the lecturer,** student-centered teaching is a useful method to improve traditional teaching strategy and practice. This approach can give students flexibility, self-confidence, and social skills (Yanseng 2004 p.7).

In students-centered teaching, the teachers teach only what he or she considers important and difficult in the lecture. POGIL is a pedagogy that uses student-centered approach.

Process-Oriented Guided-Inquiry Learning

Process-oriented guided-inquiry learning (POGIL) is both **a philosophy** and a **strategy** for teaching and learning. It is a philosophy because **it encompasses specific ideas** about the nature of the learning process and the expected outcomes. It is a strategy because it **provides**

a specific methodology and structure that are consistent with the way people learn and that lead to the desire outcomes.

Five key ideas about learning have emerged from current research in the cognitive sciences. The research documents that people learn by:

- Constructing their own understanding based on their prior knowledge, experiences, skills, attitudes, and beliefs.
- Following a learning cycle of exploration, concept formation, and application
- Connecting and visualizing concepts and multiple representations.
- Discussing and interacting with others.
- Reflecting on progress and assessing performance.

All of these ideas are incorporated into the design of POGIL in order to help students learn both discipline content and key process skills simultaneously. POGIL is built on the research base with the idea that most students learn best when they are:

- Actively engaged and thinking in the classroom and laboratory.
- Drawing conclusions by analyzing data,models,or examples by discussing ideas.
- Working together in self-managed teams to understand concepts and to solve problems.
- Reflecting on what they have learned and on improving their performance.
- Interacting with an instructor as a facilitator of learning.

To support this research-based learning environment, POGIL uses learning teams, guided inquiry activities to develop understanding, questions to promote critical and analytical thinking, problem solving, reporting, metacognition, and individual responsibility (POGIL.org p.3).

The effectiveness of POGIL has been assessed at a range of institutions and for a variety of courses. (Farrell et al., 1999; Hanson and Wolfskill, 2000; Hinde and Kovac, 2001; Lewis, 2005; McKnight, 2004; Straumanis and simon, 2006) Several common, and important, outcomes are observed in all of these studies:

- Student attrition is lower for POGIL than traditional Methods.
- Student mastery of content is generally higher for POGIL than traditional methods.
- Most students prefer POGIL over traditional methods. (POGIL project goal)

Methodology

The advantages of doing chemical research can make chemists skeptical about collecting information that is more like social science. The evidence that chemists find compelling is usually quantitave rather than qualitative, and experiments that cannot be reproduced are typically not trusted. A chemist might argue that “teaching is teaching” and not subject to discovery and advancement (Huber & Carnegie 2001).

Participants

The participants in this study are 11^{th} and 10^{th} grade chemistry class students at Al- Huda High School. Most of which have been in this school since Kindergarten. I am not very much worried about internal/external threats because throughout this year I neither have any student that is consistently absent nor does the school have athletic programs which might affect the data collecting process. The sample n=18, includes 15 females and 3 males. The duration of the data collection will be throughout the school year.

Data collection

Data will be collected from students' performance of one kind or another, such as Exams, Surveys and Interviews. So far I have chosen a survey to see how students feel about each pedagogy; questions are designed to know the opinion and reaction of each student after each lesson being taught alternating between tradition way of teaching and the POGIL approach. The goal is to administer the survey twice a month. At the end of March chi-square will be used to predict what out-come could be observed verses expected. P-value will determine whether the tradition way of teaching is accepted as much as POGIL way of teaching or not. Whether the p-values agree or not will determine my suggestion that traditional method and the POGIL should go hand in hand for better conceptual understanding**.**

Interviews

An interview format was also chosen for this research from "The General Guidline for Conducting Interviews," by Carter McManara (2007 p.2). The interview used in this study contained four questions. Interview questions include:

1. Which of the two approaches intrinsically motivated you?
2. Please explain or describe if the traditional way of teaching promoted analytical thinking, problem solving and individual responsibility.
3. Please explain or describe if the POGIL way of teaching promoted analytical thinking, problem solving and/or individual responsibility.

4. Which of the two methods was helpful with understanding the misconceptions you had? Explain.

   This interview should be useful as a follow-up to the survey administered earlier to further investigate the responds. Confidentiality will be addressed as to who will get access to the answers and how their answers will be analyzed. This is a Standardized, open-ended interview. The format facilitates faster interviews that can be more easily analyzed and compared; the same open-ended questions are asked to interviewees where responds were free to choose how to answer the question. This interview should take around ten minute with each student. Questions in this interview are about what the student thinks, and I am also looking for feelings towards each pedagogy. Last I will allow respondents to provide any other information they prefer to add and their impressing of the interview

The goal of this study is to develop an effective teaching style that promotes lifelong learning habits in students.

The fruit of this effort will be two fold. First, students will receive better chemistry education because instructional practice will take place in a significantly more informed way. Second, the faculty will see that the two intellectual processes can benefit students.

Key Insights

1) Teaching of chemistry must start, not with teachers' clear understanding of chemistry but with the misconception that students have. We need to make a greater effort to find out what these misconceptions are.

2) If we are to teach chemistry successfully, we need to help students develop the skills that they need in order to learn and apply chemistry. We need to focus on the steps of learning and coach the students in developing their skills to improve their performance in their learning process.

3) Much can be accomplished in a short fixed time that is valuable even without bringing activities to closure. Loose threads left hanging can promote subsequent thought and are not necessarily undesirable.

4) Students learn more if they encounter a problem that they may create and need to resolve.

New Technique for teaching

1) Use lecture time in different effective and interesting ways to engage students and assess conceptual understanding, e.g. intersperse presentation with group activities, concept tests, group quizzes and small group discussions.

2) Probing and understanding what students are thinking.

3) Use more group activities in both lecture and recitation sessions and formalize the grouped structure by defining roles and goals. Use peer leaders. Design appropriate group activities.

4) Stop solving problems in class, have groups do problems and report their solutions to the class.

5) More assessments of student's performance to increase skills in and amount of learning, which includes reading, writing, oral communication, and thinking.

6) Devise assessment tool to guide and stimulate reading and promote preparation.

7) Assess progress on both subject mastery and skill development.

8) Monitor and analyze students' discussions of what they are learning and using to answer questions and solve problems.

Conclusion

Educators should work on improving the traditional teaching approach by combining it with the POGIL method of teaching to increase teaching quality. I believe that it is not right to abandon the traditional teaching approach, but it can be adapted, modified and improved not only by using this pedagogy but also by integrating a range of contemporary teaching approaches.

Team work learning methods require students to have more imagination. More planning and to accept more challenging tasks. It places more emphasis on active learning and extra skill development. Active engagement promotes a thorough understanding of the concept described in lectures. The responsibility of the teacher is not only to deliver skills and provide conceptual map of the subject, but also to motivate students to be more active, adaptable, confident, creative, cooperative and inductive in their thinking. The teacher must help students make the transition from passive listeners to active participants, changing from superficial to deep learning approach, developing the students' abilities and skills for lifelong learning. We should teach them 'fishing" not gives them" fish". Students need to move from passive to active learning and from dependence to independence.

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