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# Integration the Process Oriented Guided Inquiry Learning (POGIL) into Sterile Pharmaceutical Preparation Course

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### Abstract

Teaching Process Oriented Guided Inquiry Learning (POGIL) is student-centered teaching and incorporates active, team-based learning. POGIL will also be involved in guided research using carefully crafted materials that instruct and guide students to build and rebuild their knowledge. This paper describes the basic concepts of POGIL, its features, and how it can improve the quality of student learning in the new millennium. Besides, it is proposed that POGIL be integrated into the teaching of Sterile Pharmaceutical Preparation Course organized by the Training Management Division, the Ministry of Health, Malaysia. Examples of how POGIL will be implemented is shown in this paper. The aims of this paper are to generate interest among educators, with the hope of eventually developing a kind of resource sharing community through POGIL. Hence, POGIL seems to make learning more interesting and can be as the introduction to a new concept for education in Malaysia.

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Keywords: POGIL; Inquiry learning; Collaborative learning

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### 1. Introduction

Malaysia Education system has to make the transformation due to the need of clients and also the globalization of the world. It is shown in Malaysia Education Blueprint 2013-2025 which the Ministry of

Education starts to realize the changes of the real world to educate an individual with skills and knowledge not just become an expert in subject matter but in the whole real situation of life. Thus, the government aspire to create a higher education system that ranks among the world's leading higher education systems and enables Malaysia to compete globally (Idris, 2015).

In recent years, technology has exponentially grown, and information is available at our fingertips. Educational goals have evolved from transferring only knowledge to students to developing student's critical thinking capabilities (Chang, 2011; Fesler-Birch, 2005; Levett-Jones et al., 2010; Soltis et al., 2015). Understand knowledge in any given field is no longer a possibility and now our responsibility as educators is to help our students understand the fundamental concepts of the particular realize and develop the "intellectual tools and learning strategies" that will help their learning in the future. This will able to help those students develop the skills they need to compete in the global scientific community. However, studies have shown that traditional learning methods that being implemented now may not be meeting current student needs (Bransford, Brown & Cocking, 2000; Henson, 2015). Therefore, educators need to develop a wide variety of approaches to enhance learning and emphasize attitudes and skills in addition to knowledge.

One of the learning methods that require the active involvement of students in learning is the Process Oriented Guided Inquiry Learning (POGIL). POGIL is a team-based, student-centered learning method that originated in college chemistry classrooms in the early 1990s where students work in teams to solve problems or work through guided, structured exercises (Moore et.al., 2015). According to Moog & Spencer (2008), POGIL activities have three main characteristics: i) self-managed teams that employ the instructor as a facilitator of learning rather than as a source of information; ii) activities that are designed around a learning cycle, consisting of an exploration phase, a concept invention/term introduction phase, and an application phase; and iii) subject-specific content along with process skills such as communication and critical thinking.

POGIL has been developed and validated extensively over the last 15 years in the United States (Minderhout & Loertscher, 2007; Brown, 2010; Soltis et al., 2015). However, it is entirely new in the Malaysia education scenario. Therefore, there is a need for us to shift from the traditional teacher-centric approach, mainly a broadcast model of learning, to a learner-centric approach to enable students to acquire the new 21st-century knowledge and skills and in line with Malaysia Education Blueprint spirit. This is to allow students to move towards competence. Once such a productive and exciting environment is provided, and add to this a supportive teacher, students will be more responsible for their learning. They will search for, find, assimilate and share the knowledge with others.

Some students are frustrated because, in spite of earning high grades, they cannot explain basic concepts behind their achievement because much of their learning is through algorithmic and memorization. Do students fail to learn meaningfully because of the way the instructor teaches or because of the way the student's approach learning? Hence, this paper will suggest a suitable approach that can be guided to the instructor for making the teaching and learning worth and sophisticated. Therefore, the POGIL learning approach is proposed to be implemented in the Pharmacy Assistant program, a program run by the Ministry of Health, Malaysia.

### *1.1 The Concept of POGIL*

Process-Oriented Guided Inquiry Learning is a student-centred instructional strategy. POGIL also is to engage in guided inquiry using carefully designed materials that direct and guide students to build and rebuild their knowledge. POGIL simultaneously teaches both content and critical process skills of subject matter (Roller, 2015; Mullin, 2017).

POGIL is a team-based learning technique that seeks to engage students by engaging them in activities designed to help them master and develop skills in learning, communication, problem-solving, working with others, and self-assessing learning. In a POGIL classroom or laboratory, students work in small

groups on specially designed activities that follow a learning cycle paradigm. There are three critical characteristics of the materials used in a POGIL learning environment:

- They are designed to be used with self-managed teams that use teachers as facilitators of learning and not as sources of information.
- They guide students through the exploration to build understanding.
- They use disciplinary content to facilitate the development of essential process skills including high-level thinking and ability to learn and apply knowledge in a new context.

The goal of the POGIL approach is not only to develop content mastery through student construction of their own understanding, but also to enhance essential learning skills such as information processing, oral and written communication, critical thinking, problem-solving, and metacognition and assessment. POGIL is based on five currently accepted beliefs about how people learn best, namely by

- connecting new material to prior knowledge and experience;
- following the learning cycle of exploration, concept formation, and application;
- use different representations of ideas and relate them in different ways;
- discuss and interact with others;
- reflecting on their progress and assessing their performance.

### 1.2 Past Research Related to POGIL

Recent research indicates that students learn best when they are actively engaged, and they construct their understanding. Same goes to research results from Michelle (2011) shows that POGIL pedagogy provides appropriate learning support to foster the development of scientifically accurate mental models of abstract chemistry concepts in secondary students. This study also suggests that POGIL pedagogy could be useful in reducing or eliminating achievement gaps frequently found between racial groups and the gender achievement gap.

In other research by Margaret (2010) shows that POGIL offers tremendous potential to transform chemistry education by promoting deeper student learning, encouraging increased student responsibility for learning, developing process skills needed for employment, and increasing student satisfaction. POGIL has been demonstrated to be effective in improving student retention and performance.

One study of a full POGIL implementation in a pharmaceutical Science Course for the first-year student compares the student performance and engages the higher-level thinking skill through POGIL approach over the traditional method of the same instructor (Soltis et al., 2015). The overall mean examination scores increased significantly when POGIL was implemented. Then, performance on questions requiring higher-level thinking skills was substantially higher whereas performance on questions requiring lower-level thinking skills was unchanged when the POGIL strategy was used. Hence, the student's feedback on use of this strategy was positive.

Another research was done by using experimental design, which is to identify the long-term retention improvement of information before and after treatment by full POGIL implementation (Vanags, Pammer & Brinker, 2013). This research shows that the POGIL approach to teaching can produce improved long-term learning outcomes for students even when the teaching is done by a less experienced teaching assistant. Then, student-centered learning is key to engage students in their studies and allow them to take responsibility for their learning, constructing their knowledge and assurance from facilitators that these mental representations are accurate are fundamental to long-term recall and confidence in that knowledge.

POGIL used by the researcher to solve four problems in teaching information system which improves engagement, to foster interaction, develop required skills and to effectively gauge the level of attention and comprehension within lectures and large students (Myers, 2012). Importantly, the semester that incorporate

POGIL had substantially higher results in the pertinent criteria than the semester that used traditional delivery methods, which implies this method is a causal factor in the improvement.

## 2. Integration POGIL into the Sterile Pharmaceutical Preparation Course Module

The Sterile Pharmaceutical Preparation Course is an advanced course for an assistant pharmacist who works at the Aseptic Dispensing Unit at the Ministry of Health Malaysia. This course is conducted for 6 months (Training Management Division, 2016).

This course is conducted to provide exposure to the effects of cancer medication and the maintenance of cancer drugs, reconstitution techniques, labelling and basic knowledge to the Assistant Pharmacist in the Aseptic Dispensing Unit. This course is carried out using traditional teaching approaches as lectures, tutorials and presentations. In this regard, it is proposed that POGIL will be integrated into the teaching of this course to enhance the effectiveness of the course through student-centered teaching. Examples of a topic selected using Guided Inquiry-Based Learning Process (POGIL) in the teaching is Spillage Management. The writing format is as shown in Table I below:

Table 1: Spillage Management

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Learning outcomes                           | <ol style="list-style-type: none"> <li>1. Discuss the guidelines for spillage management</li> <li>2. Explain the procedures for spillage management</li> <li>3. Discuss the SOP of spillage management</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Applied Gagne's nine events of instruction. | <p>The instructor gave a theoretical explanation for 30 minutes-</p> <ul style="list-style-type: none"> <li>• Gain Attention of the students.</li> <li>• Inform students of other objectives/learning outcomes.</li> <li>• Stimulate recall of prior learning.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Applied POGIL                               | <p>Students are split into 4 groups (1 group - 4 persons) to complete the following questions and activities. Teachers will act as facilitators to assist students in group activities.</p> <ol style="list-style-type: none"> <li>1. Discuss the guidelines for spillage management</li> <li>2. Explain the procedures for spillage management</li> <li>3. Discuss the SOP of spillage management</li> </ol> <p>Seven Steps to Spill Management</p> <ol style="list-style-type: none"> <li>i. Never Assume           <ul style="list-style-type: none"> <li>• Report the spill to the supervisor</li> <li>• Co-ordinate spill team</li> <li>• Evacuate non-spill team person (s)</li> </ul> </li> <li>ii. Assess Area           <ul style="list-style-type: none"> <li>• Consider other potential risks near the spill</li> <li>• Eliminate all ignition, heat or power sources</li> <li>• Remove portable items without coming in contact with spill</li> <li>• Determine Hot Zone Area</li> </ul> </li> <li>iii. Identify Spill           <ul style="list-style-type: none"> <li>• Do not approach spill if it is unidentified</li> <li>• Look at labels, containers, markings, the colour of container, signs, etc. to</li> </ul> </li> </ol> |

|                                             |                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                             | help determine what product <ul style="list-style-type: none"> <li>• Use MSDS (Material Safety Data Sheet) to help identify spill</li> </ul>                                                                                                                                                                             |
| iv. Respond                                 | <ul style="list-style-type: none"> <li>• Wear appropriate PPE</li> <li>• If needed, cover all drains, doorways and areas where spill can escape</li> <li>• Contain spill from spreading using granular or absorbent socks</li> </ul>                                                                                     |
| v. Clean-up/Disposal                        | <ul style="list-style-type: none"> <li>• Use spark-proof and chemically compatible equipment to clean up</li> <li>• Pick up absorbed material and place in disposal bag or container</li> <li>• All pads, granular, socks, non-reusable gloves, clothing, etc. should be placed in a disposal container.</li> </ul>      |
| vi. Decontamination                         | <ul style="list-style-type: none"> <li>• Removed the most spoiled or contaminated clothing first</li> <li>• Rinse off heavily contaminated materials in a contained area</li> <li>• Never touch clean clothing or materials with contaminated gloves</li> <li>• Rinse or dispose of any non-usable equipment.</li> </ul> |
| vii. Reporting                              | <ul style="list-style-type: none"> <li>• Report spills to a supervisor as per your spill procedures</li> <li>• All 'Reportable Quantity' spills must be reported to the proper authority.</li> </ul>                                                                                                                     |
| Applied Gagne's nine events of instruction. | <ul style="list-style-type: none"> <li>• Present the content</li> <li>• Provide learning guidance</li> <li>• Elicit performance (practise)</li> </ul>                                                                                                                                                                    |
| Practical Demo (Activity in Labs)           | Activity in Aseptic Lab (Student divide by 8 groups/ each group - 2 students)<br>Practical for the following procedures are set:-                                                                                                                                                                                        |
| Applied POGIL                               | <ol style="list-style-type: none"> <li>1. Guidelines and management of spillage</li> <li>2. SOP on spillage</li> <li>3. Spill kit content</li> <li>4. Disposing of contaminant and used/unused content of spill kit</li> </ol>                                                                                           |
| Applied Gagne's nine events of instruction. | <ul style="list-style-type: none"> <li>• Provide learning guidance</li> <li>• Elicit performance (practise)</li> </ul>                                                                                                                                                                                                   |
|                                             | Quizzes – 10 question.                                                                                                                                                                                                                                                                                                   |
| Assessment                                  | Learning reflection / 1 page.<br>Use Gagne nine event of instruction <ul style="list-style-type: none"> <li>• Provide feedback</li> <li>• Assess Performance</li> <li>• Enhance retention and transfer to the job.</li> </ul>                                                                                            |

### 3. Conclusion

The integration of POGIL into Sterile Pharmaceutical Preparation Course curriculum allowed almost good rapport between lecturer and each student and between the students themselves. The inter-relationships between students-lecturer have enhanced their relationships in the early weeks of a semester. The class

progressed quite rapidly into a community as divergent to isolated individuals or groups because the group membership, and the roles within groups, changed regularly. This evolution induced open discussions, laughter and an amicable culture that became overt from an early stage of the semester. The inter-class group exercises cultivated interpersonal skills. Students who would regularly not interact at all in class felt comfortable from the beginning of the semester to engage in interactive activities with others.

Besides, a closer student-lecturer relationship, which can positively influence student retention in first-year students, is complicated with the traditional didactic lecturing form of delivery. Students who feel separated from class and lecturers do not achieve the same confidence levels as those who interact with fellow student and lecturers, which can negatively affect attrition. Therefore, POGIL work in the first year can positively influence retention rates because the lecturer can form a relationship with individual students early in the semester. Future work could incorporate POGIL to non-attendance modes of subject delivery, explore better methods to gauge POGIL success on pedagogy outcomes and include a trial on the scalability of POGIL to even larger class sizes (Soltis et al., 2015).

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