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## Introducing Process-Oriented Guided Inquiry Learning to Foundation Year Medical Students

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# **Introducing Process-Oriented Guided Inquiry Learning to Foundation Year Medical Students**

Aamal A. Radhi

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## Abstract

A new team-based teaching approach known as the Process-Oriented Guided Inquiry Learning (POGIL) has been introduced into an organic chemistry course taught for first-year medical students. This is an innovative teaching style whereby students are transformed from being passive into active learners aiding to improve their both content-related and higher-order process skills, including critical thinking, reflection, teamwork, etc. The implementation of POGIL as a change project was done using the HSE change model and it was carried out in two phases: a pilot, compulsory post-lecture phase followed by a voluntary, full-programme pre-lecture phase. The assessment of students' performance in continuous assessments, process skills and perceptions have shown some positive results as the majority of students who committed to the voluntary phase have reported an overall satisfaction with the new way of teaching, showed positive signs of critical thinking improvement, produced good quality reflections and achieved satisfactory scores in their tests. On the contrary, the responses from those who have chosen not to participate in the voluntary programme or withdrawn from it have shown that they were either resistant to the change strategy, not the change itself, or they were still stuck in the early stages of shock, denial, etc. of reaction to change. Overall, these findings, coupled with the encouraging responses from the instructors, suggest that POGIL could achieve more promising results if a longer term, modified setting is implemented.

## **Acknowledgments**

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## **Chapter 1: Introduction**

### **1.1. Introduction**

An innovative, student-centered teaching pedagogy known as Process-Oriented Guided Inquiry Learning (POGIL) has been implemented in one of the medical universities in Bahrain. This introductory chapter will be providing a background for the nature of this implementation or change, the rationale behind it and the context in which it has occurred.

### **1.2. Nature of the change**

The change project described herein represents a planned, transitional change initiative that has been implemented in a private medical university in Bahrain – aiming to improve its first-year students' process skills as well as performance in an organic chemistry course, via the introduction of a new student-centered, team-based learning method known as the 'Process-Oriented Guided Inquiry Learning' (POGIL). This small-scaled project was primarily conducted as an action-based change initiative but did occasionally take some reflective approaches.

### 1.3. Rationale for carrying out the change

Besides their high failure rates (Figure 1), students taking an organic chemistry course referred to as Module 7 or M7, at a medical school in Bahrain, do generally find difficulty grasping and retaining the information they learn from the lectures. In spite of the lack of supportive empirical evidence, this phenomenon, as analyzed by fishbone analysis (Appendix 1), might be clearly attributed to one or more of the following main reasons: 1) the complexity of the course content and/or assessments as compared to the average first-year students' study skills; 2) huge amount of information being delivered within a 50-minute lecturing time — which goes beyond the students' normal attention and concentration capacity; 3) lack of interactive learning environment; 4) weak student background in chemistry; 5) poor students' problem solving skills and lack of adequate opportunities to enhance these skills; 6) absence of following up assignments and 7) above all large class size (Myers, Monypenny, & Trevathan, 2012).

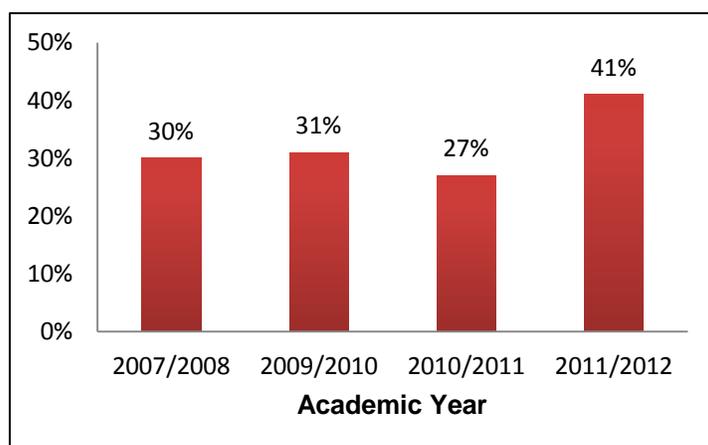


Figure 1. Failure rates in M7

Interestingly, a number of initiatives, that included recording of attendance (which has remained to be non-compulsory for most modules including M7), addition of a number of continuous assessments (CAs) to the only one summative exam, and conduction of more small-group learning classes, were implemented a couple of years ago achieving a significant improvement in students' overall pass rates (Hayes, Holden, Kavanagh, Gaynor, & Otoom, 2013); yet, this was mainly seen in the more memory-based subjects than in organic chemistry. Considering all that, one might deduce that the main problem might possibly lie in the complex course content or summative exam themselves, and that resolving of the whole issue could be simply done by modifying the course content or reducing the difficulty of the exam. While this might remain to be a valid view, a change agent with a low power, like the author who is just a chemistry tutor and has no role in neither lecturing nor exam preparation, would have no authority, or even clear understanding of why this suggestion has not implemented yet to push in that direction; especially that the corresponding department in the mother university takes an overall control in this regard.

In spite of that, it is clear that faculty members view this organic chemistry module as a good opportunity to boost scientific thinking skills in first-year students; that they seek improvement in students' performance while maintaining the same exams or course standards, probably with a hope to produce a good quality graduates. Fortunately, the good percentage of students who get first class honor (H1) in this course every year (see Figure 2), combined with an overall good course satisfaction rates (above 65%) as measured by end of semester surveys, supports the achievability of this intention and

theoretically eliminates the urgent need for any course restructuring. Nonetheless, the fact that less than 55% of students usually fill in these surveys may undermine the validity of these surveys and explain the discrepancy between the high failure rates and the data usually obtained from end-of-semester surveys; as those who did not voice their opinion might probably have a different view (Fraenkel, Wallen, & Hyun, 2012).

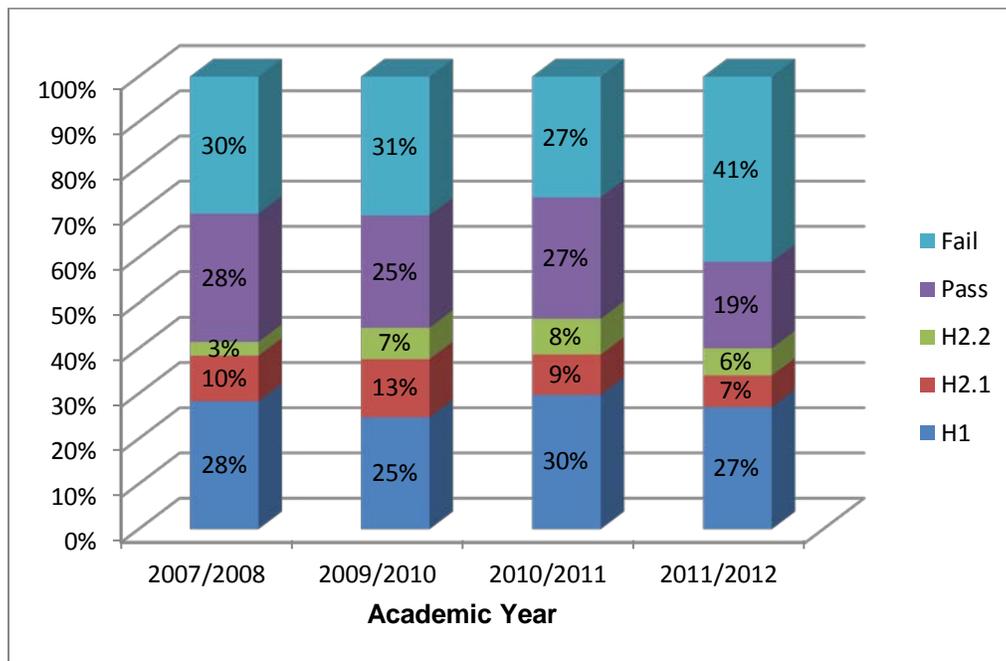


Figure 2. Distribution of students' grades in M7

Alternatively, away from this entire dilemma, and by examining the previously listed possible causes of low students' performance and retention in M7, these causes could be found to be largely synergized by or emerged as result of the large class size as well as poor study skills<sup>1</sup>. This might lead to thinking in a way in which a large number of students would have a better opportunity to learn the course material, improve their

<sup>1</sup> The low percentage of medium performance students in M7 over the past four academic years, as compared to the percentage of fail and H1 students, suggests that a big gap does exist between exams or course standards and average students' skills.

study skills and can practice problem solving without the need for breaking the current teaching/assessment standards set by the main authority in the mother university. From here came the idea of the Process-Oriented Guided Inquiry Learning or POGIL Project. This is a research-based type of cooperative learning that has been designed based on current understanding of how human-being best learns (Moog & Spencer, 2008). In POGIL classroom, pre-set activities are used to guide students learning, help them construct their own knowledge and allegedly enhance their higher-order process skills including information processing, critical thinking, team work, communication, management and assessment skills (Douglas & Chiu, 2012; Hein, 2012; Mitchell & Hiatt, 2010). This method was simply seen a good match for the above mentioned need. For a general overview of POGIL, see Appendix 2.

#### **1.4. Context of the change**

This change initiative was implemented in a non-profit, medium-sized medical university, which is based in Bahrain but is a constituent of a western university, and is under its general management. The university is attended by a mixture of Bahraini, Arab, Asian and Western students which makes it a real multicultural environment. Besides the School of Medicine, where this project was implemented, the university is composed of the School of Nursing and Midwifery and School of Postgraduate Studies and Research. The one-year foundation cycle, junior, intermediate and senior cycles make up the standard 6-year curriculum in the school of medicine. Over one hundred students, recently rose to above 140, are usually enrolled in the foundation year (FY)

cycle every year. During this year, students are given courses in basic sciences as well as medical professionalism, Arabic and English languages. Courses' material, assessments, policies and guidelines of this cycle are tightly linked with that of the mother university and are largely controlled by its different departments. Therefore, any major changes in the delivery of FY courses would need some sort of effort before it can be implemented.

The author serves as a part-time senior biomedical sciences demonstrator for the foundation year and is involved in the biomedical science laboratory demonstration/coordination and chemistry tutoring, and, hence, she has little authority-based power. The author is also responsible for conducting research on behalf of the FY department meaning that all the data obtained from this change experience are seriously considered to be later used for research purposes.

As for the main internal and external environmental forces, the shortage in the qualified healthcare workforce in Bahrain (RCSI Bahrain, 2012). could be regarded as a possible indirect external driver for this change. Internally, the newly set strategic goals, including commitment to excellence in teaching, besides the financial outcomes that are associated with good student performance, are seen the main two forces that could drive this change.

## 1.5. Aims and objectives

### 1.5.1. Project aim

The aim of this project was to implement a voluntary, pre-lecture POGIL-based programme that would promote the students' process skills and performance in the organic chemistry course taught in the second semester of the foundation year of medicine (referred to as M7).

### 1.5.2. Project objectives

The previous aim has been broken down into the following four main objectives:

- a) To assist the students who are actively participating in the M7 Pre-lecture Programme improve their understanding of the subject so that an 85% pass rate in both continuous assessments and summative exam would be achieved.
- b) To enhance and assess the development of the students' team, critical thinking and reflection skills. These skills were aimed to be brought to the "Good" level on the activity feedback form towards the end of the programme.
- c) To evaluate the students' experience in regard to the new teaching methodology by the use of self-administered questionnaires.
- d) To assess the staff's perceptions towards the new teaching methodology via the use of semi-structured interviews.

## **1.6. Summary**

Introducing the Process-Oriented Guided Inquiry Learning (POGIL) into an organic chemistry course taught for first-year students at a medical university in Bahrain is the core of this planned change project. Given its research-based design and reported effectiveness in promoting students' learning both academically and intellectually, and in line with the current environmental forces, the new student-centered pedagogy has been regarded as the most appropriate solution for the high failure rates and poor learning gains in organic chemistry. The present project, through its emphasis on improving both students' performance and process skills, does strongly align with the organizational strategic goals of excellence in teaching and is hoped to bridge the gap between current teaching standards and first-year students' skills.

## **Chapter 2: Literature Review**

### **2.1. Introduction**

To inform the present change project, a literature review was conducted using a number of educational and academic databases. A critical analysis of the selected literature and its implications for the change project will be the subject of this chapter.

### **2.2. Purpose of literature review**

This outcome-oriented literature review has been conducted to inform the following primary areas of concern:

1. The potential impact of POGIL on instructors and students' perceptions as well as its impact on students' academic and intellectual skills.
2. The challenges associated with implementing such an innovative teaching technique in an undergraduate level.
3. Possible strategies to confront those challenges.

### **2.3. Search strategy**

The databases ERIC, Academic Search Complete, Education Research Complete, Web of Knowledge, ScienceDirect, Medline, Medline with Free Text, CINAHL Plus with Free Text and Google Scholar were searched using some or all of the following keywords:

“Process Oriented Guided Inquiry Learning”, “Guided Inquiry”, “Cooperative learning”, “Team Learning” and “Peer Evaluation or Peer assessment”. Only full-text, peer-reviewed, research journal articles that were published in the English language between the years 2008 and 2013 were included in the search. To match the classroom-based nature of the present project, research articles that took place in a laboratory, high technology-dependant setting or in a non-undergraduate level were excluded. When appropriate, and to accommodate the high number of retrieved articles, the search was further limited to include only those articles that were published under the “teaching methods” subject. Eventually, forty two articles were obtained from this search.

## **2.4. Review themes**

The search for answers to the previously stated literature review questions has yielded three themes. These include the benefits, challenges and possible management strategies of POGIL or cooperative learning. Following is a critical discussion of the three themes.

### *2.4.1. Benefits of Process Oriented Guided Inquiry Learning (POGIL)*

Unanimously, whether being adopted in science (Brown, 2010; Hein, 2012; Jin & Bierma, 2010; Myers et al., 2012), business (Hale & Mullen, 2009) or in arts classes (Mitchell & Hiatt, 2010), as a part of a lecture (Myers et al., 2012), or as a stand-alone session (Hein, 2012; Mitchell & Hiatt, 2010), POGIL or guided inquiry learning,

according to the vast majority of the POGIL-specific articles reviewed herein, has been reported to have a very encouraging impact on students learning— precisely their engagement (Bilgin, 2009; Jin & Bierma, 2010; Mitchell & Hiatt, 2010), attention and comprehension in class (Myers et al., 2012; Vacek, 2011); knowledge retention (Bilgin, 2009; Myers et al., 2012; Vaughan, 2010); attrition; process skills development (Straumanis & Simons, 2008) and possibly achievement (Brown, 2010; Hale & Mullen, 2009; Hein, 2012; Ucar & Trundle, 2011; Vacek, 2011), as compared with the traditional lecture-based method of instruction. POGIL is further suggested to boost the rapport between the students, and between them and instructors, causing them, including the high-ability ones, feel more confident in class (Myers et al., 2012).

These reports, although may appear overenthusiastic, are not surprising, as many studies on collaborative, cooperative, team and problem-based learning, which POGIL is an example of them all, have, collectively, shown a very similar impact (Carmichael, 2009; M. M. Cooper, Cox, Nammouz, Case, & Stevens, 2008; Ho & Wachob, 2010; Koç, Doymuş, Karaçöp, & Şimşek, 2010; Moye, Metzger, & Matesic, 2012; Thanh, 2011). Moreover, the non-POGIL specific studies included in this review have reported a broader impact of cooperative/team learning which one would assume its applicability to guided inquiry learning, such as improving the learners' autonomy, (Ho & Wachob, 2010; Wiegant, Boonstra, Peeters, & Scager, 2012), achievement motivation (Ho & Wachob, 2010; Wang, 2012; Wiegant et al., 2012); and social support from both peers and instructors (Wiegant et al., 2012).

Theoretically, the fact that all these strategies do align with and draw from the principles of the social constructivist learning theory (Mitchell & Hiatt, 2010)<sup>2</sup> could explain and fairly support the aforementioned findings. However, one may wonder if this theoretical base would suffice to guarantee the generalizability or the one-size-does-fit-all effectiveness of a certain teaching methodology; especially that the impact of socio-cultural factors, students' individual differences and other extraneous factors on the whole process are generally overlooked in the reviewed POGIL-specific articles. Representing one of few identified exceptions, the paper by Geiger (2010) fortunately attends this issue offering a very insightful and reasonable view on guided inquiry instruction. Based on her partially less successful experience with POGIL and building on the Accelerator Model of cognitive skills versus challenge (Morgan & Apple, 2007), Geiger has deduced that the adoption of such an innovative teaching strategy could adversely affect students' learning gains, attendance and satisfaction if the students' cognitive skills do not match the new teaching challenge; or as described by the accelerator model, if the students tend to be placed in their "unhappy zone" in relation to those two variables. In addition, the same author found that the majority of first-year students in one of chemistry introductory courses, as measured by Group Assessment of Logical Thinking (GALT) test, do not have the level of cognitive skills required to handle the challenges associated with guided inquiry instruction.

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<sup>2</sup> This theory maintains that learning is best gained through an active, social process whereby knowledge is constructed by the learner on his own with the aid of social interaction (Bauersfeld, 1995). Neuroscience has proven that the assumptions of this theory do match the human natural way of learning (Wolfe & Nevills, 2004).

In the same vein, Cooper, Cox, Nammouz, Case, & Stevens (2008) noted that female students with medium cognitive skills (or at a pre-formal level of logical thinking) when paired with students of low cognitive skills (or at a concrete level of logical thinking), in a less structured collaborative groups, can achieve higher improvement in their problem solving skills compared to their counterparts; whereas students at a concrete level when paired with each other may not achieve any improvement. These studies are perceived to be very beneficial and realistic as they explain why things have had happened rather than asking whether they have had happened or not.

Interestingly, with only one exception (Straumanis & Simons, 2008), no direct, specific and original empirical evidence has been obtained throughout this review to support the primary promise of process-oriented guided inquiry learning— that is to enhance the learner’s higher-order process skills. While this might appear to be caused by a systematic publication/selection bias, one should bear in mind that cognitive skills are possibly hard to be assessed (Prince, 2004)— although there is some good evidence on the reliability of a number of cognitive assessment tests such as Group Assessment of Logical Thinking Test ‘GALT’ (Bunce & Hutchinson, 1993). Furthermore, it appears that some researchers/instructors do generally assume that having the students working in groups would subsequently improve their teamwork, critical thinking, management and information processing, etc – or perhaps they are not too seriously concerned about improving this aspect as they do with exams outcomes; or possibly assume that the later is a direct reflection of the former, which might not be necessarily true for a lot of reasons.

Logically speaking, when implementing a project with multiple objectives, very likely, some objectives could unintentionally gain more attention than others; or sometimes they might even contradict/conflict with each other. Given that almost none of the papers included in this review have paid attention to this point, it seems that all the previously mentioned benefits of guided inquiry learning should be considered with caution, as they might not be all achieved at the same time. For example, some studies have suggested a significant association between the adoption of all types of cooperative learning, including guided inquiry, and improvement in students' course performance (Brown, 2010; Hale & Mullen, 2009; Hein, 2012; Vacek, 2011), whereas other studies have not (Ucar & Trundle, 2011). Regardless how valid the used tests were in assessing the students' skills, or how ideal the implementation efforts were; and whether the desired effect was given enough time to be developed following the implementation of the new teaching style, it seems that the instructors may need to decide what objectives could be sacrificed in favor of others should a conflict occur during the implementation process; especially if achieving some of these objectives is faced with shortage of resources ( supporting evidence is later discussed in chapters 4 and 5).

Regarding the benefits to the instructors, three main benefits of POGIL were identified in the selected articles. These included: (1) the ability to monitor each student's performance in class (Brown, 2010; Hale & Mullen, 2009; Myers et al., 2012); (2) establishing better consistency between the different classes and (3) less preparation time on the longer term (Hale & Mullen, 2009). Indeed, the first benefit sound

reasonable, yet it might be hard to imagine that two instructors having a large class size, like in the case of the present POGIL project, would have the time and capacity to check all students' progress and address the common misunderstandings without taking much of the session's time. Technically, that finding does not seem to be truly applicable in the present project due to the limited resources.

#### *2.4.2. Challenges of implementing POGIL in an undergraduate level*

In spite of its widely reported positive impact on students' skills and performance, and just like any other change initiative, the adoption of cooperative, or student-centered learning, is usually met with resistance from students (Keeney-kennicutt & Simpson, 2008; Maceiras, Cancela, Urréjola, & Sánchez, 2011; Smith-Stoner & Molle, 2010) and instructors alike (Justice, Rice, Roy, Hudspith, & Jenkins, 2009). Again, as any change initiative, the students' resistance could be gradually resolved over time (Keeney-kennicutt & Simpson, 2008). Offering an insightful explanation for this phenomenon, Douglas & Chiu, (2012) have noted that students normally tend to resist active learning because they expect to be taught by an expert whom they assume is the main source of knowledge. This overestimation of the instructor's role in the learning process, the two authors assert, contradicts the nature of student-centered learning. From a change management point of view, these inferences seem strongly valid as they reflect the traditional shock, denial, etc curve of reaction to change (Kubler-Ross, 1997).

By looking deeper into the other possible root causes of students' resistance, it has been suggested that students' attitudes toward team learning is largely influenced by the group selection method (Bosco, Jervis, & Harvey, 2009); group members' personality/leadership styles as well as their behaviors and learning approaches (Krishnan, Gabb, & Vale, 2011); and of course free-riding (Jassawalla, Sashittal, & Malshe, 2009). Since this innovative way of teaching adopts a highly socialized setting, the details of this setting would naturally influence the students' perceptions of the entire method no matter how beneficial this method might appear to be. Surprisingly, these points, as well as other challenging implementation barriers, are generally underreported in the majority of the reviewed articles. Indeed, the main bulk of literature around cooperative learning, which the author succeeded to accumulate, appears to give more priority to the impact of a teaching method, rather than analyzing the experience itself. This tendency might be linked to narrow academic background which makes some researchers/instructors fail to recognize the significance of discussing such valuable information.

Concerning the group selection method, two main methods were identified in the reviewed articles: the Instructor-selected method and the student self-selected method. Some argue that the former method leads to more conflict between team members than the other method might do (Bosco et al., 2009). In the same regard, a paper by Thanh & Gillies (2010) proposed that students' reaction towards the group formation method is hugely affected by their cultural background and values. To illustrate, the two authors concluded that Western students appear to prefer mixed-ability groups while

Vietnamese students, who give a high priority for close relationships, prefer friendship grouping – wherein members help each other spiritually rather than academically. This can be also linked with another study by Krishnan et al. (2011) who noted that students may not automatically adopt a collaborative learning approach, as group members may not have the personality styles required for effective group work. All these findings do collectively, and perhaps rightly, suggest that cooperative learning is a very challenging approach. Moreover, they are viewed to fairly explain why cooperative learning is not the norm in the education or work life because if it is so education would not have adopted an individualistic approach from the start.

Lastly, other major challenging of guided inquiry instruction could include time-consuming, lengthy learning activities (Schaal, Matt, & Grübmeier, 2012) and high instructor's work load in the preparatory phase (Vacek, 2011). Fortunately, as discussed earlier, Hale & Mullen (2009) sensibly contend that once the activities are prepared, instructors would need to spend less preparatory time and would be able to give more consistent instructions.

### *2.4.3. Possible strategies to confront challenges*

#### *2.4.3.1. Training, feedback, mixed techniques & conflictive change*

As with the challenges of guided inquiry, management strategies, in the reviewed articles, are underreported too. The few papers addressing this aspect do, however, align heavily with change management principles and literature, and appear to be

strong in their logical presentation. To illustrate, Bosco et al. (2009) contend that to cope with the challenges of student-centered, cooperative learning, students need some additional preparatory training and ongoing coaching. In the same vein, Keeney-kennicutt & Simpson (2008).suggest that successful implementation of innovative teaching requires instructors to actively listen and respond to students' complains. These two recommendations match the highly effective 'facilitation and support' – and may intersect with both 'Education' and 'Negotiation'– resistance management strategy of Kotter & Schlesinger (1979). As for the teaching by 'expert' assumption, (Douglas & Chiu, 2012) recommends that students should be provided with some feedback as this might give them some feeling that they are still being taught by 'an expert'. While it can be hard to fit this approach with any of Kotter & Schlesinger (1979) strategies for resistance management, which may not be super comprehensive, it can be said that this approach may represent an instance of the individualized consideration dimension of transformational leadership; a leadership style which instructors are encouraged to adopt in order to transfer students from passive learner to active, autonomous learners (Harmon, Fontaine, Plews-Ogan, & Williams, 2012).

Examples for the reflective (adaptive) and conflictive change processes of (Van-de-Van & Sun, 2011) are also included in the reviewed literature. For example, Ginter, Swayne, & Duncan (2006) suggest using mixed teaching techniques in the class as a strategy to manage students' resistance. Geiger (2010) agrees with this view asserting that gradual increasing of the cognitive challenge is necessary to allow for appropriate students' cognitive skills growth. Indeed, this strategy might be classified as a reflective (adaptive)

management approach which maintains that transforming people might not be easy sometimes, thus adaptation would be a more effective approach (Van-de-Van & Sun, 2011).

Lastly, according to Justice et al. (2009), the challenge of finding instructors willing to employ guided inquiry teaching in their courses was successfully managed by college administrators through the initiation of debates whereby instructors supporting the change can be identified and recruited. Indeed, this idea aligns with the conflictive change model (Van-de-Van & Sun, 2011) whereby change occurs through resolving of conflict between parties with the same power. Overall, all these management strategies appear to have been effective in their contexts.

#### *2.4.3.2. Peer evaluation*

To control social loafing and domineering behavior, and to encourage effective and equal participation from all team members in the group activity, peer evaluations seem to be a good and practical solution (Lee & Lim, 2012; Peterson & Peterson, 2011). Although this technique was generally used and investigated in project-based team work setting (Ahmed & Molen, 2010; Lee & Lim, 2012) than in-class group work, the method itself appears to be generally useful in improving students' team work and communication skills (Peterson & Peterson, 2011); meaning that, with some adjustment of aim, one can expect its success in in-class cooperative-based teaching like POGIL. This inference came from the general agreement on the usefulness of both rating and

comment-based peer evaluation (May, 2008) in resolving the above mentioned problems. However, Praver, Rouault, & Eidswick (2011) suggest that comment-based peer evaluation, although may evoke embracement and sensitivities, are more helpful than close-ended assessment, specifically when the assessment entails some criticism.

Contradicting their objectives, some of the above cited papers, through their emphasis on allocation of marks for peer evaluations, appear to have undermined the value of their educational efforts. Technically, the idea of cooperative learning is generally revolving around the construction of knowledge in a social environment where students can enhance their content-related as well as teamwork skills. As such, establishing a natural, safe and comfortable learning environment seems to be very important if one wants to apply such a learning style effectively. Building on that, some might wonder if assigning marks for peer evaluation would provide this secure and warm environment or serve the educational goals of cooperative learning, because at the end, solving a problem should not trigger additional problems that contradict one's intended aim.

Moving to another aspect, after balancing the advantages of both confidential and non-confidential forms of peer evaluation, which may include eligibility to gain more honest responses for the former versus provision of more constructive criticism or feedback for the latter, Peterson & Peterson (2011) deduced that non-confidential, comment-based forms are more favorable when in-class group work is employed, particularly when conducted throughout the semester than at the end. Given that the educational aims of

the adoption of these methods is to motivate students to promote their learning process and social skills than testing or grading them, this view sounds a quite valid and compelling for the same reasons illustrated in the previous paragraph.

### **2.5. Implications for the change project**

From the prior discussion, one can clearly see that although POGIL has very sound promises, its implementation could be a bit challenging. Students' resistance as well as their individual differences should be carefully managed using a number of approaches, including the reflective (adaptive) approach, if successful implementation is desired. In the same vein, the provision of timely feedback and non-confidential, comment-based peer evaluations seem ideal for managing students' resistance to guided inquiry learning and boosting their enthusiasm to group work. Additionally, instructors should bear in mind that they may sometimes need to prioritize their objectives from the implementation of such a way of teaching. If they target the improvement of students' process skills and understanding, for instance, then they should not be too upset if the new teaching did not make any immediate improvement in students' scores, as such improvement may take time to be developed and reach the level at which outstanding exam performance can be seen. Lastly, preparatory training of students on the new learning style appears important in improving their capacity to receive the change.

## **2.6. Summary**

POGIL and cooperative learning are generally found to be very effective in promoting the students' understanding, engagement, retention, and sometimes performance.

However, problems such as staff and students' resistance to both the new change and instructor-selected grouping, free-riding and long preparatory work are very common when this type of teaching is implemented. Management strategies might include provision of feedback on students' work, preparatory training of students for the new experience, peer evaluations and reflective/responsive teaching.

## **Chapter 3: Change Process**

### **3.1. Introduction**

In this chapter, I will describe and critically evaluate my journey with managing and leading this challenging change project. Before doing so, I will present my critical review of a number of change models and explain the rationale behind selecting the HSE model to guide my change approach.

### **3.2. Critical review of approaches to change**

As a part of my early exploration of the world of change and change management, Kotter's (1995) eight steps for successful transformation efforts, along with Lewin's change model (Bozak, 2003), were, very typically, the first two change approaches that I got exposed to. At the start, I found myself fascinated over the two scholars' ability — with a personal preference to the former due to his more detailed approach— to portray the change process in such a smart, energetic, positive and, most importantly, controllable way. This impression, once I came across a real challenge, such as analysis of a case study or planning for a change initiative, like the present project, was soon damaged due to the large room of uncertainty these models did leave me to encounter. To illustrate, although they very well emphasize and provide smart tactics to manage an important side of the change process, which is the people side, I can confidently say that the two models did not help me much, as a non-expert student manager, visualize or become more aware of other aspects of change— namely the

project management and hard sides of change; nor helped me see how a change project can be optimally structured or organized, as other models did.

Supporting the previously discussed point, Siirkin, Keenan, & Jackson (2005) in their paper of the 'Hard side of change management', contended that factors such as the amount of change effort, duration between two project reviews as well as the change agent's integrity are very important for successful change execution. All these important factors, some might argue, are not clearly addressed in both Kotter's and Lewin's models of change. Given that, a junior change manager might think if the former model shall be better used as a checklist for what should or should not be done to ensure successful transformation of people throughout the change process rather than being used alone. To illustrate, for each step of the Kotter's model —although I doubt if the well known scholar did himself claim that his 8 criteria for failure change projects can make up a single change model that can be adequately and effectively used on its own — I believe I would need a lot of change tools and tactics to successfully implement them. The same thing also applies with Lewin's Model.

On the contrary, a highly structured, comprehensive and research-based change model such as the HSE or Health Service Executive model (HSE, 2008), which emphasizes both the hard and soft sides of change management, seems to have the capability to structure a highly planned and clearly outlined change project to me. In addition, this model is too rich with change tools and, hence, it appears that it would be more likely to

draw one's attention to a number of key factors to focus on in order to manage most restraining forces, including people's resistance. Above that comes the fact that this model does encourage reflective practices, as well as constant evaluation and reviewing of change efforts. This feature, I believe, makes it a very realistic, practical road map for change. Therefore, and despite that this model may look over structured and sometimes way complicated to be adopted in small-scaled projects, and although I sometimes get lost in its substantial details, by balancing its strengths and weaknesses, I think that the net result would favor the strengths side, in relation to the present POGIL project.

The forth and the last change model that I would discuss here is Young's (2009) model. Overall, I believe that the strength of this model lies in its continuous search for improvement and its highly responsive nature to stakeholders' needs and complains. Therefore, the continuous cycles of its Do-Check-Act seem very attractive to be employed in my change project. Nonetheless, the planned nature of the present POGIL project did not make this model the ideal, single model of choice to me.

All in all, a more mature thinking of the four change model discussed above could lead to this simple conclusion:

Each change model could have its strengths and weaknesses in meeting the requirements of a certain change context. A smart change agent, I propose, would take the strong bits from each model and fit it somewhere under the umbrella of his favorite

model. At the end, knowledge is too valuable to be discarded. Of course, every single model was designed to meet the needs of the person proposed it, and it represents the extract of their long experience; the experience that I do not have to be eligible to underestimate their work. Furthermore, I remind myself that all the aforementioned models should be applied in the most ethical way; a point that all models appear to have failed to clearly address, but is urged to be maintained in any transformational effort (Thomas & Hardy, 2011).

### **3.3. Rationale for selecting the change model (HSE)**

Because of its research-based and highly defined structure; richness in effective change tools and ideas as well as its emphasis on both hard and soft sides of change— combining the strengths of many change models including Kotters and Lewin’s model — I selected the HSE model as my principal change model for this project.

### **3.4. Change model (HSE)**

#### *3.4.1. Project Initiation*

##### *3.4.1.1. Preparing to lead the change*

My journey with the POGIL project started when I sent an email to my line manager, who serves as the director of the foundation year of medicine and a chemistry lecturer at the same time, explaining the requirements of this thesis and offering to become a change manager for any change project that is planned to be taken place in the college,

particularly in the second semester of the current academic year. Taking longer than anticipated, my manager responded to the sent email demonstrating his<sup>3</sup> excitement about the idea and willingness to have a meeting in this regard. Knowing how smart and trustworthy the mentioned manager is, I felt that there is something good must be circulating in his head. As expected, he did come up with an idea that incredibly matched my needs/belief. I have always suffered from the students' blank faces and desire to go over the tiny and simple details of the organic chemistry (also referred to as M7) lectures during any post-lecture tutorial; something that leaves me exhausted but doesn't help them much become any better in their learning. However, before giving my final agreement on the project, I had to spend a couple of weeks reading about the POGIL's philosophy and way of implementation until I became convinced that this is the project that would help me and my colleagues overcome the previously mentioned problem and its associated problems as discussed in Chapter 1. Besides this agreement on the project topic, we also agreed to use the data obtained from the project for some educational research purposes, a part of the new role I have been later promoted to undertake.

Reflecting on the approach described above, as a step within the project initiation phase, I think I have saved myself a lot of time and energy searching for an achievable project – something that I, personally, badly need in order to become more innovative and creative in my change approach, and that would psychologically help me start and

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<sup>3</sup> For confidentiality purposes, subjects mentioned in this thesis will be all assigned the same grammatical gender (i.e. Masculine Gender).

survive the journey at my maximum capacity. And I also guaranteed my manager's commitment to the change project at the same time. Clearly, I achieved this by: 1) adopting an idea that is raised by my manager her/himself and that I am convinced about and 2) securing a solid shared benefit between myself (as a masters student looking at this project as a requirement for her thesis) and the college represented by my direct line manager (who treats the project as both change and research project).

Now, one might argue that the approach I followed was very passive, showing a more follower than a leader behavior with regards to selection of the change project topic.

Well, here are a number of facts that explain the reason behind this behavior. First of all, I have very little power (authority/credibility) in my organization to push my own idea if that idea was not strongly supported by a more senior person (Conger, 1998).

Secondly, my knowledge, at the time, about what could be achievable or not achievable within my work setting was so little that seeking a more senior person's opinion, who is also a stakeholder, was really important. Thirdly, engaging those senior people on the onset of the change project is politically seen very appropriate and could, consequently, make them more supportive to the change (HSE, 2008).

#### *3.4.1.2. Project Initiation Document*

After we agreed on the project's idea, my manager and I had a couple of weekly meetings to discuss and agree on the project's scope and outlines. This resulted in a

project initiation document that I prepared myself and discussed with my manager. This document, along with the project proposal that was submitted for the RCSI Institute of Leadership, was very effective and helped us identify the specific details of the project, including scope, business case or rationale, potential organizational outcomes, stakeholders, impact on stakeholders, communication plan, risks, governance, timeline, etc. Concerning the governance aspect, I was, naturally, appointed as the project manager while my manager has taken the executive role.

To link between the causes of the high failure rates and low knowledge retention in M7 and the overall details of the implementation project (solution), a fishbone analysis was also created and initial agreement on the required resources were made (Appendix 1). At that point, it was thought that the current organizational politics, along with the traditional passive students' mindset, would not allow for a large scale implementation of the project. Thus, the plan was to introduce the new teaching pedagogy in a number of post-lecture tutorials of the organic chemistry course in the first semester (also referred to as M2); followed by the implementation of a full pre-lecture M7 POGIL programme, before the method is formally integrated in the actual lectures. However, by looking back on the weaknesses side, two possible weak points in this phase might be identified: 1) the lack of students' voice and 2) lack of change readiness and capacity assessment (HSE, 2008).

### 3.4.2. *Planning for the pilot phase*

As pointed earlier, the implementation of the POGIL Project was carried out in two phases:

- 1) A pilot phase, represented by two post-lecture POGIL tutorials being conducted in the first semester of foundation year under another organic chemistry module (called M2).
- 2) An actual implementation phase, represented by eight pre-lecture POGIL sessions being conducted in the second semester under the organic chemistry module of interest (called M7)

During the stage of planning for the pilot phase, the project team put a final plan for how the pilot sessions would be conducted. Two post-lecture POGIL sessions, of 120 minutes each, were confirmed to replace the traditional post lecture tutorials, while the writer and the manager, who is also one of the two chemistry lecturers involved in the teaching of that module, were decided to be the facilitators. To resolve the problems associated with the traditional classroom setting, the largest room in the college was selected for the conduction of the sessions. Lastly, and perhaps more importantly, the team agreed to control the composition of students' team using the heterogeneous group format.

### *3.4.3. Implementation of the pilot phase*

#### *3.4.3.1. Email announcement*

Few days prior to their first formal POGIL session, I emailed the students informing them that a new teaching style was about to be implemented in some of their chemistry tutorials. I tried to write the email in a way that makes the students develop positive feeling towards POGIL before they actually experience it. This was supposedly achieved by demonstrating how POGIL would be expected to help the students make better achievements and promote their learning skills, as well as assuring them that nothing of importance was needed to worry about with regards to the new setting. Honestly, I am not sure how my students, who I discovered later that they don't regularly check their emails, had received this email.

#### *3.4.3.2. POGIL introductory session*

##### *3.4.3.2.1. Colorful posters*

In order to help the students better understand and start getting used to the new methodology, a POGIL introductory session which adopts a very POGIL-like style was delivered. Few minutes before that 90 minute-long session got started, a number of colorful, A3-sized, POGIL-related posters were seen on the classroom's outer door and were distributed all over the inner walls. The intention was to market the POGIL's idea and highlight the simple facts associated with it, particularly its effectiveness and how it works, in an efficient way. To do so, some of the encouraging course results that were gained from the implementation of POGIL in one of the American colleges were

displayed in one of the posters so that students' initial conceptualizing of POGIL could be influenced and directed for the project's benefit. Unfortunately, it seems that very few students did actually notice them, maybe because of the small size of these posters in relation to the huge classroom size. Indeed, I doubt students of this generation can be easily influenced by using these traditional, non-interactive, marketing methods.

#### 3.4.3.2.2. *Students inside the POGIL class*

Once they entered the classroom, the students were welcomed and asked to sit in their assigned groups and collaboratively answer a worksheet that explains the main principles and benefits of POGIL, and illustrates how POGIL activities do look like, just in the same way a chemistry lesson in a POGIL's style would have been taught. For more guidance, the students were given a set of instructions to read before the session started. In fact, the timing of this session was so late in the afternoon that I could not find myself having the energy to stand up and give a lengthy talk explaining the POGIL method, specially that the other facilitator, for some reason, couldn't attend the session, which added more preparation workload on me; plus, I was planning to display a video illustrating the new method and its benefits, but I could not get a proper one, so I thought that it would be more interesting if I led the session in that interactive way. Unsurprisingly, and regardless how smart this introductory method might sound, and in spite of the overall positive students' reaction to it, I can confidently say that by not approaching the students in the way that they normally used to be approached with,

which is talking, I could not foster the required momentum, or 'create the appropriate sense of urgency'.<sup>4</sup>

Lastly, to get an easy accessed overview of how the students performed or responded to POGIL, all the answers for the critical thinking questions that come after each model, including closed and open ended answers, were asked to be submitted on the Virtual Learning Environment (VLE). In addition, to better visualize the students' initial feedback on their first POGIL class, an extra question was added asking for each group's feedback/suggestions for the upcoming sessions.

#### 3.4.3.2.3. *Reflection on the POGIL introductory session*

By looking back at how things went on that day and by carefully examining how students answered the worksheet, it appears that everything was fine, yet it looks that it would have been better if I made a short oral presentation discussing the rationale behind POGIL adoption. Concerning the students' feedback, a good number of students reported their desire to have more challenging questions, while few of them demonstrated their discomfort with using the VLE to submit their answers. To this end, all this is considered natural and justified. What was difficult to be justified, in my opinion, was the rude way some students behave in, just because they thought that the

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<sup>4</sup> Indeed, I believe that we, as educators, do have to think if students, especially of the late generation, own the proper reading capacity, and, thus, if we are being realistic in depending on their reading skills alone in creating a sufficient sense of urgency. To put that in a more scientific way, human beings vary in the way they make sense of the world. Beside the visual learners, there are the auditory and kinesthetic learners (L. Cooper, 2008). I think that what I clearly did was simply depending on the visual sense alone which may won't work well with all types of learners.

session should have been focusing on the subject, rather than on the new teaching style! In fact, dealing with first-year students seemed more challenging at that point.

#### *3.4.3.3. M2 post-lecture POGIL sessions delivery*

For these two sessions, my manager (who is also one of the chemistry lectures teaching this module) prepared the POGIL activities and I proof-read them before they were given to the students. The activities were designed to ensure that the students would grasp the key points in the lecture; something that a number of high-ability students found unchallenging (as demonstrated later by the programme evaluation survey). From my experience, I can say that the topics which those activities had covered are somehow uneasy for all students to understand. Therefore, and in order to cope with relatively short time of the sessions, compared with the amount of the basic knowledge we wanted to make sure that all students would develop, it appears that we, unintentionally, included only low to medium-challenging questions. By consulting the Accelerator Model discussed earlier in Chapter 2, this inclusion would mean that we managed to match the needs of students at the concrete (low) and pre-formal (medium) levels of logical thinking but not of those at the formal (high) level.

##### *3.4.3.3.1. Problems encountered during the post-lecture sessions*

Overall, the main problems we faced at that stage included the students' reluctance to fill in the self-assessment (reflection) part of the activity; their discomfort with the quite long than they had anticipated activities; their feeling of fatigue/disappointment, because of what some of them had called long session duration and non involvement of newer,

challenging problems. In addition, some of them showed dissatisfaction with the new method and/or the language in which the activities were written, which they found way complex to understand. Most importantly, many of the students, after knowing that no marks were allocated for the activities, made little commitment to solving the second activity and suddenly disappeared from the huge classroom without submitting their worksheets, whereas some of them, shamelessly, copied other groups' work. Indeed, a lot of these problems were discovered at the end of the second session so there was no much chance to do something about them. However, there were also a number of issues that we managed to observe and deal with throughout the sessions. These issues will be discussed below.

#### 3.4.3.3.2. *Management strategies*

In response to some of the challenges we encountered during this important phase of the project, and building on the electronic feedback we received from the students during the introductory session, we decided to avoid using the VLE to submit the students' answers due to the technical difficulties the students encountered while trying to submit their answers in the previous session. We also tried to explain to some of the students who we found unhappy with the new method the rationale and benefit of our new teaching approach. For example, I remember I told some of them, individually, that by solving these activities they can save the amount of time that they usually spend going over the material when they return home, because they would already have grasped it all during the session time. This rationale-oriented approach was proved later to be very effective in getting the students' buy-in of the new change. However, and due

to the large student numbers in that huge classroom, I only managed to use this technique with only few students. Going back to the students' fatigue, we agreed to give the students the freedom to have a quick break, get some food and then continue their work. This worked with some students, but not with others who preferred completing the entire activity before having any break.

#### *3.4.3.3. Reflection on the post-lecture sessions' delivery*

Considering all the problems discussed above, I feel that there is a big communication and cultural gap between us, as educators, and between the students of this generation, something that I failed to recognize during the planning stage of this pilot phase. Although there is a good portion of the class who is committed to the classroom rules and procedures, just like what we used to be when we were students, there is also a good portion that is not. Expecting all the students to show the same behavior we used to show was very unrealistic. Expecting them to treat non-graded activities as same as how they treat their graded activity was unrealistic too (L. Cooper, 2008). Indeed, it appears that the internal motivation part was missing at this point. Furthermore, I think that more effective communication tools or vehicles should be used if one would like to successfully communicate his educational vision to the students (Kotter, 1995).

#### *3.4.4. Evaluation of the post-lecture sessions*

This section will be discussed later in chapter 4.

## *M7 Pre-lecture POGIL Programme*

### *3.4.5. Planning of the programme*

#### *3.4.5.1. Wider view of management and influencing skills*

This stage was my actual self-rediscovery stage during which I made every effort to learn from my previous experience, identify my weaknesses and enhance my leadership qualities. For more detailed description and analysis of this important stage see Appendix 3.

#### *3.4.5.2. Building the commitment*

Having one-on-one informal meeting with the new wonderful team member before the date of the formal team meeting was among the best things I did after reading on persuasion (Conger, 1998). Initially, I thought I was able to get a sense of his/her initial opinion on the project. Although I, wrongly, underestimated my persuasion skills and misinterpreted his/her reaction as being negative, the result of this meeting appeared later to be fruitful. Opposite to my initial anticipation, the mentioned team member came on the day of the meeting with a very good short exercise for the new programme! He got the idea behind the new teaching strategy and showed good enthusiasm about it. The good lesson I got as a junior manager is: Hold the hope and never make quick conclusions!

Besides the point of one-on-one meeting, I learned and practically approved that the most flexible people in a system are the ones who actually controlling that system (L. Cooper, 2008). That was very evident in a number of occasions throughout the project.

Fortunately, I also managed to identify the best way through which my team members can be persuaded as well as some of their preferred metaprograms (i.e. whether they have general or specific, proactive or reactive personalities, etc.). This helped me become more efficient in my management approach.

#### *3.4.5.3. Finalizing the details of the programme*

To overcome the challenges we faced during the pilot phase, we decided to formulate a feedback form to assess the students' performance and monitor their commitment to the pre-lecture POGIL activities (see Appendix 4 Section 2.1.1). We also agreed to reduce the duration of the sessions by 30 minutes, establish a sense of competition between the different teams and announce a final prize to encourage the students' participation and commitment to this voluntary programme. Additionally, we decided to drop those who miss two of the eight sessions and run all the sessions at a time not earlier than 8.30 a.m., in order to maintain a good attendance.

#### *3.4.6. Implementation of the programme*

##### *3.4.6.1. Announcement*

The students were informed of the pre-lecture POGIL programme during their first chemistry lecture. They were then given 48 hours to register their interest in the programme, and were told that they have the freedom to withdraw from this programme any time they wish. Since the data that is going to be obtained from the programme will be used for research purposes, it was necessary to obtain the students' consent of participation and provide them with all the relevant information about the project before

they register. Interestingly, between the last post-lecture POGIL session and the deadline of registration to the new voluntary programme, I, as a programme coordinator and change agent, had no contact with the students, nor tried to influence their decision whether to register or not register in the programme. Indeed, we did not want to end up having an oversubscription in the programme, due to the lack of the sufficient resources required for managing such a situation.

#### *3.4.6.2. Pre-lecture POGIL Programme delivery*

Forty nine students out of the 141 foundation year students have registered in the programme. Some of them attended one or more sessions, while others didn't attend any, leaving about 21 active participant students at the end of the semester. Overall, the students showed better engagement and interest in POGIL. In addition, a number of them were excited over the competition side of the programme. On the other hand, the low class attendance as well as the students' difficulty in understanding the point of reflection or peer evaluation (which we lately introduced to encourage the development of their teamwork skills), remained to be the big three main challenges we faced throughout the programme.

#### *3.4.6.3. Managing low class attendance*

To solve the low class attendance problem, I decided to use one of the most successful influencing strategies, that is to trigger the two main hidden drivers for all human being

behaviors: 1) the tendency to avoid potential sources of pain or go away from problems., and 2) to achieve a goal or fulfill a need (L. Cooper, 2008). This could have been easily done by keep telling the students how complicated the upcoming lectures or exam would be, which is very true, and how they might lose the chance to boost their long memory and well prepare their mind to get the maximum benefit from the lecture by not attending the POGIL classes. However, and from an ethical point of view, I preferred not to do so as some of the students complained from the activities being not much related to lecture or MCQ questions, and I did not want to risk my credibility, although I do not believe in the validity of their view in this regard. Alternatively, I promised to give them a certificate for attendance and tried enhancing their intrinsic motivation since this has been shown to be most effective than any external motivation (Schwartz, 2009). For instance, I resorted to have more informal discussions with students whereby I can build the rapport with them and friendly explain the rationale for some aspects of the programme that were considered areas of complains; and thus I can enhance my ability to influence their thinking. I also tried some anecdotes to get the students understand the rationale for doing the reflection and peer evaluation and I think achieved a good success with this approach.

#### *3.4.6.4. Change Tools*

So far, one can easily notice that this change project used the very minimum number of change tools. Indeed, I considered a lot of these tools, including the stakeholder analysis, but did not find them to be of a significant value in this project due to its small

scope. Other tools, however, and because of the distraction between the administration, reading and writing sides of this thesis, I could not think of at the right time, or at what I think the right timing. In fact, it was hard to keep control on the all three different areas, and above all it was the fact that each person would need to consider the tools that match his context that did not allow for using a lot of change tools. Furthermore, it can be said that many change tools might not be a good investment of one's time as the time spent to carry out these tools might excel the benefit gained from them (Ilies & Sutherland, 2001).

#### *3.4.7. Evaluation*

This section will be discussed later in Chapter 4.

### **3.5. Strengths and limitation of the project**

The major strengths of this change project, from my own perspective, could be summarized in the following points: 1) strong and early management commitment/support; 2) clear project vision, outlines, implementation plan and governance; 3) responsive and adaptive approach of resistance management and lastly, 4) project team spirit. As for the limitation side, I think that better formal and informal communication vehicles with students were needed at the onset of the pilot phase in order to communicate the project team's vision in a more effective way.

Further, I can confidently say that the project would have been benefited a lot from the

presence of a more proactive project member, someone who can complement the analytical personality I have and execute much more timely and effective actions. Honestly, I feel that if I managed to improve my decision-making skills, and make more timely decisions, I would definitely lead such kind of projects in a more successful way. I also believe that having that extra and dedicated team member would meet my shared leadership style and reduce any unnecessary anxieties I have had experience; especially that review meetings or more informal discussions about the project could not be made because of everybody's busy schedule, which made me feel stressed and less productive. Lastly, cultural aspect of the new student generation should have been better studied. Other strengths and weaknesses will be discussed later as they emerged from the evaluation phase.

### **3.6. Summary**

In this chapter, I discussed how I followed the HSE model to guide my change project through its both pre- and post-lecture forms. Overall, I have tried to take a highly responsive approach to watch and deal with sources of resistance. Therefore, I used a wide range of different persuasion and management tactics, including anecdotes, personal appeal, intrinsic motivation, one-on-one meetings etc. Consequently, I think that I managed, to some degree, to motivate a good number of students to remain in the voluntary programme, increase their benefit from the classes and accept some details that they did not like initially. Although strong management commitment was clear and planned change was secured, more regular review meetings and attendance to cultural

barriers with students were required. Adding to the last point, it appears that the project vision was under-communicated with students and employing rationale-based persuasion tactic was a very effective tactic in meeting some of this resistance.

## **Chapter 4: Evaluation**

### **4.1. Introduction**

Having discussed the implementation phase of this project, the achievement of project objectives will be now assessed using a range of qualitative and quantitative evaluation methods. To begin with, the project objectives will be first revisited. This will be followed by a description of the evaluation methods before the results are finally presented and discussed.

### **Preface**

As a result of the unique nature of the author's job, her responsibilities in the present project as well as her frequent contact with the change recipients (i.e. students), the evaluation of this programme has taken a number of different forms including silent observation of students' interaction in class (reported as a POGIL observer sheet), continuous discussions with students - as recommended by Young's Change Model (Young, 2009)-, occasional end-of-class perception questions, weekly activity feedback sheets, continuous assessments, self administered surveys and faculty interviews. To cope with space and time constraints, the most rigorous evaluation methods will, however, be reported herein and later integrated – during the discussion - with the information/observations obtained through the other methods. Before this is done, the project objectives, which represent the reference point for this project evaluation, will be firstly revisited.

## **Project objectives: A revisit**

The main objectives of this change project were:

- a) To assist the students who are actively participating in the M7 Pre-lecture Programme achieve a good understanding of the subject, so that an 85% pass rate in both continuous assessments and summative exam would be attained.
- b) To enhance and assess the development of the students' teamwork, critical thinking and reflection skills. These skills are aimed to be brought to the 'Good' level on the activity feedback form towards the end of the programme.
- c) To evaluate the students' experience in regard to the new teaching methodology by the use of self-administered questionnaires.
- d) To assess the staff's perceptions towards the new teaching methodology via the use of semi-structured interviews.

### **4.2. Evaluation methods and tools**

Both qualitative and quantitative methods were used to evaluate the impact and outcomes of this change project. These methods/tools included 3 continuous assessments (related to project objective (a)), activity feedback sheet (assessing project objective (b)), students' self-administered surveys (related to project objective (c)) and

semi-structured interviews of staff (evaluating project objective (d)). For the full details of these data collection methods see Appendix 4.

### 4.3. Evaluation results and discussion of findings

#### 4.3.1. Evaluation of the achievement of Project Objective (a)

Promoting students' understanding of the M7 course material, so an 85% pass rate in both continuous assessments and summative exam is achieved, was the first targeted outcome of this project. Since the results of summative exams are not available yet, the data obtained only from continuous assessments (CAs), was used to evaluate the achievements of this objective. As shown in Figure 3, the accumulation of students' scores in three continuous assessments indicated an overall pass rate of 90% amongst M7 active participants; suggesting the achievement of the first part of objective (a).

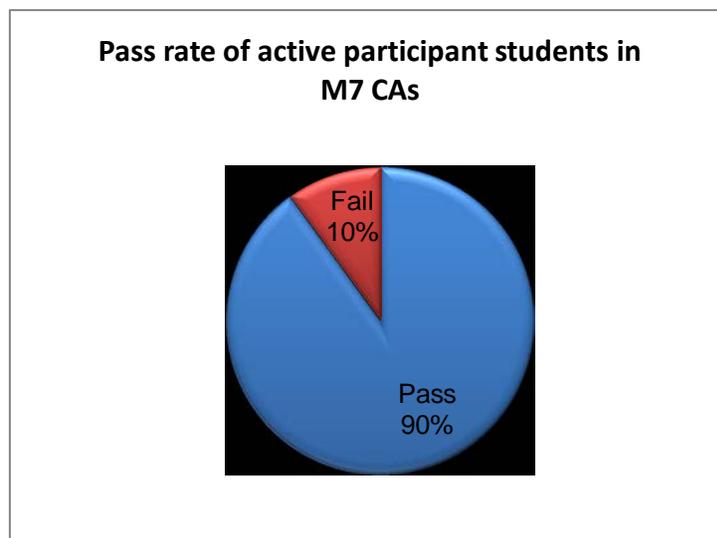


Figure 3. Pass rate of active participant students in M7 CAs

Interestingly, by comparing the results of both active participant and non-registered groups, it was found that the non-registered students scored a higher pass rate in their M7 CAs (95%), contrasting what was noted in the previous chemistry module where the active participants achieved a higher pass rate (81% compared to 72% for the non-registered students). A more comprehensive analysis, however, has shown that the first trend does still exist on the mean score level, suggesting that the discrepancy noted in the post-intervention pass rates could be clearly attributed to the unequal sample size of the two groups as well as the low discriminative ability of CAs (see Table 1). Apart from that, the general good understanding of the POGIL activities made by the participating students (as demonstrated by their attainment of at least 70% (+/-10%) in all of their POGIL activities, coupled with their high agreement with the phrase stating that “Pre-Lecture Programme has helped me learn concepts more effectively” and “forced me to think more deeply about concepts than the lecture alone would have” (see Table 2), seem to provide non-negligible evidence that attending the pre-lecture programme was an important factor for meeting the targeted pass rate.

**Table 1. Comparison of Students' Achievements Pre- & Post-intervention**

Achievement	Non-registered group (n=92)			Active participant group (n=21)		
	Pass	Fail	Mean Score (SD)	Pass	Fail	Mean Score (SD)
M2	66 (72%)	26 (28%)	56 (15)	17 (81%)	4 (19%)	62 (18)
M7 (CAs only)	88 (95%)	4 (5%)	68 (13)	19 (90%)	2 (10%)	73 (16)

*Note.* Although the number of active participants who failed their M7 CAs was almost equal to that number achieved by the non-registered students, the pass rate of the non-registered students was higher than that of the active participants due to the unequal sample size.

**Table 2. Responses of Active Participants to Knowledge-Related Items**

Please indicate your degree of agreement with the following statements:							
Answer Options	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Rating <sup>a</sup> Average	Response Count
The M7 Pre-Lecture Programme has helped me learn concepts more effectively than lecture alone would have.	0	0	1	10	10	4.43	21
The POGIL approach has forced me to think more deeply about concepts than the lecture alone would have.	0	0	3	8	10	4.33	21

*Note.* Fifty percent of students participating in M7 Pre-lecture POGIL classes strongly agreed that the programme helped them learn and think about concepts more effectively and deeply than the lecture alone would have.

a. Rating was calculated out of 5; where strongly disagree = 0; disagree = 1; undecided = 3; agree = 4; strongly agree = 5

#### 4.3.2. Evaluation of the achievement of Project Objective (b)

This objective aimed to enhance the development of students' critical thinking, team and reflections skills; so these can be rated as being 'Good' on the end-of-class activity feedback form by the end of the pre-lecture programme. Overall, the data obtained from examining the students' worksheets suggest a fair achievement of this objective (see Table 3); where signs of gradual improvement in all targeted skills, along with other process skills (including information processing, expression and organization of ideas) were fairly evident in students' work throughout the programme –with good team skills being found to be automatically secured from the first classes.

**Table 3. Results of Process Skills Assessment**

Construct	Average class rating			Improved?
	Activity1	Activity4	Activity8	
Information processing <sup>a</sup>	1=Adequate	1.57=Adequate /Good	2=Good	Yes
Expression & org. of ideas	1.4çAdequate	1.8çGood	2=Good	Yes
Critical thinking <sup>b</sup>	1.1çAdequate	1.7çGood	1.8çGood	Yes
Quality of Reflection <sup>c</sup>	1=Adequate	0.8çAdequate	2=Good	Yes
Signs of effective cooperation (Teamwork) <sup>d</sup>	2=Good	2=Good	2=Good	No change

*Note.* Unsatisfactory achievements were assigned (zero marks), whereas the adequate achievements were assigned (1 mark) and the good achievements were assigned (2 marks).

a. Assessed as students' ability to use the available information to provide correct answers (equivalent to 'understanding of content' item in the feedback sheet)

b. Defined as the students' reasoning capability (Bunce, Vandenas, Neiles, & Flens, 2010)

c. Defined as the students' ability to write insightful reflections

d. Assessed by the students' level of engagement in group work

To test the validity of these findings, some of the results obtained from the activity feedback sheets were cross checked with students' own perceptions (discussed in section 4.3.3), as well as peer evaluations – which provides some hints for the nature of students' teamwork – and they were found to be greatly matched<sup>5</sup>. However, it should be also noted that threats for internal validity do still exist as the level and length of the activities, the reflection topics as well as the number of participants do differ between the first and last activities making the results of the comparison a bit questionable with regards to the assessment of certain skills. Regardless of this validity issue, the provision of weekly feedback coupled with the use of some persuasion and internal motivation tactics as well as the special nature of this type of learning were noted to be good promoters for students' improvement. Informal discussions with students have also shown that competition between groups does have a non-negligible effect on

<sup>5</sup> More elaboration on this point will be made in subsequent sections.

students' motivation to improve the quality of their work; particularly for those occupying the top three ranks.

#### *4.3.3. Evaluation of the achievement of Project Objective (c)*

To evaluate the students' experience with the new change, two self-administered surveys were conducted; one at the end of the post-lecture phase and the second in the middle of the pre-lecture phase (after the students completed 6 out of 8 sessions). The results have collectively shown that students perceived the improvement of both teamwork and communication skills as the major impact of this project. They commonly reported group work as the part they most liked about the pre-lecture programme<sup>6</sup>. Other skills such as problem solving and ability to tackle unfamiliar problems were fairly reported to be improved too. As for the content-related learning, the views differed between the active and withdrawn students. While the majority of active participants have agreed that the pre-lecture activities have helped them better understand the material, forced them to think of the concepts more deeply and, thus, these activities should be continued to be used in M7, the withdrawn students were skeptical about that explaining that the level and/or content of the activities have undermined the learning they acquired from the programme. Although 95% of the active participants' indicated that the programme has met their expectations, that complain was fairly evident in their suggestions for improvement.

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<sup>6</sup> Both active and withdrawn students have agreed on that point.

The views also varied amongst the non-registered students on whether they benefited from or liked the post-lecture POGIL classes. These views, coupled with low perceived benefit of the pre-lecture programme as well as busy schedules, were reported as the major causes for students choosing not to participate in the voluntary programme. Indeed, the short pilot phase; its post-lecture setting that makes the students encounter the same material for the second time; and the under-communication of the vision or rationale behind adopting POGIL are believed to be the root causes for most negative attitudes. In general, those perceptions were found to be affected by two factors: 1) students' understanding of how the benefit from class is attained and 2) their personal motives for attending voluntary classes. These are outlined in the Table 4.

**Table 4. Non-Registered Students' Perceptions of Benefit and Motivation**

Benefiting from class means	Motives for attending voluntary programmes include
**** Enhancing one's understanding of the subject	**** Incentives: e.g. allocating extra marks for attendance; Certificates
*** Promoting personal and professional development	*** Suitable sessions' duration
** Good performance in exam	** Deepening understanding/ Adopting a more traditional, teacher-centered learning style
* Challenging one's understanding of subject	* Review of past exam papers

\*\*\*\* represents the most major theme; \* represents the most minor theme

Concerning the suggested areas of improvement, duration and timing of sessions, level and length of the activities were the most reported areas of improvement. Overall, it can be said that the active participants well-received the programme and appreciated its impact on their learning, while non-registered students appeared to be still stuck in the early stages of Kubler-Ross's (1997) Grief model for typical reactions to change. The withdrawn students, on the contrary, seemed to be resistant to the programme setting

or change strategy rather than the change itself. Tables 5 and 6 elaborate more on those findings.

**Table 5. Selected Examples of Students' Responses to Open-Ended Questions.**

Non-registered	Withdrawn	Active participants
"Having a lecturer explaining is much more beneficial than a group of students doing the work alone and not knowing if their answers are correct."	"Improving our social and communication skills and a better understanding towards the subject' was the thing I liked most about the programme."	"I think whenever a person figures out something by himself it will stay in his mind for ages. In the first semester it really helped me."
"I believed a pre-lecture session would not help."	"The worksheet should have questions that simplify things and not making them more complicated."	"I found it {POGIL} very helpful. I wanted to spend more time in learning chemistry because I think I can improve my level to a better and a higher level. POGIL gives me an opportunity to improve myself, my learning style and to ask questions to the lecturer at any time. Not only that, but to meet new people and communicate with them."
"We already have a condensed schedule and I would prefer studying M7 alone."	"Explanations were not clear enough to begin with so when receiving the assignments to complete I felt it was like Google was our teacher."	"I liked working in groups as it improves my communication skills. Added to that, I enjoyed exploring things, I mean when I don't understand a thing I go and read more about it .It benefits me by preparing my mind to the lecture."
"The POGIL programme doesn't suit my style of learning."	"The questions were not related to the lectures that we took."	"Some questions in the sessions were hard to follow and we didn't understand what was asked of us."  "I think the POGIL sessions should be made to where the student is able to figure out the concept and understand, not challenge the student to the point where he or she is confused and cannot understand the concept."
"[To me, a class would be beneficial if it] actively made me go out of my comfort zone"	"I think the motives were there it was just that when it was early in the morning and before a day with a considerable amount of lectures it would discourage me in going."	"I think the POGIL programme should continue to run, not only for chemistry but also for physics and biology and all the other modules. If it will make the student schedule busy and crowded then I think the POGIL should take the place of the tutorials, because POGIL is much better in making the student understand, ask and learn than the usual tutorial we have."

**Table 6. Active Participants' Responses to Close-Ended Questions**

Please indicate your degree of agreement with the following statements:					
Answer Options	Disagree	Undecided	Agree	Rating Average <sup>a</sup>	Response Count
The pre-lecture POGIL activities has appropriate difficulty	2	6	13	3.57	21
The M7 Pre-Lecture Programme has appropriate workload	2	6	12	3.57	21
The M7 Pre-Lecture Programme has helped me learn concepts more effectively than lecture alone would have	0	1	20	4.43	21
The POGIL approach has forced me to think more deeply about concepts than the lecture alone would have	0	3	18	4.33	21
The POGIL approach has helped me feel more confident about tackling unfamiliar problems	1	5	15	3.71	21
The POGIL classes has helped me improve my communication skills	0	5	16	3.95	21
I think the POGIL classes has helped me improve my teamwork skills	0	2	19	4.14	21
The POGIL classes has been effective in improving my problem solving skills	0	5	16	3.90	21
The pre-lecture POGIL classes should continue to be used in this module	0	4	17	4.29	21

a. Rating was calculated out of 5; where strongly disagree = 0; disagree = 1; undecided = 3; agree = 4; strongly agree = 5

#### *4.3.4. Evaluation of the achievement of Project Objective (d)*

Staffs' perceptions are seen very crucial in the success of any intervention. Hence, assessing these perceptions was the fourth objective of the project. Two semi-structured interviews, one with the programme executive and one with the other newly joined team member (both are chemistry lectures), were conducted. Generally, the two interviewees have shown a considerable enthusiasm towards POGIL. “[It was] interesting, a great formal learning, very positive development, excellent and definitely some students have benefited from it” the lately joined team member (or interviewee A) said. Indeed, the interviewees both perceived the new experience as a “positive learning experience” for themselves as educators as for the students. Thus, they are both considering using POGIL activities in their future classes despite the fact that they found preparing the activities and getting the right teaching venues a bit challenging; specifically, preparing the activities was a very time-consuming task for the two lecturers.

Regarding the strengths and limitations of the project, the appropriateness of such a learning style to third level students was the main strength point of the POGIL project according to interviewee (A). “At this stage, students should be learning how to learn on their own” he justified. As for the programme executive (or interviewee B), “getting the hard work done” and establishing the foundation for more future integration of POGIL in courses' delivery was the major strength of this pre-lecture programme. Concerning the limitations part, there was a disagreement between the two interviewees on the

voluntary nature and setting of the programme. Noting that the participant students were “more interested, more engaged and prepared to the lecture”, interviewee A argued that the programme should not have been voluntary. He justified his position saying that being voluntary means that “you will always have the good students would do it, [while] the ones who really need it, the weak students, they are the ones who don’t have an element of commitment or engagement” to make it. On the contrary, interviewee B mentioned that he would have never made such a programme compulsory due to the shortage of resources. He further clarified that any future integration of POGIL in chemistry or other subjects would not take the shape of pre-lecture classes as this adds “an extra unnecessary burden on the instructors”; especially that the pre-lecture programme has now served its pilot purpose. Indeed, the two views seem valid, implying that achieving a balanced relationship between the available resources and programme objectives is a major issue when adopting POGIL. More discussion of this inference will be made in the next chapter.

#### **4.4. Summary**

Qualitative and quantitative evaluation methods, including interviewing of staff, students' survey, continuous assessments and activity feedback form, have shown some good achievement of each of the four project's objectives. To illustrate, about 90% pass rate was achieved by the students who committed to the Pre-lecture Programme. These students were clearly more motivated to improve the quality of their answers to the critical thinking questions and have shown more signs of reasoning and better reflection skills. POGIL was also well-received by staff and all the students who actively participated in the Pre-lecture programme. The non-registered and withdrawn students, however, seemed to be more resistant to the change strategy than the change itself or they might be still stuck in the earlier stages of shock-denial, etc. reaction to change. Lastly, long preparation time and limited resources were the main challenging sides of the project from the staff's opinion. Table 7 summarizes all these findings.

**Table 7. Summary of Findings**

Objective	Specific Target	Evaluation tool	Achieved?	Major themes
Project Objective A	An 85% pass rate in CAs and summative exam	CAs	Yes (for the CAs part; data for the second part are unavailable yet )	
Project Objective B	By the end of the programme, students would be rated as having 'Good' critical thinking, reflection and team skills	Activity feedback from supplemented with an observer's sheet	Yes (with teamwork skills, as defined by the level of engagement in the group activity, being rated as 'Good' since the first class)	
Project Objective C	Evaluating students' experience with the change	Self-administered survey	Yes	<ol style="list-style-type: none"><li>1. students' teamwork &amp; communication skills were deemed to be improved</li><li>2. Pre-lecture POGIL classes enhanced the learning experience of the active participants and was well-received by them</li><li>3. Withdrawn students were less satisfied with the programme setting than the new learning method.</li><li>4. Non-registered students seemed to be still at the shock and denial stage towards the new change</li><li>5. Level and length of the activity need to be reconsidered</li><li>6. Duration &amp; timing of session need to be reconsidered.</li></ol>
Project Objective D	Assessing staff perceptions of the change	Semi-structure interview	Yes	<ol style="list-style-type: none"><li>1. POGIL was a positive learning experience for staff as well as students</li><li>2. POGIL will be more integrated in future chemistry classes</li><li>3. Implementation of POGIL requires a lot of resources: time, venues, staff, etc.</li></ol>

## **Chapter 5: Discussion & Conclusion**

### **5.1. Introduction**

Following the evaluation comes learning from the experience (HSE, 2008). In order to capture an objective, comprehensive but critical view of the whole project experience, various elements from the previous chapters will be now synthesized and presented in this chapter. To do that, the project impact will be discussed, analyzed and linked back to the strengths and limitations in order to extract the key learning points and draw recommendations for future improvements.

### **5.2. Implications of the change for management**

There are many implications of this change project that management might be interested to know. A main message might be that with a large class size, the implementation of POGIL becomes a very demanding process. Large teaching venues, more dedicated teaching staff to facilitate students' learning and mark their scripts, and more free slots on the timetable are needed if the POGIL classes are to achieve their maximum impact given the current project setting. However, considering such a project's impact on meeting the strategic goals of commitment to excellence in teaching, students' skills and staff innovation need a careful consideration. The upcoming pages elaborate more on these points.

### 5.2.1. *Project impact*

Selected to bridge the gap between the average first-year student's study skills and the high teaching standards set by the university, POGIL, as experienced in this project, has been shown, to a certain extent, to be an effective and suitable teaching approach for first-year college students studying organic chemistry. The aim and objectives of this project included enhancing the students' process skills and performance in Module 7, so that: (1) 85% of students can pass their continuous assessments and summative exam; and (2) their reflection, critical thinking and teamwork skills can be rated as being good by the end of the voluntary programme. In addition to these, the project objectives included evaluating both staff and students' perceptions and experience with the new experience. So far—with the results of summative exam being held—the POGIL project has met its aim and almost all of its objectives to a certain degree. For instance, 90% of students who actively participated in the M7 pre-lecture programme have passed their continuous assessments with high perceived understanding of the subject. Their higher-order process skills, with the exception of teamwork that was already good since the first classes, were noted to be gradually improved throughout the programme; and they successfully achieved the 'good' level on a feedback sheet.

Staff and students' perceptions were evaluated too, and the evaluation has shown that POGIL was also well-received by staff and all students who committed to the pre-lecture programme; whereas the non-registered and withdrawn students were found to be resistant to the programme setting/ change strategy, or they appeared to be

unconvinced or stuck in the early stages of the Kubler-Ross's (1997) Grief Model. Analysis of these achievements/ impact will be made below as part of the project's strengths or weaknesses.

### *5.2.2. Project strengths*

By examining the whole experience, one could say that the major strength of this project does probably lie in its adoption of a research-based teaching approach or change topic. The benefit of making such a selection was clearly reflected on all of the positive results obtained throughout the project, and it was further maximized by the following of change management sound practices. To illustrate, the observed improvement in the students' critical thinking, reflection and information processing, plus the high satisfaction rate of students committed to the voluntary phase of the POGIL programme, would probably not have been reported if the new teaching method did not match the human natural way of learning (Wolfe & Nevills, 2004), and if reflective practice, active listening and continuous responding to the students' concerns were not employed (Keeney-kennicutt & Simpson, 2008). As the literature rightly suggested, students were found to be motivated by the use of weekly feedback (Douglas & Chiu, 2012), incentives and internal motivation tactics (Schwartz, 2009). Indeed, each of the previously mentioned methods is believed to have added some value to the change process.

Additionally, a powerful project initiation phase that built on prior monitoring of students performance (through the use of Pareto Charts) and, subsequently, proper general

awareness of areas of improvements, was very easy to make, and it resulted in a highly focused change effort. This phase benefited a lot from the conduction of a fishbone analysis and having a project initiation document. While the former helped the project initiators visualize the possible causes for the problem in question and, consequently, agree on the best setting under which the change intervention should be delivered using the available resources, the latter, incorporating the former as a part of the project's business case, helped setting clear project outlines (e.g. scope, rationale, governance, organizational impact, communication plan, etc.). In addition, the use of the HSE model that is focusing on both hard and soft sides of change management to guide the process was very effective in optimizing the plan and change effort. Lastly, setting of smart, achievable objectives helped visualizing the impact and supporting its achievement.

### *5.2.3. Project weaknesses*

The weaknesses of this project can be summarized in Table 8.

**Table 8. Project Weaknesses**

Weaknesses	Notes
1. A change plan that was not based on deep understanding of students' needs and perceptions.	A better understanding of students' assumptions could have provided a better execution plan that is better accepted by students. To illustrate, students' reaction to change were noted to have been shaped by their understanding of how benefit from class could be achieved.
2. Students' individual differences were not attended.	In line with the accelerator model (Morgan & Apple, 2007) ● whereby the motivation of people is determined by the relationship between their cognitive skills and the type of introduced challenge ● High-ability students were found to be the most demotivated by the less complex post-lecture guided activities; whereas the low-ability ones were the most demotivated with the more complex, pre-lecture activities.
3. Lack of review meetings where celebration of success and acknowledgment of defects occur; thus, reducing change agent capacity to survive the change journey.	More review meetings and action learning set, if done institutional-wide, could improve the productivity of change agents.
4. A proactive change team member was needed to complement the change manager's analytical personality.	
5. Communication defects with students (i.e. under-communication of vision).	Class representatives could have been better recruited to bridge this communication gap. The communication department could have been also consulted for better marketing of the project's vision.
6. A short pilot phase that may have had an adverse impact.	Considering the fact that stakeholders' typical reaction to change pass through different stages before they reach the final acceptance stage, a short pilot duration may be seen to have had prevented such a natural development of reactions.
7. Lack of preparatory training.	Although students were able to produce good reflection scripts by the end of the programme, a pre-programme training on reflection could have accelerated this development process (Bosco et al., 2009).
8. More change tools could have been used.	Although the currently used change tools (including Pareto charts and fishbone analysis) have helped making an accurate analysis of the baseline situation and, thus, creating a strong business case for the project, more change tools could have been used to assess both capacity and readiness for change.

#### 5.2.4. Opportunities

Given that the project, till now, sufficiently met all its objectives, and supposing that all the weaknesses are resolved, a good chance for more successful, longer and even wider implementation of POGIL could be achieved in the near future. This implementation, on the long term, may eventually lead to improved students' attrition (Straumanis & Simons, 2008), enhanced organization's reputation and better financial outcomes. On another aspect, any future implementation of a voluntary programme may benefit from the introduction of some past exam papers and certificates (if allocating bonus marks is not possible).

#### 5.2.5. Threats

In spite of the previously discussed opportunities, wider adoption of POGIL would be somehow problematic, as it would need a lot of resources that are not available in the meantime.<sup>7</sup> The solution for this problem may entail prioritizing project objectives so that not all activities are done in a team-based setting. For example, pre-lecture activities can be uploaded before the lectures so that all the students have access to them without the need of extra resources. In this case the students would probably do them alone, meaning that the focus on improving teamwork skills could be lessened. Additionally, the questions should have medium difficulty, with the challenging questions being placed at the end so that students are more promoted for attending lectures and

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<sup>7</sup> Since the number of students is high, more facilitators will be needed to manage the class and correct worksheets. Time could also not always be available to do the reflection and peer evaluation parts.

post-lecture tutorials.<sup>8</sup> Regarding these tutorials, students could be given two challenging POGIL–type exercises, 5-minute long each, to do in groups at the end of tutorial or whenever students' attention drops. The reflection and peer evaluations could be occasionally done after that. Lastly marking and evaluation of students' scripts would be better done , occasionally, rather than weekly, to meet the lack of human resources needed for making this task.

### **5.3. Recommendations for future improvements**

These recommendations can be summarized in the following points:

- a) More involvement of the communication department in the marketing of educational goals may be required, as faculty may not have the time or capacity to do that effectively.
- b) More engagement of class representatives might help in establishing a common understanding and facilitate good informal communication with students.
- c) Students need be trained on the requirement of the POGIL classes (e.g. writing reflection) before these classes are delivered.
- d) To attend the limitations and lack of resources, POGIL classes should be integrated within the existing compulsory teaching events.
- e) POGIL activities, setting and incentives should address the individual differences in students' cognitive skills.

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<sup>8</sup> These tutorials are already existed before the implementation of POGIL and they are essential and compulsory teaching events on the current chemistry curriculum.

- f) More frequent project review meetings and institutional-wide action learning sets are needed to promote change agents' innovation and productivity.

#### **5.4. Conclusion**

The POGIL project has, in general, been a positive learning experience for all the people who committed to it, including instructors and students. It does strongly align with the new organizational strategic goal of commitment to teaching excellence, and there are a number of good indicators for more future success in terms of improving the quality of students' learning and process skills. However, more attention to the students' individual differences, assumptions and motives, programme structure and settings, change agents' motivation and, most importantly, communication of vision should be paid in future for more successful implementation.

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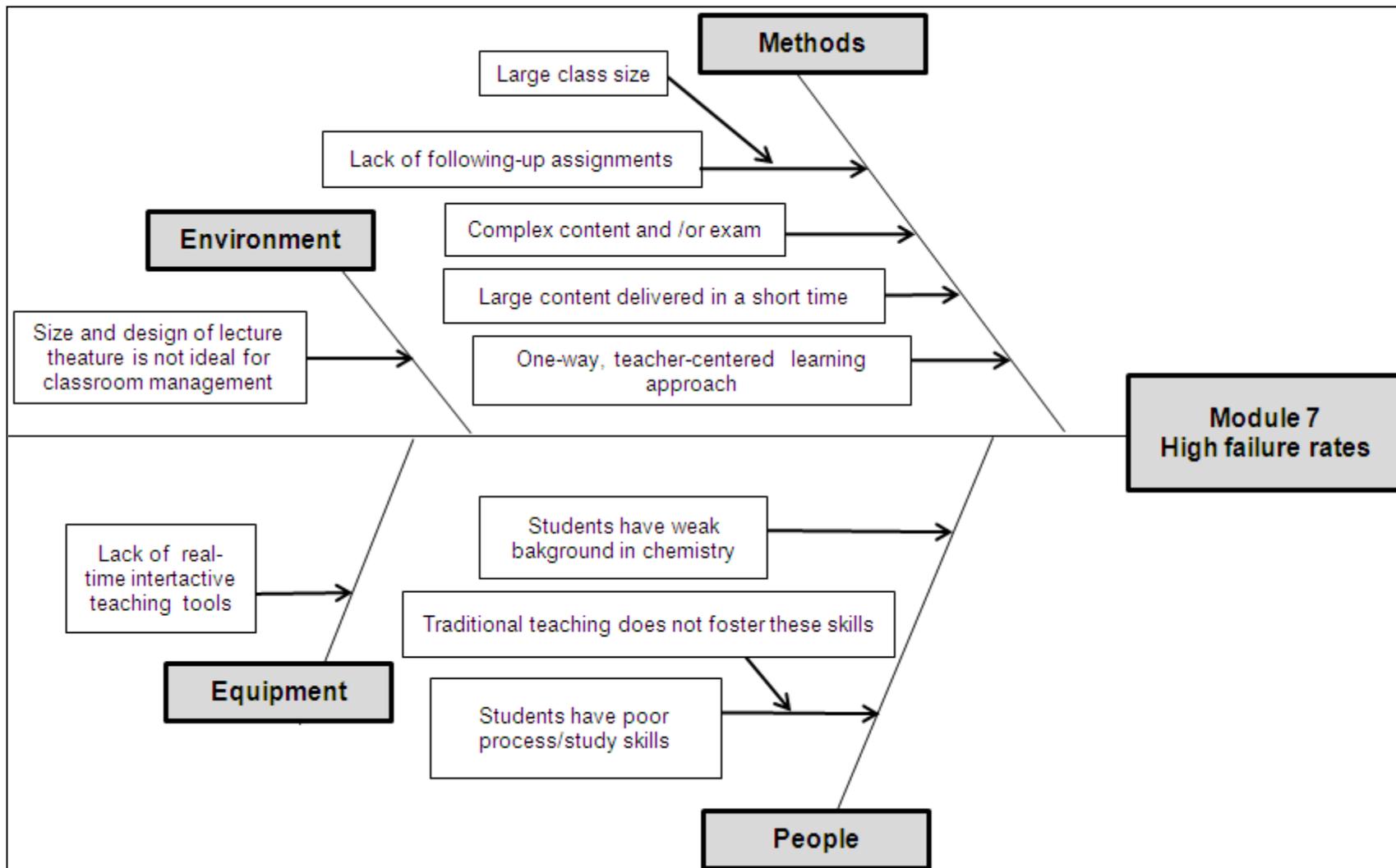
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Appendix 1: Causes of M7 high failure rates (A fishbone Analysis)



## **Appendix 2: Overview of Process-Oriented Guided Inquiry**

POGIL or Process-Oriented Guided Inquiry Learning is an innovative, team-based learning approach that employs the learning cycle paradigm of (1) exploration, (2) concept invention and (3) application to guide students to construct their own understanding of course material (Eberlein et al., 2008). In the POGIL classroom, the instructor acts a facilitator for groups of three to four student members who, in turn, take one of the following roles: presenter, recorder, manager and reflector (Bilgin, 2009; Douglas & Chiu, 2012; Hein, 2012; Schaal et al., 2012; Vacek, 2011). The learning activities start with presenting a model (or information) which the students need to read, analyze and understand in order to answer a set of subsequent critical thinking questions. Once the students finish one set of questions, they then move to another model and so on. Finally, the students are asked to reflect on and self-assess their performance in the class. This style of learning is claimed to improve the students' content-related as well as their higher-order process skills, including information processing, problem solving, critical thinking, reflection and teamwork skills (Douglas & Chiu, 2012; Hein, 2012; Mitchell & Hiatt, 2010).

### **Appendix 3: Building capacity to lead the change**

At this stage, I started to widen the scope of my readings in order to find new ways to manage the people side of my change project, and, more importantly, manage my leadership capabilities/weaknesses in order to maximize my chances to successfully lead this project. The key issue that opened my eyes on all this was the paper by McClelland & Burnham (2003) on the role of power in manager's life. By reading this paper, I realized that I must improve my need for the good power. Fortunately, the discussion of this paper with my sister who was reading at the time a book in Neuro-linguistic Programming (NLP) led me to focus on other related and important aspects in management— particularly how to best communicate with people of different metaprograms (personalities) and influence their thinking. In addition, these readings inspired me to try finding ways to overcome my weaknesses as a change agent and project manager.

All this cascade of new explorations was driven by a small instance, which was the consulting my programme director regarding the difficulties I had in controlling my change projects and exercising my project management role on my senior colleagues in the proper way. At that point, the second chemistry lecturer teaching the M7 was due to join our project, so I wanted to make sure that by becoming a project manager for the first time at work I would be using the proper tone when dealing with other team members who are more experienced than me and whom I respect a lot. Therefore, I thought that I need to consult our programme director who thankfully provided me with some useful advices as well as a number of inspiring articles on persuasion skills.

Interestingly, none of the change models taught me that this sharing of knowledge and acquiring of this positive energy and self awareness would improve my change management approach. Is it the SWOT analysis in the HSE model which I forgot to conduct as result of my busy preparation schedule that would have done so? Not sure! What I am sure of is my preference to the shared leadership style and need for continuous rich discussions and sharing of opinions.

## Appendix 4: Evaluation methods and tools

**Note:** A detailed description of each of the four evaluation methods and structures is included in this appendix.

### 1. Evaluation of the pilot phase (post-lecture POGIL tutorials)

#### 1.1. End of semester evaluation survey

To solicit the students' perceptions towards the post-lecture POGIL sessions (project objective C), a 5-point Likert-based questionnaire was administered at the end of the first semester using the Virtual Learning Environment (VLE). In this questionnaire, students were anonymously asked to indicate their level of agreement with five statements comparing the post-lecture POGIL tutorials to the traditional small group tutorials which were conducted in the same module (see Figure 4). The questionnaire was developed by the programme executive and analyzed and reported by the college's Quality Enhancement Office.

2012-13 Student Feedback: Optional Items	% Response Type			
Medicine FY1 (Bahrain)	2012-2013 (n=83)			
Category / Question / Module	NA	Negative	Neutral	Positive
The POGIL activity tutorials compared to the small group tutorials in M2: Please rate the following statements:				
encouraged me to be a more active learner in class	4%	20%	22%	54%
had appropriate difficulty and workload	4%	16%	28%	53%
were more effective in improving my communication skills	4%	14%	20%	61%
were more effective in improving my problem solving skills	5%	22%	30%	43%
were more effective in improving my teamwork skills	4%	18%	13%	65%

Figure 4. Structure and results of the post-lecture POGIL tutorials evaluation survey

## **2. Evaluation of the Pre-lecture POGIL Programme**

### **2.1. Student activity feedback sheets and observer sheet**

To assess the students' comprehension of material in each of the pre-lecture POGIL sessions and measure the improvement of their critical thinking, reflection and team skills (project objective B), an original activity feedback sheet was created by the author based on the insights gained from the pilot phase. This feedback sheet was supplemented with an observer sheet in order to provide a sense of consistency in the assessment of the time and team related skills (see the next two pages, sections 2.1.1 and 2.1.2), and it was handed to the students at the beginning of each following session.<sup>9</sup>

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<sup>9</sup> A more validate process skills tests such as GALT test, was difficult to obtain. Therefore, it was decided to construct this assessment tool.

## 2.1.1. POGIL Activity Feedback Form

Activity Title [ ]

Grp No.

Score

### General Evaluation (10 marks)

#### **A. Activity completion**

Unsatisfactory= 0                      Adequate= 1                      Good = 2

#### **B. Understanding of content**

Unsatisfactory= 0                      Adequate= 1                      Good = 2

#### **C. Expression and organization of ideas**

Unsatisfactory= 0                      Adequate= 1                      Good = 2

#### **D. Signs of critical thinking**

Unsatisfactory= 0                      Adequate= 1                      Good = 2

#### **E. Neatness and clarity of writing**

Unsatisfactory= 0                      Adequate= 1                      Good =2

### Evaluation of Reflection skills (4 marks)

#### **F. Completion of reflection**

Unsatisfactory= 0                      Adequate= 1                      Good = 2

#### **G. Quality of reflection**

Unsatisfactory= 0                      Adequate= 1                      Good = 2

### Evaluation of team and time-management skills (6 marks)

#### **H. Punctuality**

Unsatisfactory= 0                      Adequate= 1                      Good = 2

#### **I. Signs of effective cooperation between all team members**

Unsatisfactory= 0                      Adequate= 1                      Good = 2

**J. Adherence to classroom rules and procedures by showing the right attitude.**

Unsatisfactory= 0

Adequate= 1

Good = 2

**Comments**

## 2.1.2. POGIL Observer Sheet \*

DATE:-----

Criteria	Group No.													Comment	
	1	2	3	4	5	6	7	8	9	10	11	12	13		
<b>Punctuality</b>															
Members coming 10 min. late															
Members leaving early with no accepted reason															
Total # of members not adhering to class time															
<b>Rating**</b>															
<b>Signs of effective cooperative learning</b>	1	2	3	4	5	6	7	8	9	10	11	12	13	<b>Comment</b>	
Members disengaged in the activity															
<b>Rating**</b>															
<b>Adherence to classroom rules &amp; procedures</b>	1	2	3	4	5	6	7	8	9	10	11	12	13	<b>Comment (required)</b>	
Unsatisfactory attitude															
Adequate attitude															
Comment															
<b>Rating**</b>															

\*Please use this format to indicate the no. of group members showing a given behavior: I, II, III

**\*\*Rating:**

**U** = Unsatisfactory (2 members not showing the expected behavior)

**A** = Adequate (1 member not showing the expected behavior)

**G** = Good (no negative behavior observed)

**Comments**

## **2.2. Continuous assessments (CAs)**

Students' performance in three CAs was studied to see whether the first project objective (projective objective A) is met. These are 5-minute and 5-question long MCQ tests which are routinely administered in post-lecture tutorials. Results of the summative exam were supposed to be included in the evaluation too; however, this was not possible due to their unavailability at the time of preparing this thesis. The data analysis included the use of descriptive statistical analysis tools of Microsoft Excel 2007.

## **2.3. Mid-of-semester evaluation surveys**

To assess the students' perceptions towards POGIL, as a new teaching methodology, in general and the M7 Pre-lecture POGIL Programme in particular, an anonymously self-completed, online student survey was administered. The survey employed question skip logic whereby the respondents were directed to questions based on their own responses. All foundation year students including non-registered, withdrawn and active participants in relation to the M7 POGIL programme were eligible to fill in the survey, each with a different set of questions (see the corresponding paper-based version in the next pages, sections 2.3.1 - 2.3.3). This survey was developed by the author based on the instructions of Dawson (2009) and aid of some published questionnaires (Carmichael, 2009; Myers et al., 2012) and it was piloted before being administered. Both close and open-ended questions were used in order to get a better in-depth understanding of the students' perceptions. About 100 responses were received (70% response rate). These responses were then analyzed and those of the open-ended questions were subjected to content analysis using Microsoft Excel 2007.

**2.3.1.**

M7 Pre-lecture POGIL Programme

Mid of Semester Evaluation Survey

**Programme Non-Registered Student Form (A)**

This survey is aimed to understand the perceptions of **foundation year students** who did not sign up for the M7 Pre-lecture POGIL Programme towards the programme in general and POGIL as a new learning method in particular. Please note that the survey is designed for internal programme evaluation and is not intended to be used for any research purposes.

1. What is your opinion of the POGIL classes you had attended in module 2?

- a) I liked them, but didn't benefit from them.
- b) I didn't like them, but benefited from them.
- c) I liked them and also benefited from them.
- d) I didn't like them and I didn't benefit from them.
- e) I don't know

2. What does the word '**benefit**' in the previous question mean to you?

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3. Why did you choose not to be registered in the M7 Pre-lecture POGIL Programme?

**(Please justify your answer)**

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4. Did you hear any opinions about the programme from a colleague(s) who attended any of the classes?     Yes     No

4.1. If yes, what was this opinion?

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5. Did you notice any difference in understanding of the course between you and those who attended the programme?

Yes     No     I don't Know

5.1. If yes, explain the difference you noticed.

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6. What sort of motives would encourage you to attend a voluntary programme such as this programme? **Please specify them.**

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7. How much did you score in **Module 2?**

- a) Less than 40%
- b) Between 40% and 49%
- c) Between 50% and 59%
- d) Between 60% and 69%
- e) 70% or above

If you would like to be contacted regarding your comments, please provide your name:

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**Thanks for your kind participation in our survey**

**The non-registered version  
of this survey is in the next  
page**

### 2.3.2

M7 Pre-lecture POGIL Programme

Mid of Semester Evaluation Survey

#### **Programme Withdrawn Student Form (B)**

This survey is aimed to understand the perceptions of **foundation year students** who withdrew from the M7 Pre-lecture POGIL Programme -whether they attended some or none of classes- towards the programme in general and POGIL as a new learning method in particular. Please note that the survey is designed for internal programme evaluation and is not intended to be used for any research purposes.

1. Why did you register in the M7 Pre-lecture POGIL Programme?

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2. Did you attend any of the Pre-lecture POGIL classes?

Yes     No (**Go to Question 3**)

**2.1. If yes:**

a) What did you like about the programme?

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b) What do you think should be improved?

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3. Why did you withdraw from the programme?

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4. What sort of motives would have encouraged you to stay in the programme?

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5. How much did you score in **Module 2?**

- f) Less than 40%
- g) Between 40% and 49%
- h) Between 50% and 59%
- i) Between 60% and 69%
- j) 70% or above

If you would like to be contacted regarding your comments, please provide your name:

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**Thank you for your kind participation in our survey**

**The active participant  
version of this survey is in  
the next page**

2.3.3

M7 Pre-lecture POGIL Programme

Mid of Semester Evaluation Survey

**Programme Active Participant Student Form (C)**

This survey is aimed to understand the perceptions of **foundation year students** who are active participant in the M7 Pre-lecture POGIL Programme towards this programme in general and POGIL as a new learning method in particular. Please note that the survey is designed for internal programme evaluation and is not intended to be used for any research purposes.

1. Why did you register in the M7 Pre-lecture POGIL Programme?

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2. What did you like most about the previous sessions?

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3. What didn't you like about the previous sessions?

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4. What change(s) would you like to make in the programme?

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5. Please indicate your degree of agreement with the following statements:

**a) The pre-lecture POGIL activities have appropriate difficulty**

Strongly disagree      disagree      Undecided      Agree      Strongly Agree

**b) This programme has appropriate workload**

Strongly disagree      disagree      Undecided      Agree      Strongly Agree

**c) This programme has helped me learn concepts more effectively than lecture alone would have**

Strongly disagree      disagree      Undecided      Agree      Strongly Agree

**d) The POGIL approach has forced me to think more deeply about concepts than the lecture alone would have**

Strongly disagree      disagree      Undecided      Agree      Strongly Agree

**e) The POGIL approach has helped me feel more confident about tackling unfamiliar problems**

Strongly disagree      disagree      Undecided      Agree      Strongly Agree

**f) The POGIL classes has helped me improve my communication skills**

Strongly disagree      disagree      Undecided      Agree      Strongly Agree

**g) I think the POGIL classes has helped me improve my teamwork skills**

Strongly disagree      disagree      Undecided      Agree      Strongly Agree

**h) The POGIL classes has been effective in improving my problem solving skills**

Strongly disagree      disagree      Undecided      Agree      Strongly Agree

**i) The pre-lecture POGIL classes should continue to be used in this module.**

Strongly disagree      disagree      Undecided      Agree      Strongly Agree

6. Does the programme meet your expectations?    Yes    No    Undecided

6.1. If no, please explain why it doesn't.

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7. How much did you score in **Module 2?**

- k) Less than 40%
- l) Between 40% and 49%
- m) Between 50% and 59%
- n) Between 60% and 69%
- o) 70% or above

8. (Optional) If you have any additional comments, please include them here.

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If you would like to be contacted regarding your comments, please provide your name:

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**Thank you for your kind participation in our survey**

## **2.4 Faculty interviews**

Two different semi-structured interviews were conducted to assess the project executive and the faculty member' views regarding the implementation of this innovative teaching style (see the interview schedules in the next pages, sections 2.4.1 & 2.4.2 ). The interviews were audio-recorded and transcribed in a verbatim form before they were subjected to content analysis.

**2.4.1 Interview Schedule**  
**with interviewee 'A'**

1. In one word, please describe your experience with the POGIL programme.

\_\_\_\_\_

- Why do you find it so...?

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2. What did you like most about the programme?

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3. What do you think should be improved in the programme?

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4. Have you noticed any difference in the class performance of those who attended the programme? \_\_\_\_\_

- If yes, what have you noticed?
- If no, what do you think is the problem?

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5. In your opinion, what are the challenges of implementing such a new way of teaching?

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6. Would you consider using POGIL in your future classes? \_\_\_\_\_

- If yes, in what way would you use it?
- If no, why?

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7. Is there anything else you would like to say about the POGIL Programme or POGIL?

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Thank you very much for your time :)

**2.4.2 Interview Schedule**  
**with Project Executive (Interviewee B)**

Interview Schedule

1. In one word, please describe your experience with process-oriented guided inquiry instruction. \_\_\_\_\_

- Why do you find it so...?

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2. In your opinion, what are the strength points of the present POGIL project?

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3. What are the specific details of the project that you think should have been taken differently?

- Why do you think so ...?

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4. Have you noticed any difference in the class performance of those who attended the pre-lecture POGIL programme? \_\_\_\_\_

- If yes, what have you noticed?
- If no, what do you think is the problem?

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5. In your opinion, what are the challenges of implementing such a new way of teaching?

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6. Having done this project, what would be your next step? \_\_\_\_\_

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7. Is there anything else that you would like to say about the POGIL Programme or POGIL?

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Thank you very much for your time :)