Educational Reforms and Implementation of Student-Centered Active Learning in Science at Secondary and University Levels in Qatar

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ABSTRACT: The Qatari government has made significant changes in the organization and staffing of schools over the past decade in an effort to improve the academic performance of school-aged citizens. Of interest is the need to encourage teachers to move from a didactic teacher-led mode of instruction to one that is more student-centred, but also teacher-guided, which encourages the development of critical thinking, problem solving, inquiry, and investigative skills. In this article, we discuss past and current educational changes and developments in Qatar with an emphasis on an initiative in chemistry that explored the utility and cultural transferability of student inquiry learning approaches to improve student conceptual understanding as well as their attitudes and self-efficacy. Based on the current activities described in this article, we argue that the developments and commitment to educational reform in Qatar can act as a guide for other nations that wish to move from a didactic teaching to a more student-centred approach.

KEY WORDS: education reforms, Arab states, education systems, K-12, active learning pedagogies.

INTRODUCTION

Returns from the oil and gas industry have made Qatar one of the wealthiest nations in the world (Baker, 2012). Yet in the global knowledge-based economy, Qatar has yet to reach its full potential because Qatar relies heavily on expatriate expertise (Giles, 2006). This gap has not gone unnoticed: to bridge it, the "Education for a New Era" (EFNE) initiative was instigated. This initiative saw the establishment of the Supreme Educational Council (SEC) in 2002, now named the Ministry of Education; a multi-million dollar investment in science funding and the

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construction of Education City comprising eight campuses from top international universities from the USA and Canada (Supreme Education Council, 2012a). However, to ensure Qataris are effectively prepared for careers informed by science, a strong K-12 education system is needed. The students who graduate from Qatari schools must be as capable as those graduating from the world's best education systems. From a worldwide perspective, a citizenship with high literacy in reading, science and mathematics is a necessity for the sustainability and future of any nation. A recent address made at Qatar University (2015) emphasises these same points.

The policy makers or education reformers consistently refer to the international student testing systems such as the Programme for International Student Assessment, PISA, and Trends in International Mathematics and Science Study, TIMSS, as indicators of the success or failure of their education policies and/or teaching practices. For example, Qatar has been participating in PISA testing since 2003. For Qatar, the mean PISA score in science improved from 349 in 2006 to 384 in 2012 (Organisation for Economic Co-operation and Development [OECD], 2013). The 2012 PISA results portray the existence of a wider gender gap in science test scores, the second highest after Jordan. The girls' performance was 35 points higher than boys. Whereas, for both boys and girls the performance in science improved by 33 and 36 points respectively in 2006 and 2012 PISA tests. However, on a global comparison, the students' low performance in science assessment was attributed to the lack of fundamental reading, literacy and numeracy skills needed for the mastery of advanced scientific knowledge and science concepts that are being assessed (Areepattamannil, 2012; Bouhlila, 2011). Therefore, PISA results and their reception in Qatari context may have led to the exploration of innovative teaching practices in science. For the purpose of this paper, it is helpful to understand the various reform efforts that have been carried over in Qatar in order to explore the implementation of alternative teaching practices in science, particularly Chemistry, at secondary and tertiary levels.

PURPOSE OF THE PAPER AND RESEARCH QUESTIONS

In keeping with the aims of this journal, namely to "share perspectives … that will foster cooperative efforts to improve science education…" the purpose of this article is to describe educational reforms taking place in Qatar that can act as a guide for other nations that wish to move from a didactic teaching to a more student centred approach. We organise the paper in three sections by answering three research questions that attend to this perspective. Reform Efforts: What is the rationale for reform and

the direction of current developments of secondary school reform?; Post-secondary education: What are the developments of chemistry education at the post-secondary level?; and Developing and Monitoring: What is the state of introducing student-centered chemistry teaching?

REFORM EFFORTS

Beginning in the 1980s, the government of Qatar became increasingly concerned about the quality of the education system. As a result, over a 20-year period, several reform efforts were implemented in order to create highly trained and motivated citizens prepared for work and postsecondary education. These reforms were of mixed success and the need for long lasting effective reform remains. As a consequence, in 2001, the RAND Corporation was tasked with making recommendations for building a world-class education system (Brewer et al., 2007). Within a year RAND had put forward a selection of improvement options and, by 2002, the Education for a New Era Initiative (EFNE) had commenced implementation. As part of the EFNE the following reforms occurred: The introduction of independent, government-funded schools; the introduction of a new administration system to oversee schools: the Supreme Educational Council, the Education Institute and Evaluation Institute; Internationally bench-marked curriculum standards; National standardised assessments; focus on assessment for monitoring and raising quality; training for teachers and principals; "Report cards" for schools.

In 2001, RAND presented three governance options for schools to the Qatari leadership for discussion:
(1) a Modified Centralized Model, which upgraded the existing, centrally controlled system by allowing for some school-level flexibility with or without parental choice;
(2) a Charter School Model, which encouraged variety through a set of schools independent of the Ministry and which allowed parents to choose whether to send their children to these schools;
(3) a Voucher Model, which offered parents school vouchers so they could send their children to private schools.
The Qatari leadership opted for the second option called the *Independent School Model*, and the decade of reforms centred on implementing this model. In July 2012, the SEC adopted a parallel Voucher Model (Supreme Education Council, 2012b) which allows local nationals to opt to send their children to private schools in Qatar. The vouchers are valid for up to 28,000 QR ($7690) per year for each child ("Private school vouchers," 2012). There are over 100 private schools in Qatar; however at present only 71 of these schools have been approved for the voucher scheme (Supreme Education Council, 2014). There is no evidence that the

voucher scheme has led to parents moving their children from the government schools to the private schools; nevertheless there has been some disquiet in regards to the reason why not all the private schools have been approved for the scheme.

By 2004, the first 12 government funded Independent schools (all were schools converted from Ministry schools) were in operation. The Education and Evaluation Institutes (SEC) were also opened. Finally, the RAND-Qatar Policy Institute (RQPI) was set up in 2003 (Romanowski & Nasser, 2012). The pace and scope of these reforms were substantial. By 2006, there were 46 government funded Independent schools in operation alongside the Ministry of Education schools and private Arabic schools. As a result, in 2007, RQPI released a detailed qualitative policy document outlining the design and implementation of the K-12 education reforms to date. Nevertheless, the underachievement of students in mathematics, science and English language in the 2005 Qatar Comprehensive Educational Achievement (QCEA) tests and then in the 2006 PISA international assessments highlighted the need for continued improvement. At this time, the RQPI, recommended continued focus on: Building human capacity of citizens; promoting principles of the reform to all interested members; expanding supply of high quality schools; and integrating education policy with broader social reforms.

In order to monitor and evaluate the reforms, under the direction of the SEC, the RQPI began to examine the progress of these schools and conducted observations in both Independent and Ministry school classrooms from Fall 2005 to Spring 2007. During these observations they examined evidence of student-centred classroom instruction; emphasis on student acquisition of analytical and critical thinking skills; implementation of the curriculum standards in the core subjects; the use of English in mathematics and science classes; and support for teachers' professional development. Consequently, the RQPI made the following suggestions to strengthen the effects of the reforms: Limit policy changes; increase support for schools and teachers; review assessment policies especially in regard to use of English as the language of instruction and testing; and adopt approaches that engage parents and allow them to make informed decisions about their children's education.

Impact of the Reforms on the Educational Landscape
The decade of reforms has led to the establishment of two types of organizations: a set of Independent schools and a new administrative structure to oversee them. The SEC and the Education and Evaluation Institutes form the new administrative structure along with the Higher Education Institute, which was added later to provide scholarship support

for citizens pursuing higher education (Brewer et al., 2007). This administrative structure superseded the Ministry of Education and brought a move away from an authoritarian top-down governance of schools under the Ministry of Education towards governance through contractual arrangements with individual schools.

In conjunction with the newly formed Evaluation Institute, the RQPI developed a model called Qatar Student Assessment System (QSAS) – for standards-based student assessment to provide information to the community, teachers, and policy makers. One main component of the QSAS was the Qatar Comprehensive Educational Assessment (QCEA),which was under the remit of the Student Assessment Office (Jaafar, 2011). Its inauguration, in 2004, was the first time that all students in all grades in publically funded schools in Qatar were tested in a systematic, standardised way. Notably, it was the first such assessment in the region. A second major component of the QSAS was the "school report cards" which were intended to aid parents in making informed decisions on their children's education. The report cards were the product of a school evaluation, which was carried out every three years by the School Evaluation Office.

In 2009, the government announced that all ministry schools would convert to independent schools. At the beginning of 2016, there were 215 Independent schools in Qatar. Amongst these, 53 were secondary schools. In contrast to the former appointment procedures by the Ministry of Education whereby teachers and other staff were appointed to schools without consulting principals, the Independent schools were able to hire their own staff and make decisions on instructional pedagogies (Constant et al., 2010). Nevertheless, Independent schools still followed the same curriculum standards in mathematics, science, and English set out by the Education Institute. Based on observations of the Independent schools between September 2005 and May 2007, the newly Independent schools were more likely than their Ministry counterparts to report having engaged in teacher professional development, and were more likely to adopt student-centred pedagogies and be more active in trying to engage students. The Independent schools were also more likely to outperform Ministry schools scholastically but, of concern, the overall achievement was still low and inconsistent (Brewer et al., 2007).

Results from the RQPI started to raise concerns about the implementation of the reforms. These included lack of supply of school places resulting in market forces being unable to impose accountability on schools; the introduction of new policies, which reduced operator

autonomy and variability; increasingly regulatory approaches to address public concerns and hold schools accountable; and finally, a lack of clear mechanisms to encourage improved performance. The RQPI results raised concern that if there was not clear promotion and reflection on Education for a New Era Initiative values, the Independent schools could become like the schools they sought to replace especially as more administrators and teachers from the old Ministry system were joining the new system – many reluctantly (Constant et al., 2010).

In December 2013, the relationship between the Qatari government and the RQPI came to an end more than a decade after the reforms began (Meili, 2013). The media was keen to report the widespread perceived failure of the reforms (Paschyn, 2013); despite this, it was clear that reforms implemented through the guidance of the RAND were to remain. However, significant policy reforms were still occurring. The most major of these was the decision made in 2012 to change the language of instruction in independent schools from English to Arabic except for science and mathematics subjects where the teaching is bilingual. This change was not surprising. Firstly, given the evaluation by RQPI that language of assessment proved to be a contributor to student performance, especially in science. Secondly, given a growing parent perception that their children might lose their facility with Arabic if the entire curriculum was taught in English (Constant et al., 2010; Zellman et al., 2009). Consequently, the percentage of independent schools teaching science in Arabic increased from 14% to 50% since 2011.

While the teachers and students may be more confident in conversing and undergoing assessment in Arabic, the switch to Arabic has had some deeper consequences. Access to a range of high quality resources has been diminished; in particular with regard to materials which support critical thinking (Romanowski & Nasser, 2012) and student-centred learning (Knight, Parker, Zimmerman, & Ikhlief, 2014), which are two central tenants of the ENFE reforms. This lack of resources is highlighted by SEC in-house production of science textbooks. However, in a similar vein to the local production of textbooks in 1965, it appears these textbooks are compilations of materials drawn from other Arab and international texts rather than being specifically designed for the Qatari context (Brewer et al., 2007). Another issue of concern is the impact that the switch to Arabic will have on students' access to the undergraduate programmes at the branch campuses in Education City. The language of instruction in most of the undergraduate programmes in Education City is English. While most courses require a minimum band score of 5.5 in International English Language Testing System - IELTS - the most competitive courses, such as medicine, require a band score of 7.To

counter the higher education access issues, SEC decreed that Arabic is to be Qatar University's "official teaching language" (Lindsey, 2012). However, this does not alter the concerns raised about local national students' ability to access the courses on offer in Education City and also raises questions regarding how this move impacts on Qatar University's global rankings and its ability to attract the best staff and access to resources (Doha News, 2012; Lindsey, 2012).

Teaching Practices in Qatar

With limited places in the Qatari private schools, the Ministry's Independent schools are crucial to ensure that every student has access to high quality education. At present, the initial drive and vision of EFNE reforms have not filtered down in a practical manner to the classrooms as the number of Independent schools has grown. Thus, the changes have not consistently happened where they matter most – in the classroom. Regardless of the overarching policies, it is clear that teaching practices in Qatar need to change if students are to benefit from the ENFE reforms.

A report prepared for United Nations Educational, Scientific, and Cultural Organization (UNESCO) on Improving Science Education in the Arab States (UNESCO, 2011) argued that the over-emphasis on teacher-centred didactic approaches by most Arab countries leads to the negligence of the development of critical thinking, problem solving, inquiry, and investigative skills. Several studies highlighted the need for, and significance of, student-centred approaches, particularly in the Arab region (Abd-El-Wahed, 1996; Almuntasheri, Gillies, & Wright, 2016; BouJaoude & Abd-El-Khalick, 2004) as a consequence of an increasing emphasis on the curriculum that promoted critical thinking and creative skills. The over-emphasis on didactic teaching had been corroborated by observations in Qatari classrooms (Constant et al., 2010; Ikhlief & Knight, 2013; Knight et al., 2014; Zellman et al., 2009). Research-based active learning approaches with well-organised teacher guidance provided growing evidence that these approaches were effective in enhancing students' conceptual understanding(Furtak et al., 2012). Indeed, meta-analyses by Hattie (2009) showed that non-didactic teaching strategies facilitated students' application of cognitive processing and meta-cognitive strategies. Active teaching practices underpinned by the theory of social constructivism (Vygotsky, 1978) which offered the much needed background for the conceptualisation and development of many such innovative teaching practices.

Based on the above comments, it is not surprising that few research studies have been conducted that identified the existence and/or practice of student-centred teaching and learning in Qatari educational

institutions. The most recent published studies (Constant et al., 2010; Ikhlief & Knight, 2013), which investigate student-centred teaching practices in elementary mathematics and science classrooms, provide useful information on the conditions of such strategies. Ikhlief and Knight (2013) reported low levels of student-centred interaction at randomly selected schools, where the new curriculum standards had been implemented for at least three years. Their study focus on the content of classroom instruction, the depth of conceptual understanding and student off-task behaviour. Based on the comparison of the amount of off-task behaviour and the kinds of activities observed, Ikhlief and Knight inferred that the student-centred strategies were not enriched enough to allow for students' deeper conceptual understanding. Indeed, the study identified very little evidence in support of student-centred learning environments in independent schools. Of concern, it appeared that the amount of student-centred learning has diminished over the period 2005 – 2007 (BouJaoude & Abd-El-Khalick, 2004). Further, Knight et al. (2014) argued that several factors for the non-existence of the conditions for student-centred teaching and learning in independent schools included lack of English language proficiency among teachers and students and the lack of socio-cultural relevance of the adopted curriculum. Importantly, they state that ongoing and targeted coaching and feedback might be needed for teachers, rather than intense workshop sessions, to develop the complex teaching skills required in order to implement student-centred pedagogies.

Potential Student-Centred Pedagogies for Qatar

Appropriate student-centred teaching, as argued by Furtak et al. (2012, p. 300-329), is crucial to improve the academic outcomes and motivation of students but the question remains about how to engage teachers in adopting these strategies. Knight et al. (2014)called for more teachers' professional development programmes, which focus on the development of skills needed for student-centred teaching in independent schools. These programmes must meet the teachers' needs and guide them carefully through the process of moving from a didactic classroom to a more student-centred one. Consequently, there is a need to provide teachers with adequate support to introduce a range of well-articulated strategies and resources in order to move beyond their comfort boundaries.

There is a range of teaching and learning approaches focusing on the student at the centre of the learning experience that could be implemented in Qatari science classrooms – Problem-Based Learning (PBL), Peer Led Team Learning (PLTL) and Process Oriented Guided Inquiry Learning (POGIL). PBL is an experiential learning paradigm, which focuses students' investigation and resolution on real-world problems and simultaneously develops conceptual knowledge. According

to Torp and Sage (2002) in PBL, the students are actively engaged as self-directed learners in identifying the problem, the conditions needed for a good solution and pursuing meaning and understanding. PLTL involves recruiting and training those students who had successfully completed a course to become peer leaders of tutorials or workshops for new students (Gafney & Varma-Nelson, 2007; Hockings, DeAngelis, & Frey, 2008; Platt, Roth, & Kampmeier, 2008). POGIL involves small-group interaction where the learners identify the concept and refine its meaning by critically exploring information (Straumanis, 2010). Utilising group roles and highly structured activities in a POGIL instructor-facilitated non-lecture environment, students master the content and also develop essential process skills such as critical thinking, problem solving and communication skills. Having explained the innovative teaching practices, it is however desirable to consider how well these innovative teaching practices accommodate various cultural aspects relevant to the educational context of the Arab region.

POST-SECONDARY EDUCATION IN QATAR

As previously mentioned, in Qatar's Education City there are several campuses from top international universities from the USA and Canada; in the past ten years, there is much of this kind of international higher education globally and in particular in the Middle East (Miller-Idriss & Hanauer, 2011). At present, there are about 57 transnational institutions or programs in the Middle East, of which eight are in Qatar. This section describes the context of Weill Cornell Medicine-Qatar (*formerly*, Weill Cornell Medical College in Qatar), an educational institution in Qatar where POGIL has been adapted as a student-centred pedagogical intervention in Foundation Chemistry course.

Weill Cornell Medicine - New York, USA (WCM-NY) was invited by Her Highness SheikhaMozah bint Nasser Al-Missned to establish a medical college in Qatar, thus Weill Cornell Medicine -Qatar (WCM-Q) was opened in 2001. The first medical students graduated in 2008. The establishment of WCM-Q strengthened cross-cultural links and enhanced science and education in the region (Hajjar & Gotto, 2013). It is important to note that the degree is granted by Cornell University, Ithaca, New York, USA. As a result, the curriculum from WCM-NY was adapted in its entirety for on-site training in Qatar. Consequently, all classes were co-educational and taught in English by faculty who were mainly from the US, Canada and Europe. The 6-year graduation plan at WCM-Q consisted of a two-year non-degree pre-medical component followed by a four-year of medical curriculum leading to the M.D. degree. The pre-medical program provides students with an opportunity to acquire knowledge and skills needed to meet the admission requirements for the medical school in

Qatar. Admission requirements for the pre-medical program were highly competitive with an expectation of a high Grade Point Average - GPA, standardised SAT scores and high proficiency in English, followed by interviews. Internationally, as well as in Qatar, acceptance into medical school was an accolade reserved for a very few high achievers.

However, there was a growing concern within the local population that secondary schools were not adequately preparing students for university, especially those international universities in Education City (Fazeena, 2012). Indeed, despite outreach efforts and other support strategies, challenges remained in recruiting local nationals who met the admission criteria of the Pre-medical Program. Once admitted, sustained participation issues still remained and therefore a Foundation Program was introduced in 2007. The Foundation Program was aimed to enhance student success by exposing students to English language medium of instruction, which not only improved their English language skills but also enhanced students' critical thinking skills and knowledge in the basic sciences, which included biology, chemistry, physics, and mathematics. Besides preparing the students academically for their pre-medical studies, the Foundation Program also allowed students to become immersed in an institute where students were exposed to the culture of American higher education institutes. Since the Foundation Program had ran for ten years, the foundation alumni encouraged new students to appreciate the benefits and privileges associated with being in the program. Some of those benefits and privileges included having a small student/faculty ratio and an opportunity to become a part of the Cornell community prior to entering the pre-medical program.

Although the aim of adopting US-based medical college in Qatar was to test the model in a different cultural setting, it clearly brought unexpected demands. It was important to bear in mind that cultural differences were reinforced in any education system (Heffernan, Morrison, Basu, & Sweeney, 2010), and that culture played a major role in learning (Kolb & Kolb, 2009). Faculty and students might have different orientations toward learning and expectations reflecting their own backgrounds and values and this might result in a mismatch between teaching methods and students' preferences (Lemke-Westcott & Johnson, 2013). As noted, by Lemke-Westcott and Johnson, students coming from the Arabic private and Independent schools into American institutions might experience "cultural shock" in their initial year.

Despite a growing body of knowledge of the relationship between culture and learning, few research studies have focused on this aspect in the Middle Eastern context. One exception is the research by Lemke-

Westcottand Johnson (2013) who analysed the preferences for learning of Middle Eastern students at the University of Calgary-Qatar (UCQ) using Kolb's learning style inventory (Kolb & Kolb, 2005) and Vermont's learning style inventory (Vermont, 2005). The Kolb assessment revealed that Qatari students preferred active experimental methods such as hands-on learning experiences combined with critical thinking and reflection, whilst the Vermont assessment revealed that these students like step-by-step processing and strong links between learning and practical career outcomes. The students in the study also expected teachers to make the classroom a stimulating and collaborative environment. These findings corroborate research by the Global Leadership and Organizational Behaviour Effectiveness (GLOBE) team, which reported that Middle-East countries (e.g. Qatar, Saudi Arabia, Turkey and Kuwait) were 'high on in-group collectivism and low on future orientation' (House et al., 2004, p. 476). On the other hand, western countries (e.g. USA, Ireland, Australia, and UK) were found to be 'high in performance orientation and low in in-group collectivism' (House et al. 2004, p. 747). Thus the former, middle-eastern culture, was less 'competitive and results-orientated' and more orientated towards 'families or similar groups' than western cultures.

To mitigate this "cultural shock," the Foundation Program at WCM-Q, in addition to preparing the students academically for the two-year pre-medical studies component of a six-year medical degree was structured to allow students to become immersed in an American institute whilst also uniquely trying to build a small community relationship between students and staff. The small student/faculty ratios fostered this relationship and allowed staff to personalise their guidance and pedagogies without compromising on the curriculum standards. Consequently, faculty within the pre-medical department aimed to develop their pedagogies in active learning. They attended workshops in the US and reviewed the three types of active learning described above: PLTL, PBL and POGIL. The three methods were evaluated for use on the Foundation Chemistry course in the Foundation Program. The PLTL method was ruled out due to the lack of peers, further on in the program, to teach the incoming students. Originally, PBL presented a potential opportunity for the WCM-Q learning environment; however, it proved challenging to align PBL activities with the pre-medical curriculum. In the end, POGIL was selected for chemistry because the faculty considered that it best met the learning needs of the students as they entered into a new educational milieu and provided the best transition for students who had primarily experienced didactic teaching and rote learning methods. This sentiment was summarized as follows:

[POGIL] presented a manageable transition from traditional lecture to more active student engagement and a methodology to move from sole focus of content to consideration of learner self-development. The POGIL workshops and published materials provided a foundation to enable instructors to more confidently shift their teaching practices (Geiger 2010, *p. 21*).

As with all innovative pedagogical changes, support from colleagues and administration are crucial. In this respect, the pre-medical faculty and leadership team are invaluable. To contextualise the innovations, it is also important to mention that when WCM-NY undergoes curriculum reform, WCM-Q must also embrace these new changes in concepts and innovation. Problem-based learning that is incorporated in POGIL has become a key feature of many medical education programs (Fazeena, 2012).

DEVELOPING AND MENTORING STUDENT-CENTERED LEARNING

In keeping with the aims of this journal, fostering networks was key to improving pedagogical practice. Consequently, the effectiveness of the POGIL implementation in the WCM-Q Foundation Chemistry course was enabled by a grant from Qatar's National Priority Research Program (NPRP). This research investigated the utility and cultural transferability of student inquiry learning approaches that involved improving conceptual understanding, attitudes and self-efficacy (Qureshi et al. 2016). The WCM-Q Foundation Chemistry course, with a class of up to 20 students (predominantly for Qatar nationals) was designed to guide the students towards self-directed learning and independent thinking. For this purpose, POGIL format that used small group interaction was adopted from 2011 until the present. The Foundation Chemistry course at Weill Cornell Medical College was delivered over two semesters - spring, and fall, each comprising of 68 days of classroom interaction. POGIL workshops (each of 50 minutes duration) were held three times a week and, sometimes, complementary lectures were embedded into POGIL sessions to further assist students in understanding the concepts. The students' laboratory work was also structured according to the content covered in POGIL classes.

Aligning POGIL with the Curriculum
The POGIL materials used in Foundation Chemistry are carefully structured in accordance with the curriculum outlined in CHE090 (Foundation Chemistry I), and CHE091 (Foundation Chemistry II). CHE090 is an introductory course covering basic concepts and the content covered include: matter and energy, atomic structure, chemical periodicity,

structure and bonding in compounds, inorganic nomenclature, chemical calculations, properties of gases, chemical equilibrium, acids and bases, organic chemistry and the chemistry of the earth. Similarly, for CHE091, the topics consist of kinetics and chemical equilibrium, which includes acid base chemistry. An introduction to organic chemistry includes the following topics: nomenclature, functional groups, particularly reactions and mechanisms of alkanes, alkenes, alcohols, and halogenoalkanes.

Perceived Benefits of POGIL

The benefits of POGIL were summarized in the experience of the chemistry course director from WCM-NY who observed the POGIL exercise in action, who commented:

> "The class I attended was a POGIL exercise of the concept of weak and strong acids and the factors that controlled such behaviour (X-H bond strength, and H partial charge). The exercise was rigorous and I think the students really got the concept and exercised it in depth through small group collaboration (each group is 3 or 4 students). The use of social interaction and specific, rotating responsibilities in each group enhanced learning and engagement in the subject. It looked like this was a very successful experiment in getting students engaged in learning core concepts and their use in problem solving (rather than rote memorization). I was especially pleased to see that the foundation students were speaking only English in the class and especially during the POGIL team exercises. Since these exercises required much more verbal interaction than in the typical lecture class, this was already a big plus" (F. J. DiSalvo, personal communication 2011).

Students in the Foundation Chemistry course in Qatar are very socially aware and consider it a duty or obligation to help a member/friend in their POGIL group or to help the class as a whole. To motivate students in embracing POGIL, different strategies are employed such as the video of POGIL in action by the founders, which can be accessed through www.pogil.org. Nevertheless, the students offer resistance at the beginning of every academic year as POGIL poses radical changes to their ideas of didactic learning which they bring from their high school. For learning using POGIL approaches, students need to develop their self-confidence and skills to participate in group activities (De Gale & Boisselle, 2015).

The following examples illustrated the opinions of some anonymous students about their first experience of POGIL: Student A commented: "My first POGIL experience was not pleasant because I was

not used to that method of teaching". Student B reported: "Very informative. There were things I didn't know how to solve, but my classmates helped me". Student A commented at the end of the year: "I became more experienced in solving them, we got used to the pace and we improved our teamwork skills" while student B said: "At first I thought it would be risky; depending on ourselves, but then I realised that there is no better way to learn chemistry than practicing it ourselves". Other instructors outside Qatar have faced a similar experience when they introduced POGIL to their students. In their experience, they stated that students think that lectures would teach them everything and they were unaware of the actual gains they were making, even when their grades were good (Geiger, 2010; Qureshi, Vishnumolakala, Southam, & Treagust, 2016; Rajan & Marcus, 2009).

DISCUSSION: IMPLEMENTING STUDENT-CENTERED ACTIVE LEARNING

The EFNE reforms have ensured policies are in place to support Qatar institutions in the implementation of student-centred learning. At the superstructural level, strong links have been fostered between the POGIL research team and several secondary schools and colleges. These links have been built through strategy meetings with high school teacher and academic lecturer workshops to inform educators how to utilise POGIL. As a result of this, a pilot research project has developed POGIL resources in the Arabic language for reinforcing the purpose and learning behind some challenging Year 10 chemistry concepts in Independent secondary schools in Qatar. POGIL seminars have also been delivered locally, for example, at the Second Teaching and Learning Forum 2015, and regionally at the American University of Beirut, Science and Mathematics Education Centre (AUB SMEC) and other conferences (Qureshi & Grifarrd, 2012; Radhi, 2013). Importantly, WCM-Q in collaboration with Curtin University, Australia have organized POGIL workshops for local science teachers and Education City science and mathematics faculty in 2014. The overall aim is to bring early adopters of POGIL on-board to develop a distributed leadership model of dissemination of practice in schools and universities (Gronn, 2000). Furthermore, as has been shown to be the case in the USA and in Australia where POGIL has been introduced, the Qatar researchers can conduct seminars, workshops, and develop POGIL materials for the benefit of school teachers/lecturers, who wish to adapt POGIL style instruction in their institutions, and in other countries in the Middle East where teaching tends to be more didactic (Qureshi & Grifarrd,2012).

For successful implementation of student-centred active learning pedagogies, it is important to work with the networks and knowledge base

that are already in existence. While not an exhaustive list, as it grows each year, it is pertinent to mention some of the continuing professional development opportunities for, which are occurring in Qatar. In 2014, the University of Calgary Qatar (UCQ) has hosted its second post-secondary teaching and learning conference(Rahbek-Nielsen, 2014), while, Qatar Foundation has hosted the first teaching and learning forum and the prominent World Innovation Summit for Education – WISE, (www.wise.org). In addition, the Supreme Education Council has conducted a 3-day education forum and has included the 6th national students fair and exhibitions of outstanding teaching practice. After-work public health seminars on health issues, related to Qatar, have also been conducted on a variety of topics. As Hajjar and Gotto (2013)explain, Qatari researchers persistently work with international collaborators to achieve high quality education for the development of Qatar as a sustainable society.

However, the efforts toward implementation of active learning strategies remained challenging with the current attrition rates of teachers in Qatari schools. In the Education Institute's annual report for 2012/2013, the percentage teacher turnover for Independent schools was 38% while for private Arabic schools it was 64%. These percentages were cause for concern and were compounded by the fact that many competent teachers were often promoted to administrative positions – an issue of concern also in Australia (Ferrari, 2014). A teacher-in-service model, where the more experienced educators mentor advised to less experienced educators, relied on those educators trained in student-centred practices remaining in schools in order to share good practice with colleagues. Consequently, it was important to note that the creation of an online community for teachers to share and distribute resources, such as the Times Educational Supplement (TES) in the UK (www.tes.co.uk/teaching-resources) would help mitigate the loss of knowledge and also would help build on the availability of Arabic teaching resources available in the region. The impact of the voucher model of school governance (parallel with the Independent school model) introduced in 2012 was also worth noting; whilst its impact on school was at present unknown, it could add another level of instability to classroom environment. Too many policy changes could also feed into feelings of instability and this instability often hindered teachers' willingness to implement new pedagogies in their classroom.

Despite these challenges, the goal of implementation of a student-active learning pedagogy such as POGIL in Qatar has the potential for great returns. As a research group working in transnational institutions, the authors of this article are not only working with colleagues in

Education, but also with Qatari educators and science specialists in the Supreme Education Council (SEC) to strengthen the project by involving them at the outset of the project. As noted by Hanauer and Phan (2011), transnational institutions and programs are a significant development in both the globalisation of higher education and local education reform in the Gulf region. Thus our educational plans and related research enables us to consider how best to utilise student-centred learning to unite the demands of both local and transnational education.

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