Correlating Beliefs and Classroom Practices of Public School Science Teachers in Abu Dhabi, U.A.E.

Martina DICKSON[1] , Hanadi KADBEY[1] and Melissa McMINN[2]

[1]Emirates College for Advanced Education, Abu Dhabi, United Arab Emirates
[2]Higher Colleges of Technology, Abu Dhabi, United Arab Emirates

ABSTRACT

The education system in Abu Dhabi, the capital city of the United Arab Emirates, has undergone radical changes over the past seven years. A major emphasis of these reforms has been to increase the degree to which students can self-motivate, inquire and carry out work independently. Nowhere is this more critical than in the subject of science, which has been historically taught in the U.A.E. as a didactic subject. The vision of Abu Dhabi's Educational Council (ADEC) is for science to be taught very differently with a focus on inquiry based learning, exploratory approaches and a facilitation of student autonomy to do this. Research on the relationship between teachers' belief systems and their classroom practices often (though not always) shows a positive correlation between the two. We explored whether this relationship was true for science teachers working within the challenging reforming education system in Abu Dhabi. We employed a survey questionnaire which asked teachers to rate belief statements about science learning and about their reported classroom practice. 248 teachers responded, the vast majority of whom reported beliefs in science which are well aligned with accepted 'best practice' including the need for students to learn independently and using inquiry based approaches to learning. However, only a weak statistical correlation was found to exist between their beliefs and science classroom practices, due to constraints such as a lack of resources and lack of trained science lab assistants which they report as rendering them unable to practice their ideals about science teaching and learning. This research is significant for the scientific education community, particularly as it adds to the body of research describing teacher behavior amidst educational reforms.

Keywords: Beliefs, Emirati, Science teachers, Teaching practices

INTRODUCTION

Educational Reform in the United Arab Emirates

In response to calls to modernize the education system in the U.A.E, the emirate of Abu Dhabi began testing out a variety of policies and practices in its governments schools. In 2006, many schools were assigned to educational advisory consultancy companies whose remit was to provide subject and pedagogical advice, and coaching and mentoring of local staff in order to raise the quality of the teaching to international standards. This was no easy task by all accounts at the time; various authors reported teacher-centred learning

environments with little or no opportunities for students to apply what they had learned in a hands-on fashion (e.g. Dickson, Kadbey and McMinn, 2015). Whilst there were varying degrees of success in these projects, it was felt by some that a lack of a coherent strategy and inconsistency among companies, along with a lack of consultation by the advisory companies of the schools in some cases, hampered progress (e.g. Crabtree, 2010, Thorne, 2010). By 2009/2010 the consultancy companies mostly ended their tenures, and although in-service advising still took place, it was in a much less frequent and intensive form with advisors mostly coming from Abu Dhabi Educational Council (ADEC) itself. 2010 also heralded the first waves of major recruitment of primary school teachers from overseas, who would, in theory, bring years of experience and training from developed countries with established educational systems and implement these international practices into classrooms in Abu Dhabi.

The educational reform in Abu Dhabi has involved major financial and human resource investment, yet there has been little research to date of the effectiveness of science classroom practice in the midst of the reforms. This paper will explore the relationship between what these teachers actually believe about ideal ways in which students learn science, and how they themselves practice science teaching in the classroom. We then attempt to explore whether or not the practices of the teachers live up to the vision which ADEC has well-articulated in its New School Model documentation, i.e.: "the nature of learning opportunities is meaningful and encourages active involvement. This is evident when the teacher establishes: a meaningful context for learning, a balance of focused teaching, demonstration, discussion and practice, [and] children are encouraged to explore their learning actively through creativity and problem solving" (ADEC New School Model Cycle 1 Teacher Guide, 2013, p. 8).

Science Teaching within ADEC's New School Model

In science, the New School Model (NSM) emphasises inquiry based learning. Learning through inquiry holds a variety of different understandings for different teachers. For example, some consider the concept to be about the teacher posing challenging questions for students to answer, others think of it as a 'question-centred' conception where students develop their own questions, whilst others yet think of it as being experience-centred, with sensory experience playing a large role in the inquiry (Ireland, Watters, Brownlee & Lupton, 2012). ADEC defines inquiry based learning in the classroom broadly as when students are "working together, constructing meaning through collaboration with others, engaging in critical thinking and problem solving, reaching conclusions with regard to the 'rich' question from their research, presenting their conclusions and using the knowledge and understanding they have gained, developing their understanding of the process skills of acquiring knowledge" (ADEC New School Model Teacher Guide, 2013, p. 21). Key to these descriptions is the fundamental philosophy wherein the classroom teacher acts as a facilitator and supports students to reach their own conclusions, allowing students to become more self-directed, responsible and increasingly independent thinkers. These concepts, and ADEC's definition of inquiry in science as above, form the theoretical framework from which we derived our research tool, described subsequently.

The Links between Teachers' Beliefs and Practices, and Factors affecting Practice: Literature Review

We will now give some consideration to why an understanding of teachers' beliefs is so critical when examining the efficacy of classroom practice. This is examined through the lens of ADEC's New School Model, and in view of the context which is the developing education system being rolled out at full speed, coupled with the variety of experiences of the

expatriate teachers joining the classrooms in Abu Dhabi. We must consider if, in theory, beliefs actually affect ones' practice in order to fully explore whether classroom practice is aligned with the New School Model's ideals, or is ever likely to be.

It has been repeatedly shown in research that a teacher's perceptions and beliefs have a very strong bearing on their practice and style as a teacher (Bryan & Atwater, 2002, Savasci-Acikalin, 2009, De Souza & Marcos, 1997). There appears to be a direct link between pre-service teachers' attitudes towards science and science teaching and learning, and the hands-on science inquiry activities which they experience at school (e.g. Bleicher, 2006; Dickson and Kadbey, 2014; Mazur, 2009,). Teachers' practices are often directly related to their perceptions and beliefs of science (Fitzgerald, Dawson, & Hackling, 2008; Howit, 2007) and Bandura (1997) upheld the perspective that teachers' beliefs are a very strong predictor of actual behavior and highly influential to this. Beliefs can be strong predictors of behavior and may be more influential than knowledge in understanding an individual. This idea of a high correlation between beliefs and practice, that teachers' instructional decisions are closely related to beliefs about how students learn best, is commonly held in literature both recent and less contemporary, (e.g. Haney, Czerniak & Lumpe, 1996; Keys & Kang, 2000; Seung, Park & Narayan, 2011,). The low confidence levels of pre-service science teachers has also been shown repeatedly by researchers (e.g. Kucuk and Cepni, 2015) and the critical importance of self-efficacy (Karaduman and Emrahodlu, 2011).

Mahmoud offers a different viewpoint to this, professing that due to the variability of teachers' beliefs and the 'simplification' which may occur when categorizing beliefs in what he surmised to be a limited fashion, it is "necessary to take into account the contextual factors which have shaped and formed certain beliefs" (2009, p.32) before declaring a clear correlation between beliefs and practices. Contexts within which teachers work is significant, according to Ernest (1988), who cites factors such as others' expectations, curriculum and schooling systems, which may sometimes be out of teachers' control, as impactful. Mahmoud (2009) sums this up by suggesting that the relationship between beliefs and practices are very complex, due to the fact that beliefs could be at times both contradictory and (again) context dependent. He argues that teachers' beliefs and practices simply cannot be properly examined in isolation of the context.

The rationale of our study was to investigate, for expatriate teachers working within the reforming context of government schools in Abu Dhabi, the relationship between beliefs and practices. We were guided by the following research questions:

1. What beliefs about best science teaching practice to the school teachers hold?
2. How do they describe their actual practice in Abu Dhabi classrooms?
3. How well do these described practices correlate with their beliefs, and with the vision of ADEC's New School Model?

In doing so, we hoped to illustrate science practice in classrooms within the context of reform, but also to add to the growing body of international studies which examines the effect of teachers' perceptions on their science teaching practice.

METHODOLOGY

A mixed methods research approach was adopted, whereby a survey questionnaire with questions utilising a four point Likert scale was used to gather quantitative data, whilst qualitative responses could be added via a prompt for additional information for that item. The questionnaire was devised through a process of linkage to the framework briefly outlined in the previous literature and this was used as a basis for the questions, which would (it was hoped) probe the teachers' beliefs about science teaching and learning in order to then provide a context for their described practices. An important limitation of asking teachers to report

their practices is of course in the nature of any self-reported data and we do take this into consideration while discussing the results. Nonetheless, such data can give important indications of trends which can later be triangulated by classroom observation or other means of data gathering. The final version of questions was piloted on ten teachers who had previously taught in government schools but who were not eligible to take part in the survey. Adjustments were made on the basis of their feedback and their questioning during the survey taking (indicating a problematic question), thereby cross-checking the questionnaire's content validity. The authors carefully studied each question for its value and alignment to the overall framework provided by the literature, along with its relevancy to our research questions, discarding, modifying and adding questions as we went along. We leaned carefully on the ADEC definitions and descriptions regarding an inquiry approach to learning to provide our framework for the questions. These relate in particular to collaborative learning opportunities, allowing students to think, create questions and explore ideas without teacher interjection.

The survey comprised of four sections, one relating to some basic demographic information such as number of years of teaching experience and grade taught, along with nationality of the teacher carrying out the survey (specifically, Emirati versus non-Emirati). The latter is important because we were focusing on the beliefs of expatriates and so wished to eliminate the Emirati teachers' responses from this particular study. Some of this data has more significant for other research questions which are explored in other papers, but it provided an interesting background for discussion of practice in any case. Secondly, teachers were asked about their practices in the classroom to see how closely aligned their reported practices were to ADEC's vision for science education, as well as internationally standardised 'best practices'. They rated their responses using a four point Likert Scale of how often they would be likely to do these things, opting to omit a neutral option so as to push candidates towards making a choice (Newby, 2007). Finally, they were asked to respond to a series of statements on "how children learn science best" which were accompanied by another four point Likert scale; this time (strongly disagree/ disagree/ agree/ strongly agree).

The survey was sent out to 60 public schools in Abu Dhabi via the school principals, which they were asked to forward to the relevant teachers. ADEC primary schools have generalist teachers for Maths, Science and English taught through the medium of English; it was these teachers whom we targeted. All of the respondents were female due to the policy within Cycle 1 schools of feminization of primary school teaching staff. The teachers had a wide range of years of teaching experience, with half of the sample having more than ten years' experience. Due to the anonymity of the survey responses, we did not know which schools (or how many) had partaken in the survey, only the number of respondents. Using a very rough estimate of there being around 8-10 English medium teachers per primary school, this would mean that the survey response rate fell within the region of between 40-60% overall, by most accounts a very reasonable response rate for an online survey (Nulty, 2008).

FINDINGS and DISCUSSION

RQ 1: What beliefs about best science teaching practice to the school teachers hold?

The teachers were asked to rate their agreement with a number of belief statements. These statements lean heavily towards a student-centred, inquiry-based approach to learning and are all illustrative of the kind of classroom environment aligned to international based practice for science education, as well as with the NSM. For each of the statements it can be seen that the majority of teachers agreed or strongly agreed with each of the statements; between 92% and 98% across the statements were in these categories (Table 1). These high mean responses indicate a leaning towards the education philosophies stated earlier and

suggest uniformity across teachers. They also suggest uniformity across teachers in government schools and a cross section of nationalities and training backgrounds. High mean percentages of responses would appear to bode well for the implementation and success of ADEC's goals, in theory at least. Let us now look at how all of these concepts come together and fit with actual classroom practice, as reported by the teachers.

Table 1. *Teachers' Beliefs about how students learn science best*

Items	Strongly disagree %	Disagree %	Agree %	Strongly agree %	*n*
1. Students learn science more effectively when they work in groups and share ideas.	0	2	56	42	246
2. Students understand science best when they discuss concepts with their partners.	0	7	56	37	245
3. Students' interest in learning science increases when they pose their own questions and discover the answers by themselves.	0.4	7	53.6	39	245
4. Students remember a scientific fact when they discover it by exploring and observing by themselves rather than when they hear about it from their teacher.	1	7	46	46	245
5. Students broaden their scientific inquiry skills by communicating, sharing and reviewing each other's results.	1	6	54	39	245
6. Students understand scientific concepts better when they are given time to think before answering questions in class and time to reflect on their learning.	1	3	49	47	245

RQ 2: How do they describe their actual practice in Abu Dhabi classrooms?

Learning science through inquiry is one of the most fundamental and universally recognized strategies which has to be employed in the classroom in order to produce students who are able to question and think critically. For the NSM, this is of fundamental importance. Teachers' reported practices, again aligned to best practices, were overall responded to less positively than their belief statements may have predicted (Table 2). Many statements had a relatively high proportion of teachers agreeing that they often or always carried out those practices, and many practices were answered only 'sometimes', and some even 'never' as high as 55% of respondents for one statement. The practice statements closely align to the practical implementation of the belief statements, yet some teachers report that they never, or rarely, practice certain strategies, for example allowing students to explore science concepts independently (21%). Only a tiny percentage of teachers 'always' allow for this (2 %).

Table 2. *Teachers' Reported Classroom Practices*

Statement of Practice in the Classroom	Never/ Rarely %	Sometimes %	Often %	Always %	Response Count (n)
1. I allow my students to explore and discover science concepts on their own with minimal teacher input.	21	61	15	2	245
2. I involve students in class debates and	18	30	37	16	244

	discussions.				
3.	I actively involve students in hands–on activities and investigations.	2	38	46	15	246
4.	I provide opportunities for students to work in pairs or very small groups	3	22	44	30	245
5.	I incorporate scientific inquiry skills in my science classes.	5	38	44	13	245
6.	I encourage collaborative learning among my students	2	19	47	31	245
7.	I arrange library lessons and field trips connected to the science topics	55	37	6	1	243
8.	I relate science concepts studied in class to our daily life and to the real world.	1	20	47	31	244
9.	I create differentiated resources to support student learning in science	13	42	35	9	244
10.	I create differentiated activities and experiments to support student learning in science	14	44	34	7	243
11.	I use different science assessment tools, not only projects and exams.	11	31	45	13	244
12.	I demonstrate practical work to my students first before they begin the work.	16	20	46	33	245
13.	I help my students to make connections between Science, Maths and English.	2	23	47	28	244

RQ 3: How well do these described practices correlate with teachers' beliefs, and with the vision of ADEC's New School Model?

We examined the teachers' responses and brought together statements of belief and practice which have a direct pedagogical link, in order to explore a possible correlation. Literature predominantly reports that beliefs often inform practices, and will form a critical part of a teacher's eventual profile. We wished to test whether this was true in the case of teachers in Abu Dhabi too, that is, whether their beliefs which they brought with them from lands afar, translate into related practice in the classroom.

Some of the statements for which the responses were highly negative (i.e. many never/rarely choices) can be explained by exploring the qualitative statements. For example, 55% said they never, or rarely organized to take their students onto school trips. From the qualitative comments, we came to understand that general classroom teachers have no authority to do this in the government schools and the role appears to be undertaken by the teachers of Arabic medium teachers, e.g. "Field trips are arranged by the Arabic teachers. The EMTs (English Medium Teachers) are never allowed to arrange Science trips." and "At my school, we are not allowed to arrange our own field trips, only to suggest. We get only one a year. All my science related suggestions were turned down." Changing this policy could help with the lack of empowerment these statements suggest is felt by the teachers. It could also help provide teachers with opportunities for teaching students about the nature of science in a deep and meaningful context. Kucuk and Cepni (2015) found that students' understanding of science (and therefore, likely, their confidence) could be improved by using direct-reflective methods rather than indirect methods.

Taking a belief statement such as 'students learn science more effectively when they work in groups and share ideas' which teachers overwhelmingly agreed or strongly agreed

with (98% of the sample). A teacher who holds such a belief (which the sample overwhelmingly did) would, it might be hypothesized, be expected to strongly practice collaborative work in the classroom. However lower scorings on the practice statements 'I provide opportunities for students to work in pairs or very small groups' and 'I encourage collaborative learning among my students' indicate a less optimistic picture of classroom practice. Indeed, descriptive statistics would appear to marginally support this, with 98% of teachers either agreeing or strongly agreeing with the belief statement, and 77% sometimes or always providing opportunities for students to work in pairs or groups. It is not, however, as strong a relationship as one may have imagined. The discrepancy of 22% and over, of teachers believing that collaborative practice makes more effective science learning, yet not actually putting this into practice, is noteworthy. To take this a little further, we then used the Excel statistics toolbox to run Pearson's correlation coefficient testing for these items and found that the correlations between the belief and practice statements were not statistically significant (Table 3).

Table 3. *Correlation of Beliefs with Classroom Practices*

Belief Statement	Practice Statement	Correlation Coefficient *(Pearson's CC; r >0.5 considered significant correlation)[1]*
1. Students learn science more effectively when they work in groups and share ideas.	4. I provide opportunities for students to work in pairs or small groups	0.29
1. Students learn science more effectively when they work in groups and share ideas.	6. I encourage collaborative learning among my students	0.32

Responses to other belief statements such as 'students' interest in learning science increases when they pose their own questions and discover the answers by themselves' and 'students remember a scientific fact when they discover it by exploring and observing by themselves rather than when they hear about it from their teacher' also scored very high (92% for both) agreement or strong agreement with these statements. Again, this might lead us to expect reported statements of active classroom practice according to some of the research mentioned earlier. Both of these belief statements are illustrative of a teaching philosophy which embraces the concept of inquiry based learning and allowing for student autonomy in order to explore and independently answer, all of which would fit into the objectives of science education in Abu Dhabi's educational reform objectives. These questions are formed on the basis of inquiry based approaches, and upon the premise that exploratory learning opportunities are optimal for students. The statements of classroom practice which best align with these beliefs are selected and re-represented in Table 4. Here, we see a far less positive response; very few teachers reportedly 'always' practice these exploratory, hands-on and inquiry approaches. Poor correlations of positive beliefs with practical approaches to inquiry are particularly poignant, given the emphasis from ADEC on the teaching of inquiry skills. ADEC's Science Curriculum Teacher Guidebook (2013) specifically articulates the ideas which should be covered, and the need to focus on such skills.

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[1] Newby (2010)

Table 4. *Correlation of Beliefs with Classroom Practices*

Belief Statement	Correlations (r) of Beliefs with Practice (>0.5 considered significant correlation)		
	1. I allow my students to explore and discover science concepts on their own with minimal teacher input.	3. I actively involve students in hands–on activities and investigations.	5. I incorporate scientific inquiry skills in my science classes.
3. Students' interest in learning science increases when they pose their own questions and discover the answers by themselves.	0.23	0.12	0.2
4. Students remember a scientific fact when they discover it by exploring and observing by themselves rather than when they hear about it from their teacher.	0.11	0.19	0.13

We have seen earlier how the number of teachers who said they often or always used particular practices considered to be exploratory/inquiry based are relatively low, such as allowing students to explore and discover science concepts on their own with minimal teacher input (18%), actively involving students in hands-on activities and investigations (60%), incorporation of inquiry skills in the science class (57%) which would appear to be at odds with the high responses to the belief statements which embody these ideas. The statistical correlations between these two entities are displayed in Table 4. Here, it can be seen that no correlation is greater than, or even close to, 0.5, the threshold for statistically significant correlation (Newby, 2010).

Having seen that the relationship between teachers' beliefs and practice is not statistically correlated for our data, we now delve into the additional qualitative comments which teachers added to the survey to attempt to understand why this would be. One teacher showed an understanding of the need to allow students to explore independently sometimes: "I don't always demonstrate as I want my students to find things out by using their enquiry skills". This, however, was something of an anomaly in the data. Many commented that the levels of students' behavior in government schools severely hampered their ability to make their lessons more hands-on and practical, in particular working collaboratively in groups. Some expressed nervousness about the students' handling of equipment due to the behavioral issues too.

The teachers' statements appear to corroborate the idea that their beliefs are indeed aligned with the NSM model's vision, and indeed international best practice in science. However, practices seem to deviate widely from these ideals for a number of reasons. Firstly, the teachers repeatedly mention the language barriers they face in the classroom and how this prevents them from fully embracing inquiry learning. Many commented that they need an Arabic teacher to co-teach science, that much more support was needed with bilingual resources such as signage, and many even said that science should be completely taught in Arabic, expressed in quite emotive terms. For example:

"teaching [science] in English is doing a huge disservice to the students and I fear that an entire generation of potential scientists will be lost due to the language barriers that are formed."

One teacher even described resorting to having the students demonstrate their findings in Arabic, which she did not herself understand, but which she observed the other students

responding very positively to. Most felt that the low levels of English language skill among the students rendered many of the ideals mentioned in the questionnaire, particularly with discussion of concepts and ideas, unattainable in English.

This sample of teachers certainly seem well aware of what needs to be done and what constitutes 'ideal' practice in the science classroom. Some voiced frustration that they cannot do this in practice due to the perceived constraints they are working under, e.g.:

> "My answers are based on what should be happening, but because of language barriers, Grade 1 has no idea most of the time what is being taught. They can't form questions, collaborate/discuss most of the topics."

A perceived lack of adequate resources was mentioned very frequently (some even said their schools had absolutely no resources for science experiments and activities), and needing to supplement or purchase resources personally was another frustration commonly voiced. An articulate example of this is:

> "Science is a very important subject. "Science kits" that contain teaching experiment materials would be MOST effective for me. Time and resources are not on our side. I have spent a lot of money to find materials. I can't afford it!"

One teacher added that "The fact that schools are not provided with science kits and materials is failing our students."

In addition to the lack of science equipment and resources, an absence of trained science lab support personnel came up frequently in the responses, emerging as another theme for why their beliefs are unable to translate into actual classroom and providing further explanation for the poor correlations we observe. Although most schools do have a named person responsible for organizing science labs and setting up experiments, in reality it would seem from the responses that these may not be properly trained, nor even available to support most of the time as they are allocated to other tasks within the schools. This corroborates a theme explored by Guo (2007) who found that struggles in obtaining science equipment in order to perform experiments was highly stressful and a major factor in a poor science teaching practice. Atav and Altunoglu (2010) also found that pre-service teachers perceive themselves as only partially competent in both the effective use of laboratory instruments, and the teaching of techniques in the lab.

The positive correlation between beliefs and practice which other researchers (e.g. Bandura, 1997) have found has not been observed in this study. Instead, these results align more closely with the work of authors such as Mahmoud (2009). The vast majority of the studies which were earlier quoted took place in environments where students are in their first language environment, which makes it difficult to draw comparisons. Mahmoud, in a wide-scale literature review on the subject of science teachers' beliefs and practices, found that "inquiry-oriented and constructivist teaching appeared to conflict with more traditional beliefs about the nature of science and some aspects of science teaching and learning " (p. 40). From the statements we posed, this did not appear to be the case since all questions pertaining to inquiry-oriented, or what could be conceived as 'constructivist' were answered very positively. Mahmoud considers that the relationship between beliefs and practices to be complex, due to the fact that beliefs could be, at times, contradictory, and again, context dependent. He argues that teachers' beliefs and practices simply cannot be properly examined independently from context. This would appear to be the case for our data too. Teachers in this study were clearly articulating an awareness that their beliefs don't match up to their practices, that they know what they 'should' be doing but that due to their contextual constraints, are unable to. For example, one teacher wrote that *"this* [referring to the practice statements] *would all be done in the "perfect" setting."* and:

> "Each of these points are true when the students are confident to express themselves in a way that will be nurtured by the teacher, but if English is

especially difficult for them, they often lack the confidence to follow instructions or express their results".

One also made the point that the concepts were good in theory and she agreed with all the statements on how students learn best, but that "we have to teach children how to collaborate, how to work independently, how to enquire and how to ask questions... before they can use these skills IN learning." Many teachers commented on their students' dependency on rote learning and the challenges they faced in pushing them to think more independently, which may be another factor in putting beliefs into practice. The necessity of dynamic teaching practice in science is well understood and researched, for example, Bas (2012) notes that students who learned a particular science concept through the vehicle of Multiple Intelligence theory tended to exhibit higher motivation levels and self-directed learning.

CONCLUSION

In conclusion, we have found that the teachers in this study overall held lofty ideals regarding best practice in science, and that their beliefs were in close alignment to accepted 'best practice' in science education internationally. However, according to the self-reported practices of teachers which are described here, these beliefs were not fully able to be converted into practice due to a number of factors. Chief among these are a reported lack of classroom assistance and lab technician support to help in the preparation and setting up/ clearing away of activities and experiments, lack of equipment and resources (e.g. "*If there were resources students would be able to do all of this. It is not the teachers' position to purchase items. The school should have these resources for the teachers and students for them to teach the outcome properly")* and time constraints. The teachers felt unable to teach in the hands-on, student-centered fashion they would like to in some cases because of unresolved student behavioral issues along with language barriers which hamper students' ability to understand tasks and concepts.

Feyzioglu (2012), in a discussion about teachers' beliefs, suggested that when beliefs are not aligned with what is considered to be best practice (usually based upon constructivist principals), teachers were normally clinging on to traditional beliefs. They suggested that professional development sessions in collaboration with presenting research findings, be employed to change teachers' beliefs. Our findings do not support this, and suggest that it is not necessarily always true that beliefs are indicators of practice, even self-reported practice. However, what can be done when in fact the opposite is true, when teachers appear to hold all the beliefs in theory which well match the ideals of the educational system within which they are working (ADEC, in this case) but when their environmental constraints apparently do not allow them to put these beliefs into practice? The issue of the language issues is more problematic to solve, because a dual language approach to learning is key to ADEC's long term goals. The teachers in this study are not against this in theory, but are saying that science is not a subject which should be included in this policy, since in their view not only is this damaging students' understanding of science concepts, but it is also hampering their pedagogy and ability to teach science as they wish. This is an issue which would need to be addressed at governmental policy level.

We suggest that professional development programs and in-service training of these teachers (the majority of whom are highly experienced classroom teachers) are unlikely to be effective if their aim is to overturn beliefs. Instead, since the teachers' beliefs indicate they would likely (under ideal circumstances) be able to be effective and ideal science practitioners, we suggest that more emphasis, resources and funding are channeled towards the provision of trained and qualified lab assistants who would provide practical support, and towards providing science equipment and resources which would prevent the need for teachers to purchase their own. The findings that teachers' beliefs about science education

practice are not reflected in their reported practice has significance not only at a local level, but is also applicable to science education fields internationally, particularly within other educational reform settings. The possible reasons given for this mismatch between beliefs and practice are also applicable to settings outside of the Middle East, and add to a body of literature which echo the need for teachers to be support by both resources, funding, trained personnel to be able to teach science in the most effective way.

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