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CHANGING FROM A TRADITIONAL APPROACH TO LEARNING: TEACHERS' PERCEPTIONS OF INTRODUCING WEBQUESTS INTO MATHEMATICS AND SCIENCE CLASSROOMS IN QATAR

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Abstract

Several studies have identified stress factors that teachers might experience in changing from a traditional approach to a more student-centred inquiry-based learning (IBL) approach. In this study, we report on teachers' perceptions following professional development (PD) that introduced WebQuests as a didactic tool alongside ongoing classroom support into Qatari mathematics and science classrooms with students grades 4 to 8. The findings suggested that the use of WebQuests as a didactic tool provided a structure for many teachers that supported a change in teaching towards a student-oriented approach. Nevertheless, some stress factors remained, in relation to control of learning, managing time and classroom behaviour and the integration of IT.

Keywords: Inquiry-based learning; professional development; teaching approaches; WebQuests

Introduction

Whilst research evidence suggests that student-oriented inquiry-based learning (IBL) can encourage student engagement, understanding and relevance in learning mathematics and science (Lederman et al. 2014, Maass & Artigue, 2013), professional development (PD) is not always successful in helping teachers take on student-oriented practices. There is often a disconnect between theory and practice in transforming pedagogies within PD (Korthagen & Kessels, 1999).

In Qatar, the Curriculum Standards Office (CSO) sets out the nationally expected curriculum and attainment in key subject areas, including science and mathematics (Ministry of Education and Higher Education Qatar, 2018). Skills such as critical thinking, inquiry and reasoning are emphasised in the science curriculum, and real-world problem solving is valued in the mathematics curriculum. In addition, the use of information technology (IT) is seen to promote learning and communication. Despite these emphases, teaching in Qatar has traditionally related to a transmissive teacher-oriented approach with an emphasis on the acquisition of knowledge (BouJaoude, 2003), and the PD provided by international agencies, has done little to change this approach (Said & Friesen, 2013).

Evidence suggests that, for PD to be successful, the initiative should be practical, classroom-based and manageable, with sustained professional support in the classrooms (Supovitz & Turner, 2000). So, to optimise the supportive and practical elements of the PD we considered three criteria: 1) the PD should be developed with personnel in Qatar; 2) teachers should be provided with practical, classroom-based, manageable strategies; and 3) the PD should include sustained regular in-class support. Hence, the PD for our project was devised in collaboration with the National Center for

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Educator Development (NCED) at Qatar University, alongside the national context of mathematics and science education in Qatar. The PD was designed around the use of WebQuests within collaborative groups and was delivered by Professional Development Specialists (PDSs) in science and mathematics employed by the NCED. These PDSs would provide regular in-class support and feedback for the teachers.

Originally devised by Dodge (1995), a WebQuest provides a structure for students to follow and research answers to questions on websites within an authentic context. The structure consists of an introduction to capture the students' interest, the task or end-product, the process or steps to take (often a set of questions), online resources for students to access and research, evaluation of the students' performance and a conclusion for reflection on learning. Their use has been shown to inspire students to investigate, to research answers to questions, and to explore different solutions (Calder, 2011; McCoy, 2005; Salsovic, 2007). Furthermore, they are practical and manageable for teachers within the timetabling constraints of their classrooms and curriculum expectations for both subjects. The strengths and challenges of introducing WebQuests have been researched (e.g. Halat, 2008) and the use of WebQuests in PD has been evaluated in relation to technological and pedagogical skills in searching and evaluating websites (e.g. Iskeceli-Tunc & Oner, 2016). As yet, little is known how teachers perceive the use of WebQuests in changing their practice towards a more student-oriented approach.

The overall research aim of our project was to evaluate the potential of PD based on the use of WebQuests to support Qatari teachers in developing IBL in teaching mathematics and science in Grades 4 to 8 classrooms. Our assumption in developing the PD had been that WebQuests would provide practical, manageable classroom strategies to scaffold a change in practice. However, we were also aware that there would be tensions in shifting practices, and that the teachers' existing practices and views could play a large role in determining how IBL was adopted (Anderson, 2002). In our previous investigation (Murphy, Abu-Tineh, Calder, & Mansour, 2018) we explored the teachers' perceived benefits and concerns about introducing inquiry before the start of the PD. Several teachers expressed concerns related to stress factors (Grant & Hill, 2006). In this article, we investigate teachers' perceived benefits and concerns about the use of WebQuests to develop a student-centred IBL approach following the PD.

Challenges and stress factors in introducing IBL

In the project, we referred to Tafoya, Sunal, and Knecht's (1980) continuum view of IBL from teacher-oriented to student-oriented teaching approaches. At one end, there is little or no inquiry. The teacher tells students the outcome of a problem and gives instructions on how to carry out an experiment or investigation. In the middle is guided inquiry, where the teacher gives a prompt or question as a starting point, and students find their own way to answer the question. At the other end is a full open inquiry where students initiate their own questions and formulate their own processes to answer their questions. Pedagogy that relates to student-orientation differs from teacher-orientation. In a teacher-oriented approach, a teacher has a firm grasp on the subject content and leads the students towards solutions. In a student-oriented approach, the students find the knowledge themselves and, in doing so, the learning may move away from directed objectives and content (Lipman, 2003).

This shift of control of learning may pose challenges as teachers and students take on new roles and responsibilities (Crawford, 2000; Foster, 2014). The teacher no longer directs the process and steps for students. Instead, the teacher orchestrates and facilitates the learning processes (Calleja, 2016). This shift may mean the teacher learning new skills, such as group and time management. As such, the classroom environment may feel less controlled, disquieting and uncomfortable as the teacher encourages students to ask questions and examine possibilities. The teacher may perceive they are no longer in command of the content being taught, as students find the knowledge themselves and may follow multiple pathways (Lipman, 2003). Grant and Hill (2006) identified five stress factors that teachers and students might experience when moving to IBL. Those factors are: (1) recognition and acceptance of new roles and responsibilities on the part of teachers and learners; (2) comfort level of teachers and learners; (3) tolerance for ambiguity and flexibility; (4) confidence in integrating technology; and (5) integration of the new pedagogy within the larger realities beyond the classroom

(p. 23). Research has related Grant and Hill's stress factors to teachers' transformations of pedagogy (e.g. Dole, Bloom, & Kowalske, 2015) and found that sustained PD with teacher reflection can overcome many of the stresses. The interest of our study was whether WebQuests, as a didactic tool, could also play a role in overcoming such stresses.

Our main findings from the previous investigation of teachers' perceptions prior to the PD suggested that some teachers felt they would be taking risks in relation to their repertoire of teaching strategies and their existing didactic relationships with their students. Teachers felt they might need to unlearn established expectations in their classrooms that would involve challenges, risks and discomforts. For example, teachers perceived risks in meeting the learning needs of students, in managing their role of monitoring and guiding students in inquiry, and in their students' acceptance of a new pedagogy. In this article, we consider if the teachers continued to feel the stress factors following the implementation of WebQuests and sustained classroom support. Where the teachers no longer experienced these stresses, we consider how the use of WebQuests supported them. Using data from teachers' interviews following the PD, we examined the following questions.

- How did teachers perceive the benefits and challenges of using WebQuests in moving towards student-centred IBL?
- How did these perceptions suggest that WebQuests were helping to address stress factors?

Research methods

In this project, we worked with teachers from primary schools (grade 4 and 5) and from secondary preparatory schools (grades 7 to 8). The schools were separated by gender and instruction was in Arabic. Science and mathematics were taught separately by specialist teachers both in primary and preparatory grades. It is common for science laboratory facilities to be available to students in both primary and preparatory schools. However, computing facilities are often concentrated in technology laboratories and there is little use of mobile or other digital technologies in other classrooms.

The lifetime of the larger project was over three years, and the methodology was based on a transformational model of PD (Leys & Bryan, 2001), where teachers make decisions in how to adapt pedagogical strategies in contexts that are relevant to their classrooms. The first year involved eight teachers from four schools in a pilot introduction of the PD. The second year involved sixteen teachers (eight science teachers and eight mathematics teachers) from eight schools. The third year of the project involved the voluntary establishment of schools as learning centres for continued dissemination of practice.

The data focused on in this article are from the second year of the project when the major intervention took place. In this second year, eight PDSs (four specialists in mathematics and four specialists in science) presented initial workshops and provided in-class support at intervals across two school terms. The classes were predominantly girls with two boys' science classes and two boys' mathematics classes. The sixteen teachers had a range of teaching experiences from two years to twenty-two years. All the teachers had at least a degree-level qualification, either in the subject area they were teaching or in education with a specialisation in the subject. In presenting the results, pseudonyms have been used to maintain anonymity.

Interviews were carried out individually with each teacher towards the end of the school year, following two terms of PD development. All the teachers had developed and used at least two WebQuests in their mathematics or science teaching. The interviews lasted approximately thirty minutes and were carried out in Arabic. Notes were taken by the interview and these were later transcribed into English for analysis. The questions were structured around the use of WebQuests to support student learning and to enhance inquiry, the challenges experienced in using WebQuests and whether the teachers would continue to use WebQuests.

Results and analysis

Constant comparison thematic inquiry approach was employed. Such an approach involves both inductive grounded analysis whilst also allowing for deductive analysis of themes derived from

literature in relation to a context (Butler-Kisber, 2018). At an initial inductive level, descriptive themes were identified in relation to the perceived benefits and challenges of introducing WebQuests. These themes are further related to conceptual themes based on Grant and Hill's (2006) stress factors.

Perceived benefits in using WebQuests

Student learning and motivation

When asked whether the use of WebQuests had enhanced students' learning, many of the teachers referred to affect and motivation. They indicated that their students enjoyed the WebQuest tasks and that their confidence and interest in learning had increased. Farah (Grade 5 science teacher) said, "The students who did not like science become more excited in science lessons." Other teachers felt that WebQuests encouraged students to discuss the information that they found and that they were more likely to remember their learning and achieve lesson objectives. Irfan (Grade 8 mathematics teacher) referred to a change from the traditional textbook-based lessons. "It [the WebQuest] changes the traditional approach to educational action and encourages students to build their own learning beyond the limits of the textbook." Furthermore, Chaima (Grade 7 science teacher) stated that the use of WebQuests provided opportunities for low achieving students to conclude concepts themselves using a variety of resources.

Changing roles and responsibilities

In reflecting on the benefits of using WebQuests, Omar (Grade 7 mathematics teacher) indicated that they had helped to increase his students' role as a self-learner and his teaching role as facilitator. Lina (Grade 5 mathematics teacher) described how the students learned by themselves, and Katya (Grade 7 mathematics teacher) suggested the students were less reliant on her explanations. Science teachers also commented that students were less dependent on their teacher, they would design experiments and test their own ideas.

Some teachers explained how the structure of WebQuests provided skills training for students in becoming self-learners and that this changed their behaviour. The students learned to carry out searches online, make decisions and justify them based on information they had found themselves. Students were thinking critically as they were able to judge how accurate or relevant the information was. Some teachers also explained how the WebQuest structure helped them to implement their teaching. Lina (Grade 5 science teacher) explained, "It organizes the educational process," and Farah (Grade 5 science teacher) suggested, "The WebQuest continues learning for both teacher and students."

Experiences of the PD

Teachers often referred to the ongoing classroom support of the PDSs. They felt the PDSs helped to introduce the WebQuests in an applicable way to accept IBL and to identify the role of the teacher. Teachers commented that the sustained support provided help with resourcing and planning as well as monitoring implementation and providing feedback and action plans. Individual support enabled teachers to ask freely and discuss concerns, to modify their practice, and learn how to manage time during the lesson. Nadia (Grade 5 mathematics teacher) felt that the feedback and action plans helped her to develop quality teaching and learning, and Chaima (Grade 7 science teacher) stated, "She [the PDS] helped in changing my concept about inquiry and its implementation."

Concerns about using WebQuests

Student learning and motivation

One Grade 8 mathematics teacher, Perla, stated she would not continue to use WebQuests in her mathematics lesson because "It is a big responsibility because sometimes I need to check students'

understanding and I repeated the lessons.” A similar concern about student learning was raised by Dina (Grade 5 science teacher) who felt that her students’ achievement did not improve. She stated that “during the lessons, some ideas and facts did not confirm in the student minds.” Dina related this concern to students working on their own.

Changing roles and responsibilities

Several teachers were concerned about student readiness and their lack of skills needed to work independently. Irfan (Grade 8 mathematics teacher) commented that the students were not trained to work in this way, they were not always motivated and talked out of topic. Jena (Grade 5 mathematics) also indicated that some of her students preferred to work individually and that some students would dominate group work.

Classroom management and resourcing

Further concerns were raised in relation to time management, as some teachers described how students spent longer on tasks than expected. Esma (Grade 5 science teacher) commented on the problems she experienced accommodating time for students to visit resources, analyse the content and answer questions. Concerns were raised in meeting the curriculum content, managing the constraints of a school system, and the limited time to train students to work in this way due to the academic calendar. In some cases, teachers spent time teaching reading and IT skills, rather than focusing on science or mathematics. Further concerns were raised regarding planning and resourcing, particularly in finding appropriate websites in Arabic that met the students’ reading abilities.

The use of IT was raised as a concern in relation to the reliability of computers, technical difficulties in using the internet and the availability of accessories such as headsets for students to work together. Some teachers were also less prepared to teach their lessons in the IT laboratories and would have preferred the flexibility to use digital devices in their science laboratories or mathematics teaching rooms.

Conceptual themes in relation to stress factors

The above descriptive themes are examined in relation to Grant and Hill’s (2006) stress factors: recognition and acceptance of new roles and responsibilities, the comfort level of teachers and learners, tolerance for ambiguity and flexibility, confidence in integrating technology, and the larger realities beyond the classroom.

Teachers who spoke of benefits suggested that WebQuests had helped students accept new roles and responsibilities for their learning. These new roles supported student learning and motivated students by increasing enjoyment and interest in their learning. Some teachers commented that the WebQuest had helped to structure their use of IBL and helped them to feel comfortable in managing their classrooms, although several commented that the on-going classroom support had helped them to overcome strategies such as time management and resourcing. Teachers who saw benefits appeared to be tolerant of ambiguity and flexibility, suggesting that the opportunity for students to research across a range of sources had encouraged decision-making and critical thinking.

In contrast, some teachers indicated that WebQuests had not been sufficient to train their students in accepting new roles and responsibilities in learning. Some teachers indicated that their students preferred to work individually and that attempts to change roles and responsibilities created physical discomfort in their classroom, with students talking off task, and a lack of motivation and collaboration. Time management and resourcing was also a physical stress factor for some of these teachers. These teachers may also have felt stress in tolerating ambiguity and flexibility, as they felt that their students could not arrive at correct solutions and understanding without teacher instruction.

Concerns were raised by many teachers in relation to integrating IT into their mathematics and science classrooms. Often these concerns related to technical issues, resourcing and the availability of devices rather than a lack of confidence. School policies in managing the use of IT was a reality

outside the control of some teachers with the need to teach lessons in computer suites. Whilst teachers did not refer explicitly to other external realities, teachers were concerned about meeting curriculum objectives and the restrictions within an academic calendar.

Discussion

In the previous study, several teachers were concerned about moving towards a student-oriented approach prior to the introduction of IBL (Murphy et al., 2018). Following the PD, many teachers saw benefits in using WebQuests. These teachers felt they had moved to the role of orchestrating and facilitating rather than directing (Calleja, 2016). Teachers observed that their students were becoming critical in making judgements and were no longer reliant on teacher direction. As such, they felt they could release control of the learning. For these teachers, the WebQuest may have acted as an organising tool that helped them to move to the role of facilitator and their students to the role of self-learners. Whether the WebQuest could fully support this move is not so clear. Teachers also referred to support from the PDSs in the sustained PD and how this enabled them to reflect on and transform their practice.

Despite the organising tool of the WebQuest and the sustained PD, some teachers still felt concerns about control of the learning, and discomfort in managing time, students' skills and student behaviour. Furthermore, teachers felt restrictions from external realities in the school systems and curriculum requirements. Whilst many teachers recognised the benefits of students researching the internet to discover knowledge themselves, they experienced difficulties in integrating IT, often due to reliability of devices and the internet. Fullan (2013) promoted the integration of technology and the use of the internet as a powerful tool in transforming pedagogy, and this seemed to be apparent in this study. However, further decisions on how to best use technology in classrooms are needed.

Conclusion

Overall, the teachers' interview responses suggested that the use of WebQuests provided a structure for changing from a tradition of teaching and, so, enable a shift in the IBL continuum (Tafoya et al., 1980). Furthermore, the sustained PD gave teachers supportive monitoring, feedback, and reflection. Hence, the use of WebQuests, as a didactic tool within a transformational model of PD, provided a scaffold that enabled many of the teachers to adapt pedagogical strategies relevant to their classrooms. One concern within our research team was that the use of WebQuests might become another process to support the continuation of traditional approaches, rather than helping the teachers to overcome risks and stress factors (Murphy et al., 2018). In this study, it seemed that many of the teachers recognised a shift in their teaching from a more traditional teacher-oriented approach and that the WebQuests helped them to overcome stresses related to introducing IBL.

Fullan and Langworthy (2014) promoted the adoption of new richer pedagogies for students to gain the competencies and dispositions for twenty-first-century innovative economies. Analysis of the stress factors in relation to teachers' concerns and benefits can help us to understand the best ways to transform practices towards these new pedagogies. Studies such as Dole et al (2015) have suggested that transformative PD and the role of sustainment and reflection can provide opportunities to address the stresses and challenges teachers experience. This study suggests that using a didactic tool can also help to scaffold this transformation.

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