TECHNOLOGY EDUCATION IN PRIMARY SCHOOLS OF NEW ZEALAND AND SAUDI ARABIA: A COMPARATIVE STUDY

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Abstract

The purpose of this paper is to compare the status quo of Technology Education in the New Zealand and Saudi Arabia primary school curricula. In New Zealand, Technology Education has recently become a major area with its own philosophy in the curriculum (Ministry of Education, 2007), whereas this subject has only been embedded into Science subjects in Saudi Arabia curriculum. Our goal from the study is to explore whether Technology Education should also be taught as a separate subject in Saudi primary schools. It also aims to inform a re-conceptualization of Technology Education in the Saudi curriculum. A qualitative approach within a comparative perspective was conducted in both contexts that included three instruments of data collection: education policy and curriculum documents analysis, class observation, and interviews with participants. This paper presents early findings from the documentary analysis and classroom observations. The findings suggest that Technology Education may be a worthwhile addition in the Saudi national curriculum and that more research is required.

Introduction

The world has been witnessing fundamental technological, economic, social and cultural changes that have pushed many countries to review their governmental systems in order to meet those changes in general and to meet a new era of technological revolution in particular. Technology has become a priority in many countries' educational system. For instance, since 1990 Technology Education has emerged as an area of study in countries such as Australia, the United Kingdom, USA, Canada, South Africa, and New Zealand (Jones, 2009, p.13). Those countries have set this concept "within the historical, cultural, and political environment" (p.13). Saudi Arabia has moved significantly towards educational reform, especially in terms of curriculum development. The Ministry of Education (2010a) in Saudi Arabia has launched a development plan, which includes goals in a range of educational aspects to ensure that Saudi students receive valuable learning. The first aspect of the plan aims to develop the Saudi curriculum in order to comply with modern scientific and technological development that meet the needs of students in different areas, including professional skills.

Although Technology is considered to be a separate subject in the New Zealand curriculum (Ministry of Education, 2007), some philosophers such as Bank and McCormick (2006) believe that there are some clear similarities between Technology and Science. They explained that "both subjects make much of 'hands-on' learning; both claim to promote problem solving and other 'processes'; both try to explicitly link school tasks to useful learning for everyday life and the needs of the work-place" (p. 285). It is important to note that Technology Education in Saudi has not been separately defined for primary schools and it is embedded into general Science. In order to remedy this, we believe that bringing Technology Education into the Saudi

educational environment will enhance Saudi students' technological literacy. Therefore, it was essential to investigate Technology Education in an environment that offers good practice in teaching this subject, such as in New Zealand (Almutairi, 2009; Turnbull, 2002). This enabled us to compare the teaching of similar topics in both contexts and to explore what is happening in relation to Technology Education in both countries. The evidence may then be used to inform a preliminary foundation for Technology in the Saudi primary curriculum. For this purpose, we used Bank and McComic's framework of analysing Science and Technology Education (2006, p.286) that includes three strands: curriculum rationale (the specified curriculum), teacher knowledge (enacted curriculum), and pupil learning (experienced curriculum). The framework includes the fundamental strands that were used for comparison in this study.

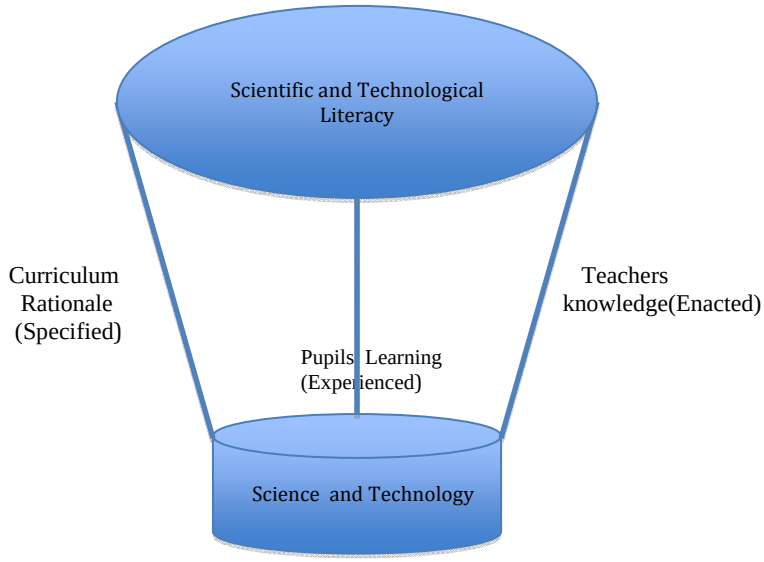

Figure 1. Analysis framework (adapted from Bank & McCormic, 2006: 286)

Technology Education was studied in both contexts. The first study was in New Zealand from 23-8-2010 to 2-11-2010 and the second study in Saudi Arabia from 16-11-2010 to 25-1-2011. This study aimed to answer the following key questions and sub-questions:

Preliminary study in New Zealand

A. How is Technology Education implemented in the current primary curriculum of New Zealand**?**
   1. How is Technology Education documented in the national curriculum and related materials for participants?
   2. What perceptions of Technology Education are held by participants?
   3. How is Technology Education, as implemented in classrooms, recognised for good practice?
   4. Does observed practice comply with the stated curriculum?

Main study in Saudi Arabia

B. Where does Technology Education sit in the primary curriculum of Saudi Arabia?
   1. How is Technology Education documented in the national curriculum and related materials for participants?
   2. What perceptions of Technology Education are held by participants?

3. How is Technology Education implemented in classrooms in primary schools?
4. Does observed practice comply with the stated curriculum?

Methodology

A qualitative approach was taken to gain a better understanding of Technology Education. Strauss and Corbin (1990) claim that qualitative methods can be used to better understand any phenomenon about which little is yet known. Hoepfi (1997) added that qualitative methods can be used to gain new perspectives on things about which much is already known, or to gain more in-depth information. Consequently, this method was adopted to enable us to gain a rich understanding the phenomenon of Technology Education in both contexts. Use of the same approach in both contexts allowed us to compare the situation of Technology Education in both countries.

Documents analysis and a classroom observation were used as major instruments of data for the investigation. A theoretical analysis of Technology Education within the national curriculum of both countries was undertaken by analysing three important documents: the education policy of two countries, the New Zealand Curriculum document that includes Technology Education, and Science curriculum in boys' primary schools in Saudi Arabia. Observation of the practical teaching of Technology Education in a classroom environment that represents a good example of teaching this subject enabled the researcher to gather evidence of teacher behavior and student learning. Therefore, we deliberately conducted the observation in one of the primary schools in Christchurch that was recognized for good practice in teaching Technology. The school was chosen with the assistance of Technology Education advisor at the College of Education at Canterbury University who has a background of Technology Education in Christchurch primary schools and is recognized as a national expert. This sampling is referred to in social research as "purposive sampling" (Punch, 2005, p. 187).

Year 2 and 6 classrooms were chosen to observe how Technology is taught there. An observation instrument included three main components: learning environment, process of teaching and learning, and indicators of progressions of the three strands of the Technology Education in the New Zealand curriculum: Technological practice, Technological knowledge and nature of Technology. Techlink (2010) explains that the Indicators of Progression provide support for teachers to interpret the Achievement Objectives (AOs) for each strand of the technology curriculum within The New Zealand Curriculum (2007). The national curriculum includes eight levels of AOs that students should achieve across the 13 years of general education in New Zealand.

The same process of data collection was implemented for the second study in Saudi Arabia. However, technology teaching was observed in Year 5 and 6 classrooms because the topics related to Technology only exist in upper classes curriculum. For the early analysis presented in this conference the observations are limited to Year 2 in New Zealand and Year 5 in Saudi Arabia.

Technology Education in the New Zealand curriculum

For this study the educational policy and Technology Education curriculum were important sources of evidence as to how Technology Education was interpreted in New Zealand and Saudi Arabia contexts, and the way they were presented for teachers. It

was obvious from the educational policy that the Ministry of Education in New Zealand manages an education system based on education strategy. This strategy is called National Education Guidelines (NEGs); this is a foundation of building the national curriculum that was developed and released in 2007. This New Zealand national document (2007) stated that there are eight learning areas including Technology as a separate subject. In addition, the curriculum document indicated that information communication technology ICT is a major area in Technology Education amongst other Technological areas: structural, control, food and biotechnology.

Technology was clearly defined in the curriculum (2007):

> "Technology is intervention by design: the use of practical and intellectual resources to develop products and systems (technological outcomes) that expand human possibilities by addressing needs and realising opportunities. Adaptation and innovation are at the heart of technological practice. Quality outcomes result from thinking and practices that are informed, critical, and creative…. Technology is never static. It is influenced by and in turn impacts on the cultural, ethical, environmental, political, and economic conditions of the day." (p.32)

In addition, this shows that the overall aim of teaching students about Technology is to develop a broad technological literacy that could be reached by implementing the new concept of Technology Education. This concept reflects the structure of Technology that comprises three strands:

1- Technological practice: through this strand, students can develop a range of outcomes based on a written plan that includes the three major steps of designing the wanted product. These steps are the components of Technological practice: *brief development, planning for practice*; *and outcome development and evaluation.*

2- Technological Knowledge: this strand helps students to understand how and why things work.

3- Nature of Technology is the third strand that shapes the theoretical dimension of Technology Education and aims to help students to distinguish the subject from other disciplines (Almutairi, 2009).

Technology Education in a classroom in New Zealand

To explore how Technology Education is taught in the selected classroom and how students experience the subject, we designed the observation sheet, and also used a digital camera and a digital recorder to record the learning process in the classroom. In the first author's observation of teaching Technology, it was evident that the concept of Technology Education was very well recognised by the teacher of Year 2 pupils. She was able to teach the subject by applying her experience of teaching for eight years while using the national curriculum as a fundamental guideline.

Four sessions were observed in the classroom so as observe the teaching a whole unit. The unit was about making a "Gecko enclosure." Students were asked to make an enclosure through using learning steps that reflected the concept of Technology Education. The observation showed that the learning environment and process of teaching and learning were considered by the teacher to teach this topic. All Technology

materials required by students to make the enclosure were available including, wood, hot glue gun, cartons, bulbs, a craft knife and colours. In addition, a variety of pedagogical methods were used to enrich students learning through using problem-based learning, enquiry learning and discussion. The unit plan was set up to guide the teacher to implement the topic according to a specific process that the plan clearly identified: 1-The area of Technology that is going to be taught, namely 'structural'; 2-The achievements objectives and the learning outcomes 3-The teaching and learning sequence 4-Resources 5-Assessment schedule.

The teacher derived the achievement objectives from the National Curriculum (2007) and she focused on the first strand, *Technological practice*, with the emphasis on achieving Level One, which meets the ability of students at this age. The Technology indicators of progression matrix (Level One) were used to explore in depth to what extent the process of learning reflect these indicators by observing how the teacher guided her students to learn and also by observing what students achieved. The teacher focused only on the *Technological practice* strand because she believes that the two other strands are not necessary at this stage.

The component for *brief development* was the first step in the learning process designed by the teacher who provided the opportunity and developed the conceptual statement in negotiation with students. This was clearly observed when the teacher showed the problem to the students by saying, "Our problem today is about an injured gecko. It needs a home and you will be asked to design and to build a suitable one for it." Thus, the teacher aimed to develop a conceptual statement and to give students the opportunity to negotiate this design with her. For example the teacher asked students "to design a suitable home for the gecko" and "this home must have a place for the gecko to hide." She asked students, "Why do you think we are making gecko houses?" Some answers given by students, were "to save it" and "Geckos can live longer". Moreover, the teacher guided students to identify the attributes and an appropriate outcome, which is the gecko's house. She pushed students to do that by discussing, "What information do you know and what information do you need to build a house?" This encouraged students to talk about the gecko's house that was to be made, and they collaboratively identified its attributes during the introductory session. For example: they said to the teacher that they need to know, "How big?" "What food? "What type of gecko it is?" Also, they named some required items: "Camouflage," "materials," "windows," "light." Additionally, students were able to give reasons for using these materials. For example, they said, "We use the light to keep a gecko warm," and "The windows allow the sunshine to enter the house." Students were also encouraged by the teacher to think about the most appropriate attributes of the product through answering this question, "If the gecko is coming up and pushes with his head, what do you need to do to stop him from getting out?" One student suggested covering the enclosure with a piece of plastic. The teacher then asked, "Then how can we bring the water and the food in?" Another student said "By leaving one side open" to which the teacher replied that the gecko might escape. A third student suggested, "Make a lock." The teacher agreed with this option and she said, "Make a latch which is a spring lock, similar to the door."

The teacher's second step was the second component, *planning for practice.* This is the step where students can transfer their ideas into a drawing plan. At this stage, it is essential for the teacher to ensure that there is a brief for planning to develop an outcome and to provide students with a detailed plan of what they will be doing. Our

observation indicated that the teacher encouraged students to use the facts that they had identified to design the gecko's house, and she provided them with a detailed plan of what they would be doing to make a design of the house. She gave them instructions for making the enclosure. "Now I am going to give you your sheet and you are going to start to give some drawings of your gecko enclosure. When you are drawing the picture, I would like you to think about what the outside is going to look like. What is the inside going to look like? What might the color be? What might the shape be?" We observed that students worked through the design process using a scaffolded plan that included the steps and the resources used. For instance, each student was given a piece of paper to draw the design he likes and to name its parts. While they were working on the design, we asked some students about parts of the design and the materials that they could use. They explained, for example, "We need a light bulb to make the house warm".

Outcome development and evaluation was the last component that we focused on during the observation process to understand how the teacher and students work together to evaluate the outcome against determined attributes. The teacher requested the students, "If you have finished, you need to look at your design and think about if there are any changes you need to make to it." She also provided them with some hints for this purpose. For example, "there must be a place for your gecko to hide in, you must be able to see inside your home and the house must be colorful."

A simple booklet 'My Technology Learning Journal' was used to help each student for the evaluation process. It was useful to incorporate thinking hats into the learning process. The journal included these aspects: problem, design brief, information hat, creative hat, good points hat and problems hat. We observed that students succeeded in using the right color hat with the appropriate fact. For example, the teacher them, "Once you have finished your gecko's home, which thinking hat would you put on?" One of the students answered, "For good points we put on the yellow hat."

Technology Education in Saudi curriculum

The Ministry of Education (2010b) states that education policy in relation to primary education includes three dimensions: General aims of education, objectives of primary education, and objectives of subjects (including Science). In fact, an analysis of the policy document showed that there was not a clear emphasis on teaching Technology or even connecting scientific facts to Technology. From article 31(B) in the education policy, however, it can be recognised that the Ministry encourages students to investigate the scientific principles of different machines in order to reach an innovation level. Also, article six (in relation to Science objectives) takes into account applied sciences by providing an opportunity for a student to do experiments and tests and also to help him or her to acquire some manual skills and practical experience. In general, the policy focuses on Science subjects although there are a few technological topics that could be useful if they were taught in an independent Technology classroom. Therefore, the conclusion of the analysis indicates that the mainstream of teaching Science in Saudi primary schools is based on teaching students some scientific laws and rules that should be tested and experimented on within the classrooms or the laboratories. There is no indication that students are encouraged to think about, design, or to evaluate products.

Science is a major subject in primary education that is taught from Year 1 to 6 amongst eight subjects that are taught in boys' primary schools. The content is selected, determined and distributed by the Ministry of Education; schools and teachers are not allowed to exclude or include any topic and they have to deliver them to students on time using the content provided.

Recently, in 2009, the Ministry of Education decided to develop a Science curriculum in cooperation with 'McGraw Hill Education Company' from the USA. Based on that agreement, the curricula have been translated and aligned to fit the Saudi education philosophy. The development steps will be implemented through three stages: Years one and four in 2010, Years two and five in 2011, and Years three and six in 2012. Our study was conducted in 2011and it was appropriate to shed light on the Year five Science curriculum by exploring its content and how it is delivered to students, whereas the Year two curriculum does not have any topics connected to Technology. We found that the content of Science in Year five consists of six units, which are taught over the year namely: life diversity, ecosystems, earth and its resources, weather, material, and powers and energy. Each unit in turn is divided into two chapters. We scanned all units to discover if there were any topics relating to Technology Education, which may have some tasks that help students in designing and modeling any technological product or system. We only found that the third and the sixth units include some topics that were pertinent to Technology.

This led the first author to observe how one of these topics was taught in the classroom. The topic was about wind, water and solar energy, which were a part of the 'earth resources protection' unit. The observation sheet used was slightly different to the one used in New Zealand. In addition to the basic information that was used in the observation sheet in New Zealand, including the learning environment aspect and learning and teaching process aspect, it was based on the observation sheet that is used to evaluate Science teachers by the principals and Science supervisors.

Technology Education in a classroom in Saudi Arabia

The first author observed how the teacher taught the selected topic by attending only one session, which also gave a general idea on how other topics would be taught in the coming sessions. Our observation aimed at seeing how Technology teaching takes place in the Science curriculum. The lesson plan and the method of teaching were significantly relevant to Science, but we did not observe any part of the learning process that would encourage students to learn about Technology. This was evident from the lesson objectives that were identified by the teacher: the plan did not include any objectives related to Technology but were about Science.

The plan indicated that students should: 1-understand how the air energy can be transferred into another form of energy that moves objects and generates electricity by using windmills 2-discover how the wind moves objects 3-define "fossils" 4-understand fossil fuels 5-distinguish between the renewable resources and non-renewable resources 6-understand how the energy is produced from the Sun, water and air 7-realize methods of energy saving.

The teacher opened the lesson with a brief workshop that aimed to refresh students' knowledge about the previous topic: renewable and non-renewable resources. This part of the lesson allowed students to share knowledge with their peers. This activity was

followed by a general lecture that dominated the learning process over the period of the session (45 minutes). The penta-method was used to teach students. This comprises five elements: preparation, investigation and exploration, explanation and interpretation, enriching and expansion. This method is recommended by the Ministry to teach a new curriculum (Ministry of Education, 2009a). The teacher used a projector to show students some film clips that explained how the electricity energy is generated by wind, water, and solar energy and he commented on the clips. For example, he explained to students the basic parts of a windmill and how it generates electricity. At this stage, we expected that the teacher might engage students in a task to motivate students to design a windmill and to investigate the issues that may face them and to develop this product further, but the teacher concluded the discussion about wind energy by encouraging students to think about the current windmills and how they could be better in the future. Students were given no opportunity to develop technological thinking skills. The observation showed that students discussed with the teacher some positive and negative impacts of energy on the environment and ways of protecting it. Thus, their discussion presented the Nature of Technology (Characteristics of Technology component) as a basic strand of technological literacy.

The teacher was not prepared to teach technology and he needed to cover a tightly packed curriculum. The teacher skipped any practical tasks to complete teaching the subject within the specific time, despite the specified curriculum including directions for a practical task on this topic.

Comparative analysis of theoretical and practical aspect of Technology Education in both countries

The analysis of the educational policies espoused in the Saudi Science curriculum and in Technology Education in the New Zealand national curriculum showed that the status of selected documents was different in each country. The New Zealand Curriculum (2007) clearly considered Technology Education as a major learning area that aims to develop students' technological literacy. The curriculum also defined the subject and its structure. The instruction of Technology Education comprises three fundamental strands *Technological practice, Technological knowledge* and *Nature of Technology.* These represent the philosophical concept of the subject within the educational environment. In addition, the national curriculum identified the Achievements Objectives (AOs) for each strand that should be achieved throughout eight levels of achievements across primary and secondary education years. Thus, it is obvious that the current characteristic of Technology Education allows this subject to take its place within the national curriculum, and also that it helps teachers to understand what Technology Education means, and why and how it is taught.

In contrast, despite some attempts of developing curriculum in Saudi Arabia through the cooperation between the Ministry of Education and some of the curricula developers in the USA in relation to math and Science, the concept of Technology education has not been included in the agenda. The content of the education policy does not include any statement about teaching Technology Education; this led to the absence of this subject from the national curriculum. However, this did not stop us from exploring this concept within Science textbooks, we analysed Science textbooks from Years 1 to 6. The analysis shows that the Science textbooks of Years 1 to 4 do not support teaching Technology Education as the contents focus only on life systems, the human body, and environmental issues. In Years 5 and 6 a few topics could help students to develop their

skill in Technology, but only if these topics were linked to this concept. The minimal evidence of existing Technology Education in Saudi primary curriculum led us to explore how it is taught in the classroom by comparing it to the teaching of this subject in New Zealand.

The classroom observation was first conducted in New Zealand, as it was to guide the development of Technology in Saudi Arabia. In fact, the clear philosophy of Technology Education in New Zealand helped this subject to be perfectly implemented into the classroom. The technology unit was to be focused on the technological area of structures, with the focus on Technological practice strand, and the brief was to describe the design of the house to be built to protect a gecko as the outcome. The teacher's experience and the Technology curriculum guideline helped to produce a systematic learning that enhances technology literacy amongst Year two students in this class. The unit was taught according to an organised plan that shows the roles of the teacher and students to achieve the unit's goal. This helped students to work on practical solutions that were clearly situated within authentic learning, which means, "Students need to be involved in practices which reflect understanding of the culture of real technological practice" (Turnbull, 2002, p39).

On the other hand, the situation of Technology Education in Saudi Arabia was very different to that in New Zealand. The differences can be seen primarily from three aspects. Firstly, the national curriculum does not consider Technology amongst essential learning areas, and so the education policy neglects the importance of Technology Education to the next generation. Secondly, there is a difference in the relationship between Technology Education and Science. We found that Technology has been relatively embedded in Science textbooks in a form of some technological topics for Years 5 and 6 at least. This led to the teacher dealing with those topics as part of Science. However, there was no encouragement for students to be involved in Technology Education, despite the opportunity to teach using a different strategy that could cover it. For example, the teacher only explained the parts of the windmill and how it generates the electricity without asking students to think of designing their own and to investigate issues around this technological innovation. Thirdly, the teacher himself lacked an understanding of Technology Education as a new subject. This is to be expected as a result of the weak foundation of Technology Education in both education and the national curriculum in Saudi primary schools.

Conclusion

The purpose of this paper was to explore the situation of Technology Education in a good example of practice in New Zealand and in a Saudi primary school, and to compare the situation in both countries in order to develop the subject in Saudi primary schools. The documents analysis and classrooms observation have started to reveal that Technology Education in New Zealand stands on a solid foundation that reflects the continuous efforts of technology education experts whose efforts have helped to make this subject one of the essential learning areas in the national curriculum. It has its own name and philosophy that enable teachers to develop strategies in their teaching pedagogy to support the teaching of this subject to their students. The study, which was conducted in New Zealand, helped to provide us with tools to investigate Technology Education in the Saudi context. In contrast, there was no clear evidence given in the Saudi Ministry of Education national documents that supported teaching this subject or to introduce it in the future. The literature also showed that educators in both general

and higher Saudi education did not pay attention to this subject. However, the literature showed that 'occupational education' has recently been introduced to the new subjects plan for primary schools (Ministry of Education, 2009b) without giving a theoretical base for the subject including a rational for why it should be taught.

Given fundamental technological, economic, social and cultural changes that have occurred in the 21st century, we suggest that it may be time that a basic foundation of Technology Education was considered for the Saudi primary schools. We recommend that the Ministry of Education support relevant research in this field and to encourage the partnership with the countries such as New Zealand that made progress in teaching this subject.. Further analysis and research is planned by this team, including analysis using the whole dataset and application of the framework described in Figure 1. Cross cultural dimensions will also be considered in some depth.

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