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RESEARCH ARTICLE

Teachers' Perceptions of Science Curriculum Reform in UAE: A Study in an American Private School in Dubai

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Abstract:

Remarkable science curriculum reform is coming about in the United Arab Emirates (UAE), reflecting a remarkable shifting from the previous science curricula. This type of reform has significant suggestions for teachers. There are limited research studies on teachers' perception regarding these reforms. This qualitative study aimed to explore the impact of the Next Generation Science Standard, being the latest science education reform in the UAE, on teachers who are involved in implementing reform. The study was carried out in a US curriculum school in Dubai. Semi-structured interviews with 14 science teachers who teach different grade levels (K-12) were conducted along with 6 class observations. The other source of data collection was the NGSS curriculum documents. The findings showed that the obstacles faced by the teachers with the NGSS curriculum reform were that the curriculum involves big innovative ideas within short timelines, teachers' inability to shift the classroom towards the desirable outcome, and the shortage of organization and coherence between the school's stakeholders. These finding could be utilized to plan for professional development sessions to support the teachers with more ideas and strategies to convey the implementation of the three-dimensional science curriculum. Moreover, this study could help the leaders and policymakers to ensure the readiness of the teachers and the school before any reform implementation.

Keywords: curriculum reform, three-dimensional science curriculum, next-generation science standards, instructional practice

1. Introduction

1.1. Background

The curriculum is a system built from three different components: an attained curriculum, an implemented curriculum, and an intended curriculum. The attained curriculum refers to what students are learning in the classroom environment, the contents they engross and retain. The implemented curriculum refers to the actual happening in the classroom, the teachers presenting the material effectively, the time and resources spent on teaching the required content, whereas the intended curriculum includes guidance documents used by the ministry of education or other educational authorities which dictate the material required in schools (Van den Akker, 2010). The way toward improving and building up the curriculum is critical. To keep up its significance, the curriculum ought to be consistently reformed to keep pace with economic, technological, scientific, and social development around the globe. This is especially significant for the science curriculum since new scientific findings are prompting the rapid improvement of our comprehension of the natural world (Koti, 2016).

The significance of science curriculum reform is declared by Ryder and Banner (2013), who pointed out that there have been multiple attempts to change the school science curriculum. Ryder (2015) found that this constant change and reform are unavoidable consequences of the continued change and development in policy, education, science, society, and technology. The curriculum reform has a notable impact on the teachers' work and the students' experience in the classroom (Alghamdi & Al-Salouli, 2013). In 2013, the international standards benchmark of the Next Generation Science Standards (NGSS) was released and embraced by chosen states along with abroad US curriculum schools in the Middle East and North Africa (MENA) region (Achieve Inc., 2014). NGSS represents the latest product of the science education reform in the United States (National Research Council, 2012).

Over the last eighteen months, NGSS science curriculum was introduced and implemented in several American schools across the MENA region (Kuwait, Jordan, Saudi Arabia, and the United Arab Emirates). Teachers are walking into training sessions to be familiar with unpacking and implementing the new science reform (Simpson et al., 2017). The Curriculum Department in the UAE Ministry of Education (MOE) incorporates the leading aspect of looking into and affirming textbook manuscripts (which is integral to become principal assets for teachers in classrooms) just as the quality of examinations being used. This differs from most of Organization for Economic Cooperation and Development (OECD) nations. There is no all-encompassing educational program archive in the country which outlooks the objectives of several educational programs. Overall educational program structures ordinarily layout the execution and substance levels needed for students in each evaluation and subject (Department for Education, 2014; Schmidt et al., 2001). The MOE in the UAE signed a seven-year agreement in 2016 between the MOE and McGraw-Hill Education to create science education program which is aligned with the new NGSS curriculum standards (Sahoo, 2016).

The integration of engineering education and the science content is completely new to the science classroom. NGSS focuses on the problem solving, the inter-disciplinary approach and on correlating the science experience with the real-life practice to replace the old practices of the previous memorization approach, as students learn the topic without any rigor and in-depth knowledge and without any connections between the contents as well as without applying the knowledge and the aptitude outside the classroom setting (Al Basha, 2018). However, the teacher who is implementing the new science reform in the classroom is the same old teacher who used to rely on "inch down and a mile wide", who assesses the students based on recalling the information rather than applying High Order of Thinking, HOT (Anderson et al., 2001). Therefore, to assess the outcome of NGSS science curriculum in the school setting, it is suitable to consider the viewpoints of science educators. Their suggestions, criticisms, and recommendations are crucial for the development, reinforcement, and revision of the NGSS science curriculum.

1.2. Problem Statement

New trends in pedagogy, science, and technology require effective, flexible, and modern science curricula. The NGSS science curriculum focusses on developing the skills and habits that engineers and scientists use in daily life practice (Hoeg & Bencze, 2017). The curriculum is formulated to help students to think, not to tell them how to think (Bybee, 2013). In the UAE context, the NGSS science curriculum was introduced to prepare students for future trends and social development. However, there is a chance that some teachers might not fully understand the purpose of the curriculum. Therefore, they might not move their classes towards the full implementation of the three-dimensional approach. Thus, opinions of teachers and their perceptions of new curriculum content must be considered to design professional developments in order to assure the successful implementation of the NGSS which would impact on the students learning.

1.3. Purpose and Objectives of the Study

The purpose of this study is to investigate the teachers' opinions and perceptions of NGSS science curriculum in an American Private School in Dubai. The study consists of the following objectives:

- Inquire the receptivity of science teachers to the NGSS.
- Explore the perceptions and the opinions of science teachers to the NGSS.
- Evaluate the extensiveness of science teachers' instructional practices using the NGSS.

1.4. Research Questions

The study seeks to answer the following questions:

- How do the science teachers encounter the NGSS science curriculum?
- What are the perceptions of science teachers regarding the NGSS science curriculum?
- What are the different teachers' opinions regarding the implementation of NGSS science curriculum?
- To what extent are science teachers persuaded about the NGSS science curriculum effectiveness?

1.5. Significance and Relevance of the Study

The significance of this study is based on the idea that any new curriculum reform has certain pros and cons. As the NGSS science curriculum was introduced for the last two years to the UAE context (Ridge & Kippels, 2017), its implementation is still a challenge for the implementation tool (teachers). Therefore, this study will provide a reference about the teachers' opinions, needs, and suggestions in order to shift the implementation towards success. Furthermore, limited reliable data on the implementation of the NGSS science curriculum is available within the UAE studies. Therefore, this study could add more findings to previous research. At the same time, the outcome of this study could be utilized as recommendations for the policymakers and leaders to prepare and design courses and professional developments sessions to assure that the planned educational programs turn into the instructed one.

2. Literature Review

2.1. Curriculum Reform

Curriculum reforms must be able to influence and improve the dimensions of the practice of science education. The curricula rise as the primary source that reforms these new standards. Improving and applying a curriculum enclose many activities on numerous levels of the educational system: National/regional (macro), school (meso), class, teaching group or teacher (micro). These levels interconnect, and curriculum planning must allow for all of them (Dello-Iacovo, 2009; Beacco, et al., 2016). On a national, micro-level, teachers are required to be resourced and supported to take part in significant curriculum development procedures. Where conceivable, comprehensive decisions about content and strategies ought to be made at this national level, they need to be explicitly related to learning outcomes and curricular purpose (Elmas et al., 2014; Wu et al., 2015).

Multiple research studies only cared about the discouraging outcomes on the micro levels, resulting in one-sided blaming and shallow criticism of certain groups. Teachers are the key actors in the process of reaction to the curriculum reform; their perceptions might be changed according to the curriculum (Priestley et al., 2012; Priestley, 2016). Therefore, the way the curriculum is perceived is obviously essential. Many teachers accept new reform plans and curricular ideas and successfully implement them (Porter et al., 2015), while others are unable or unwilling to develop their pedagogical strategies according to the new reform (Penuel et al., 2007). The second group of teachers have concerns related to their new roles due to more hands-on activities, many connections with social contexts, a wide range of resources, student-centred pedagogical style, and collections of cooperative and collaborative activities. Teachers who accept the ideas of the constructivist do not exhibit that they have not learned teaching methods appropriately. Thus, multiple teachers need an exhaustive professional constructive session through pre- and in-service methods and periods on how to properly execute them in a classroom environment, along with designing activities and lessons used to support this method of learning (Van Driel et al., 2001).

Research studies show that despite the innovative curriculum reform, teachers, in general, retain their traditional viewpoint of science (Heidenreich & Spieth, 2013). This resistance is due to the challenges formed by the salient assumptions based on teachers' thoughts, beliefs, and ideologies. That also includes self-images, self-identities, and multiple royalties to regular school science (Eick & Reed, 2002). On the other hand, there are problems associated with the implementation of curriculum reform, like the difficulty in lesson preparation, inadequate subject knowledge (Hill et al., 2005), insufficient of teachers in new pedagogies (Tondeur et al., 2013), poor textbooks quality (King, 2010), and not enough training and support (Gibbs & Coffey, 2004).

Although teachers know what advantageous is in the new curriculum, however, implementation was practically affected by constraints, time limitation, students' level of enthusiasm, content overload, and teachers' background and knowledge. Therefore, when obstacles with curriculum reform are experienced, some science teachers prefer the retention of the traditional learning approach (Allchin et al., 2014; Elmas et al., 2014).

Yet, the significant obstacle in curriculum implementation is the teacher's perception. Science teachers believe that providing the principles of science in their teaching methods is the most important task, and that affects their ability in forming a new cohesive teaching style in a different reform (Elmas et al., 2014). Understanding teachers' beliefs and value structure is important in improving their professional career. The most sought-after constructs in instructional design for teachers are beliefs and perceptions. Their beliefs and perceptions are the motivators that influence what type of teacher they are (Walkington, 2005). The focus on teachers' opinions and perceptions is vital and a requirement for the long-term change being imposed (Vescio et al., 2008).

2.2. The Trajectory Development of NGSS

In 2011, forty-one composing group started to work on the primary draft of NGSS. With a collaborative exertion, the record was discharged for the survey at different times. By 9th April 2013, the ultimate NGSS was discharged (Haag & Megowan, 2015). The NGSS diagram what all the learners ought to know and be able to do by the time of high school graduation. NGSS are based on the learning advancements of the disciplinary core idea, cross-cutting concept over the practices and discipline that will permit learners to utilize their disciplinary information in noteworthy ways. NGSS Science and Engineering practice are clearly identified not only as confined learning targets that define what learners ought to think about the strategy of science, but also as strategies used for recognizing the consideration behind the conversations, and the utilization of middle considerations in science. (Bowman & Govett, 2014).

The science and engineering practices indicated in the NGSS are posing inquiries and defining issues, creating and utilizing models, arranging and completing examinations, dissecting and deciphering information, utilizing arithmetic and computational reasoning, developing clarifications and structuring arrangements, participating in contention from proof, and getting, assessing, and conveying data (Pruitt, 2014). The way toward making the NGSS was driven by 26 lead states. These states contributed assets and backing to the improvement procedure and are required to be pioneers in the reception and usage of the NGSS. The decision to actualize the educational program and the structure these educational programs will take are subsequently at the tact of individual states (Bowman & Govett, 2014).

2.3. Modelling Instruction and NGSS

Modeling instruction combines a student-centered teaching method with a model-centered curriculum (Jackson et al., 2008). It implements inquiry structured techniques to teaching the fundamentals in mathematics, quantitative estimation, data analysis, and proportional reasoning, which lead to the development of critical thinking including the capacity to articulate hypotheses and evaluate them with evidence and rational argument. Modelling instruction has three parts: classroom discourse management, the modelling cycle, and the models (De Freitas et al., 2008). The pedagogical content knowledge is the understanding of these components that are needed for successful classroom implementation (Blum et al., 2007).

Modelling research has concentrated on argumentation in science instruction, the role of models and science instruction, coordinating cognizant and instinctive learning, as well as building and updating models in the science classroom (Haag & Megowan, 2015; Petrosino et al, 2015). Teachers would learn about the modelling instruction through their participation in an intensive workshop. Teachers would acquire certain skills such as participating in laboratory investigation, experimental designing, data collection, analysing, data interpretation and classroom engagement. Teachers would be able to convey the characterized modelling learning in the science classroom (Buty & Mortimer, 2008).

The Modelling Instruction Program has been present since 1990. From its underlying beginnings in primary and secondary school science curriculums, it has spread over the science disciplines into biology, chemistry, physical science, and middle school (coordinated) science. Quantitative proof supporting the effect of Modelling Workshops has been built up through examination attempted as a feature of the Modelling Workshop Project assessment and the U.S. Division of Education has identified Modelling Instruction as one of two Exemplary K–12 Science Programs (Perry & Richardson, 2001).

3. Methodology

3.1. Research Approach

According to the nature of qualitative research, data was used to create a framework related to the problems in research being examined. The current study focused mainly on the common implications of encounters related to the phenomena experienced by some people. Phenomenology is the study of lived encounters and the manner in which we comprehend those encounters to build up a world view (Connelly, 2010; Elmas et al., 2014). Therefore, different observations and interviews were conducted. This study intended to capture the lived experience of science teachers teaching all grade level about the implementation of NGSS science curriculum.

In phenomenology, the main methods of people or different groups who experience this phenomenon and can reflect their experiences in depth are the main data sources. (Hays & Wood, 2011). Similarly, the participants of this study were science teachers from all grade levels (Kindergarten to grade twelve) who have been implementing the NGSS science curriculum. Semi-structured interviews were carried out to put together comprehensive ideas about their perceptions of the curriculum and the classroom implementation along with the challenges of the implementation. Furthermore, six classroom observations were conducted targeting different phases (kindergarten, elementary, middle, and high school) in order to collect data for a comparison between the described and operated practices. Collecting the data using both semi-structured interviews along with the observation is an effective method for circulating the data and results validation (Yin, 2011; Creswell, 2013).

All participant teachers graduated from different institutes, but mostly they have a bachelor's degree (B. Sc) in the area of specialization. However, five of them held a degree from a different educational faculty with their experience of teaching ranging from 5-15 years. The following data outlines the demographic information about the participant teachers.

Table1. Demographic Information about the Participant Teachers (P = participant teacher)

	Gender	Education level	Grade level taught	Discipline	Teaching experience	Teaching experience with new curriculum
P1	Female	B. Sc	Kindergarten	Early Childhood Education	5 years	2 years
P2	Male	B. Sc	Kindergarten	Early Childhood Education	5 years	2 years
P3	Female	B. Sc	Grade 1	Science Education	7 years	2 years
P4	Male	B. Sc	Grade 2	Science Education	6 years	2 years
P5	Female	B. Sc	Grade 3	Science Education	9 years	2 years
P6	Female	M. Sc	Grade 4	Biology	6 years	2 years
P7	Female	M. Sc	Grade 5	Physical Chemistry	11 years	2 years
P8	Male	B. Sc	Grade 6	Physics	9 years	2 years
P9	Female	M. Sc	Grade 7	Chemistry	15 years	2 years
P10	Male	B. Sc	Grade 8	Chemical Engineering	8 years	2 years
P11	Female	B. Sc	Grade 9	Botany	6 years	2 years
P12	Female	Ph. D	Grade 10	Chemistry	10 years	2 years
P13	Female	B.Sc.	Grade 11	Physics	12 years	2 years
P14	Female	M. Sc.	Grade 12	Microbiology	9 years	1 years

3.2. Data Collection

3.2.1. Interview

In order to allow the science teachers participants to disclose their own thoughts without controlling their response and due to the variation of teachers' beliefs and personalities, an interview was adopted rather than a questionnaire. The interview is a method that is used as an important tool for data collection used in qualitative research (King et al., 2018). It is an effectual way to achieve an in-depth understanding of the data and to establish the interviewee feeling and thought within a short time. The semi-structured interview lasted for 25 to 30 minutes. Interviews were tape-recorded after signing a consent form by every teacher participant (Appendix A). Their responses were transcribed verbatim. These interviews all took place in the school's science lab.

The semi-structured interview schedule was used including the questions (Appendix B) and follow-ups assuring that the same query was followed with each participant (Lutz et al., 2006). The themes of the interview schedule were the structure of the curriculum, acceptance of the curriculum, the effect of the curriculum on the teacher, feelings about the curriculum, implementation of the curriculum, opinions about the curriculum, personal accountability for the curriculum, and teachers' competency.

3.2.2. Observations

Physical settings such as the class size, seating chart, and availability of technology are all important requirements for the curriculum implementation. In this study, the purpose of the observation was to have a deep thought at the school and the classroom. Regarding school's observation, certain items were checked such as the library, science laboratory, multimedia system, courtyard, and so on. For the classrooms however, the items that were to be checked included: the seating map chart, the technological instruments, the MAP test result charts, and so forth. Observations data related to these items are used to establish the data for interviews (Jamshed, 2014).

3.2.3. Documents

The other source of data collection of the study used the curriculum documents, which represented the main source of data implementation to ease the curriculum broadly. The collected data gave the researchers insight into the ideas and the thoughts of the NGSS science curriculum. They were complementary sources of the main data observance procedure to comprehend the phenomenon in detail. Examination of the curriculum provided the framework for what is anticipated out of the teacher and what sort of instructional design. The curriculum analysis is used to check the interviews and observation.

3.3. Data Analysis

Pre-determined themes are utilised for the schedule of the interview, but the researchers would rather include the data inductively. This content was used to expose categories, themes, and patterns in the data. Categories, patterns, and themes were obtained through the engagement with the data and the interactions of the analyst rather than forcing it by literature. The analysis method resulted in disordered data patterns due to looking for known themes. There are four main steps used in the process including data coding, themes generation, data description and coding according to the themes, analysis, and interpretation of findings. In the process of coding, all data were used for analysis to expose any other factors or themes other than the ones that exist. Following the construction of first-level coding, comprehending patterns and themes, the second level of coding was created. Codes on the first level and sub-level codes were arranged to deduce more useful and systemic themes which were allowed in reporting the process.

In the final step, analyses interpretation used the themes. The study validity and results were used by experts and quotes while reporting. Reliability and validity were used for the constructive point of view and the social construction (Kukla, 2013) and the dependability (reliability), confirmability (objectivity), credibility (internal validity), and transferability (external validity) were considered (Yilmaz, 2013). Data credibility was assured by using source and analyst triangulation (Billups, 2014). Therefore, data gathering from interviews, observation, and documents confirmed the triangulation of the source. To allow transfers, characteristics descriptions of the settings, the process, the sample were all given in detail to the source. Furthermore, the sample selection fully aimed to expose the wide range of teachers' experiences

(Seidman, 2006). For reliability, an audit trail was done. The study was sent to a Ph. D. colleague who did not have any connection to the study being conducted and it was unknown if the interpretations, findings, and the conclusions were fully related to the data provided.

4. Findings and Discussion

An American Private School teachers' opinions and perceptions regarding the NGSS science curriculum are shown. These findings acquired from the interviews are supported by the classroom's observations. Fourteen teachers from different grade levels (Kindergarten, Elementary, Middle, and High school) and different response to questions from the interview are touched upon in the interview themes.

4.1. Structure of the Curriculum

Changes within the curriculum standards where some of the few points teachers were asked to provide in terms of assessment, student's role, teacher's role, supportive materials, student's activities, teaching style, and textbooks. Answers exposed that teachers, in general, had knowledge regarding the major aspects behind the new curriculum, trying to adapt to the new curriculum. They identified the importance of the NGSS science curriculum having a student-centred aspect rather than being revolved around teachers.

Teachers indicated the increased number of tasks being assigned. For instance, according to Participant Teacher 3, teachers must have more creativity in the new curriculum. On the other hand, most teachers confirmed that the roles of students have shifted; now they are more creative and self-dependant inside the classroom. Participant Teacher 1 summarized the major changes:

> According to the new curriculum, the content load decreased, topics are simpler than the previous curriculum. Students find it easier, no calculations, no formulas and they are actively participants in the new curriculum.

Additional to the changes in students and teachers' roles, as stated by teachers, activities and assessments also changed drastically. More hands-on activates connected to daily life practice, based on 21st-century skills (collaboration and teamwork, creativity and imagination, critical thinking, and problem-solving (Bell, 2010; Molnar, 2015). On the other hand, the assessments according to the new curriculum also varied including matching, multiple choices, true and false, projects and performance tasks (Chu et.al 2017).

Whereas the common problem mentioned by the teachers was preparing a project, guardians, at the most do not allow students to experience and overcome crucial obstacles while making the projects (Savage et al., 2008; Elmas et al., 2014). The complaint raised by the teachers is that parents commonly do the project or ask somebody else to prepare these assignments; therefore, those students may get a higher score, as Participant 5 outlined, "Most of the parents prepare the projects for their kids or ask someone to prepare them. This is an obstacle for the students to achieve the objectives of the lessons."

Regarding the teaching style, most of the interviewed teachers mentioned that they altered their teaching methods in response to the reforms in the curriculum. Teachers started to use different kinds of teaching strategies, such as group work, visualization, and models. According to P4, most of the classes are student-centred rather than direct instruction and there are no more formulas or calculations. However, the challenge was the international benchmark tests PISA and TIMSS. Teachers were obligated to direct the students to familiarize them with the format of the exams or give them samples of the questions to practice these tests. Teacher Participant 7 indicated that:

> Although students are more lesson centred, however, I must direct them when it comes to PISA and TIMSS. The mathematical questions must be explained, mathematical formulas and symbols and units should be given, otherwise, their scores in theses benchmark test will never get improved.

4.2. Acceptance of the Curriculum

Teachers encountered difficulties to adapt the NGSS science curriculum since the time of starting the implementation is not long (almost two years); however, they confirmed that they are getting to be familiar with the new curriculum over time. The experienced teachers faced more difficulties than the less experienced ones. P12 affirmed that the new component of the curriculum is still a mystery:

> I spent ten years teaching certain topics in Chemistry, I cannot imagine that there is no standard can cover the laws of gases or stoichiometry. I am still working on adapting the new science curriculum and asking for help when needed to prepare my lesson plan according to the new trend of science.

4.3. Effect of the Curriculum on the Teacher

According to teachers, their teaching style, perspectives, and research habits have changed dramatically. Since their teaching design has changed, they gained more experience in using sorts of technological applications such as Gizmos, Socrative, Plickers. According to P8, who declared that these applications connect the lesson with more hands-on activities, sometimes the lab experiments are replaced by a virtual lab, so more detailed information is grasped, and more inquiry could be implemented.

4.4. Feelings about the Curriculum

Participant teachers were asked about their feelings regarding the implementation of the NGSS Science curriculum. Teachers varied between being enthusiastic and tired of this curriculum. The enthusiastic teachers were happy to measure their students' success in participating in national competitions and being able to integrate between Science Technology, Mathematics, Engineering. (Think Science Competition, 2019). Teacher Participant 12 mentioned:

> I am very proud of my students who thought out of the box, they are only 15 years age and were able to come with ideas to invent a paint that can absorb the radiations of cell phones, we went further to score the second rank in the competition.

On the other hand, the exhausted teachers outlined that they feel tired while they implement activities. Teacher Participant 7 explained, "Teachers ought to be a maestro in the homeroom. As it is more students-centered curriculum, students should be dynamic in the classroom and this results in issues with the class management. This is another process which is oppressive."

4.5. Implementation of the Curriculum

No significant changes in some teachers' preparation procedures for the course. When teachers were asked what kind of resources they used and what they did when planning the first hours of the course, they stressed the pressure of testing in their planning, P11 emphasized the use of different textbooks apart from the new curriculum, different types of test questions were practiced related to the subject matter. Therefore, due to the high-stakes testing pressure, teachers teach using different test questions as a classroom teaching approach. Participant Teacher 9 specified the difference in lesson planning: "My lesson planning is based on the 5E's learning strategies that includes Engage, Explore, Explain, Extend, and Evaluate**.**"

Teachers also complained about the parental factor. Teachers confirmed that the parents are unaware of the curriculum, parents are not aware of the performance expectation for the given assignments, and they get themselves involved in the tasks given to their children. So, when their children get a low grade in theses assignments, they started to demand for high scores for these assignments. Parents are not concerned with the learning development rather than high grades; parents do not monitor their extracurricular activities. Teachers highlighted the complaint regarding the students' prior knowledge in the curriculum implementation. Teacher Participant 8 said,

> The main problem in the curriculum implementation is the students' prior knowledge. In my point of view, although you apply the best strategies in the lesson, sometimes the lack of the student prior knowledge could hinder the planning of the lesson. Students should acquire basic skills and prior knowledge for the best implementation of the curriculum.

Furthermore, even though most teachers do not believe that the administration has any sort of negative effect on the implementation, they do believe that the administration can provide motivational factors. The main obstacle with the management is the missing guidance training. Both Teacher Participants 1&2 outlined,

> The implementation of the curriculum requires providing a science classroom in the kindergarten section that always ready for fun and lots of activities, in this age students do not need to go to the science lab like elementary or middle-grade level.

4.6. Opinions about the Curriculum

Science teachers were asked about their opinion of the NGSS science curriculum in term of strengths and weakness, the content, the unit organizer, and the daily life connection. Teachers' responses varied; some teachers admitted that the new curriculum strength is being student-centred and the STEM approach (Hoeg & Bencze, 2017). However, insufficient infrastructure and time restriction are both considered as a disadvantage. Regarding the contents, all teachers affirmed that the curriculum is divided into three main domains: life science, earth and space science as well as physical science (Quinn et al., 2012). The content is sufficient per grade level. The challenge in the content is to meet the performance expectation of the three dimensions curriculum. Regarding the unit organizer, most of the teachers admire the unit organization and they are aware of the spiral structure. Although most of the teachers stated that they like the unit organizer, few of them argued that some topics need to be taught in a complementary fashion at a certain age level. Teacher Participant 10 indicated,

> There is a pass over from one topic to another. For example, teaching the students about the chemical bonding should be in a complementary fashion in the same grade level, while according to the new curriculum this topic is divided to be taught in two years. Students will disconnect their minds; hence the elaboration of the lesson might not be possible due to the need for repeating the initial concept.

All teachers agreed that students are excited with all the activities and examples since they are connected to daily life. Teachers always choose the experiments that are familiar with everyday practices rather than using the instructed lab experiments.

4.7. Personal Accountability for the Curriculum

In this regard, teachers were inquired whether they carry out the essential obligations in terms of the pedagogy related to the NGSS science curriculum. They were inquired about the professional development sessions they included. Many of them expressed that the professional development sessions provided were insufficient to fulfil their understanding of the standards and how to correlate them to achieve the three dimensions curriculum. Participant 14 indicated that "The training mostly superficial and does not provide sufficient perspectives for implementation in the classroom, for instance how to unpack the standards was not clear, how to correlate them with the depth of knowledge was not evident."

However, another teacher contradicted the previous one; the session attended was sufficient, lots of details given about how to implement the student-centred approach were clear, and how to correlate the classroom activities with the daily practice was useful to grasp the full idea about the curriculum.

4.8. Teacher Competency

Teachers were investigated regarding three areas: student-centred education, activity preparation, and content knowledge. In general, teachers do not feel competent in the three areas. Teachers' competency in teaching design is one of the notable concerns because implementing the student-centred approach requires proficiency in classroom management, subject topic, and collaboration with stakeholders. Teachers are not well prepared in these constructs; therefore, executing a student-centred approach becomes a challenge for subject teachers as well as teachers' supervisor (Sungur & Tekkaya, 2006).

Teachers have problems in preparing activities as they lack knowledge of practical implementation. Also, they have an issue with time management as well as class management. On the other hand, teachers reported that the required materials for conducting an activity are not always available. Teachers were also concerned with the content they teach. Some of the teachers are specialized in a certain discipline, so they feel incompetent in other disciplines. Participant Teacher 14 outlined, "I have graduated from a biology department; it is not easy for me to do physics."

4.9. Class Observation

Six class observations were conducted using the same observation sheet. The results from the observation are summarized in Table2.

Table 2. Classroom Observations

Class	Description of the School			Description of the classrooms	
	Science lab	Computer lab	class size	Seating plan	Technology
1	✓	✓	15-20	Square	Smart Tv
2	✓	✓	19-21	L- shape	Projector
3	✓	✓	20-27	Traditional	Smart board
4	✓	✓	15-18	circle	I pad
5	✓	✓	20-23	U shape	White board, smart Tv
6	✓	✓	22-26	Moving chairs	Smart Tv, White board

Most of the lessons were carried out either in the computer lab or science lab to make sure that the students are equipped with the required material as well as the technological sophistication. All the classes were preforming a group work and a hands-on activity, especially when the lesson was conducted in the computer lab for a STEM approach. The only exception was Class 3, as it was traditional and there were no collaborative work and no communication; it was mainly teacher-centred. The class size was a crucial factor to implement more hands-on activities; however, the class management was poor except for Class 3 (Renaud et al., 2007).

Differences in teachers' perceptions of the implementation of the NGSS science curriculum can generally be ascribed to the following reasons:

- Professional development sessions: the paradigm shift internalization along with the new teacher's role was achieved by effective PD sessions.
- Experts and teachers can get help from expert people to improve themselves regarding the student-centred strategy, activities preparations, and unpacking the standards.
- Teachers' licensure: they encounter difficulties in adapting the curriculum because they lack the knowledge related to the pedagogical strategies. This could be explained as most of the teachers have an academic degree in the area of specialization rather than an educational degree.
- Student readiness: teachers hold an accountable responsibility for the student readiness for the insufficient implementation of student-centred learning.

5. Conclusion, Implications and Limitations

5.1. Conclusion

To put things into perspective, innovators must acknowledge the physical settings, stakeholders, and all the resources in order to make large innovations in the educational sector. Relying on external educational products from contexts of different countries may not have a positive outcome for the local educational system. Multiple conditions must be met such as reforms being placed properly in the country's reality, or even using a flexible timeline to follow up on. The flexible timeline must be adopted with an outstanding teacher training, as well as more support such as learning specialists. Furthermore, students' ideas and contributions are often neglected, and their interests are swept aside. This should be changed to include the students' thoughts and opinions in the reform process. In general, the outcomes of this study were consistent with another study conducted in the UAE targeting American Schools related to the implementation of the NGSS in terms of teachers' receptivity and perceptions (Saleh, 2018).

5.2. Implications and Limitations

This study is limited since it was conducted on a US curriculum. It focused on the investigation of the intersection between the design, understanding, and the implementation of the NGSS science curriculum constructed on teachers' interviews and class observations. The study's outcome could not be an explicit consequence. Yet, it serves as a pathway for the educational future in the UAE context. At the same time, it will help the educational leaders along with the policymakers to reconsider the teachers' need for certain courses and professional development sessions to mentor and instruct science teachers aiming to assure that the understating curriculum is the one that is taught and implemented in the classroom.

5.3. Future Research

As the current study was conducted through a qualitative research method approach, the future study could be conducted by using a quantitative method or a mixed one. The participants in the future study could be extended to include more schools following the US curriculum across the UAE and include students' perceptions of the implementation and science curriculum designers. On the other hand, another future study could include a comparison between the old science common core standards and the NGSS standards from the teachers' perceptions.

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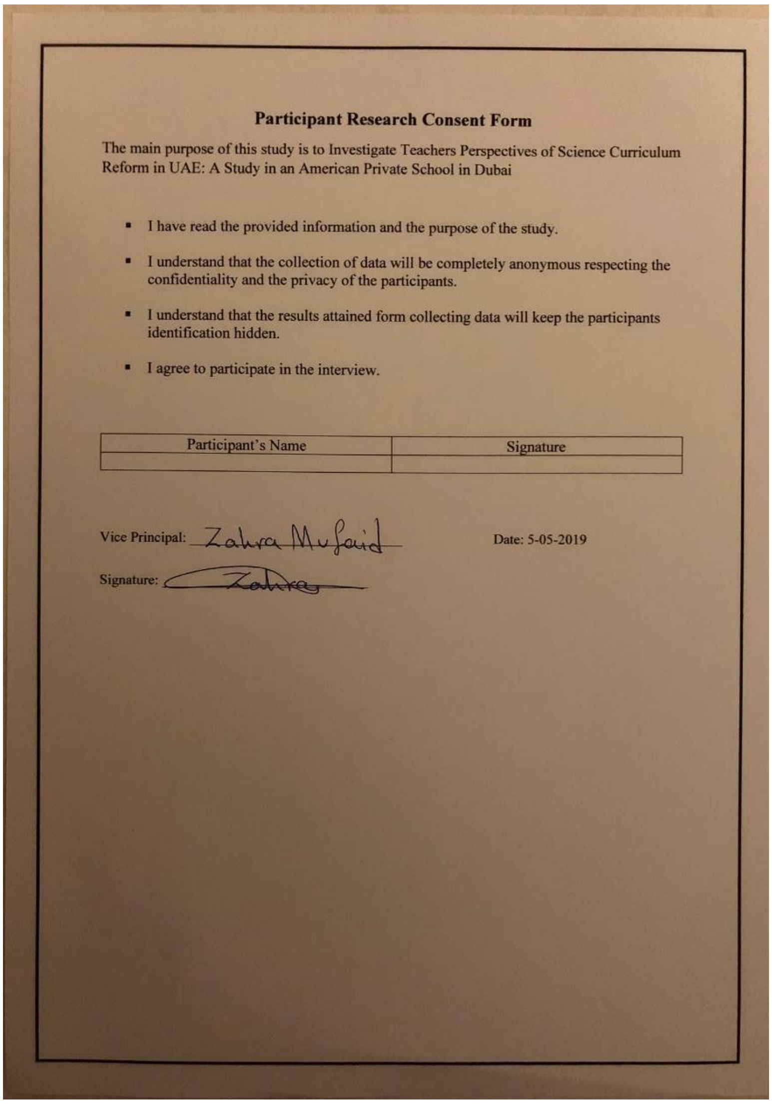
Appendices

Appendix A:

School Permission

Participant Research Consent Form



Participant Research Consent Form

The main purpose of this study is to Investigate Teachers Perspectives of Science Curriculum Reform in UAE: A Study in an American Private School in Dubai

- I have read the provided information and the purpose of the study.
- I understand that the collection of data will be completely anonymous respecting the confidentiality and the privacy of the participants.
- I understand that the results attained form collecting data will keep the participants identification hidden.
- I agree to participate in the interview.

Participant's Name	Signature

Vice Principal: Zahra Mufaid Date: 5-05-2019

Signature: Zahra

Appendix B:

Teachers' Interview

Interview Protocol Project: British University in Dubai (BUID):

Date:
Place:
Interviewer: Enas Ghazy Shaker
Interviewee:
Position of interviewee: Teacher

<u>Brief description of the study:</u>

The purpose of this study is to **Investigate Teachers Perspectives of Science Curriculum Reform in UAE: A Study in an American Private School in Dubai**. This study was located in one of an American curriculum private schools in Dubai, UAE. Teachers' insights, towards their opinion of the NGSS Science curriculum Reform. All the data provided will be analyzed in the illumination curriculum practices' results to assess the status of students' learning outcomes.

- **Demographic Information:**

School						
Name* (optional)			Nationality			
Gender	Male	☐	Female	☐		
Academic qualifications	Bachelor	☐	Master	☐	PhD	☐
Teaching experience	1-4 years	☐	5-10 years	☐	More than 10 years	☐
Grade level taught	Elementary school	☐	Middle school	☐	High school	☐
Professional development training	Yes	☐	No	☐		

- **<u>Questions:</u>**

The teacher interview questions were the following:

- what has changed with the new curriculum in terms of assessment, student role, teacher role, supportive materials, student activities, teaching style and textbooks?
- What are the difficulties in adapting the NGSS science standards?
- Did you change your teaching style, perspectives, and research habits?
- Do you feel that implementation of the NGSS has an influence on the student's achievements and the outcome?

To what extent you are aware about student centered education, activity preparation, and ➢ the content knowledge?