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Students' Best Science Teaching Practices

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Abstract

This study seeks to find out from elementary students teaching practices that help them learn science better. It also investigates whether there are statistical differences between male and female students' perceptions. For this, a questionnaire was developed from Danielson's framework of teaching. This research used descriptive methodology. Data was gathered from two hundred and nine randomly selected students. Findings revealed no statistical differences between male and female students' perceptions. They also highlighted the most effective science teaching practices in students' (1) learning environment, (2) role in class, (3) activities and (4) progress.

Key words: Best teaching practices, Elementary Education, Science Education, Danielson Framework for Teaching. Students' perceptions on teaching practices.

Introduction

The current emphasis of science education for this millennium worldwide is for all students to be scientifically literate individuals (Hodson, 2014; McFarlane, 2013). Lindsay (2011) argues that science education in the elementary sector revolves around what teachers do with their students in class, and the decisions they make about (1) what students should learn and (2) how they should learn (Lindsay, 2011). Therefore, teachers need to be supported to teach science in ways that matter to students (Fitzgerald & Smith, 2016). This support may well be incomplete if students' views on teaching have not been considered. Indeed, there are many reasons why we should seriously take students' views into account when planning classes and designing professional development provisions. First, as advanced by Öqvist and Malmström (2016), valuing students' views of teaching may well reinforce their commitment to learning, and hence create a positive learning environment which is geared toward *"… making them feel like 'subjects' in teaching rather than 'objects' for teaching"* (Manca et al. 2016 as cited infrasonic et al., 2018, p. 2156).Second, when the learning environment is positive, the students not only perform well academically(Back et al. 2016, Dorman and Adams, 2004) but they tend to build better rapport with their teachers (Raufelder et al. 2016; Wubbels et al., 2015). Third, Manca et al. (2016) Messiou and Ainscow (2015) Messiou et al. (2016), and Witte and Jansen (2016) claim that when educators are more receptive to students' views, they are gaining insightful information on how to evolve as professional teachers. Despite the above-mentioned assertions about the significant role of students' views in shaping good teaching learning situations, it has been found that these efforts*"…only contributed limited knowledge in a k-12 context"* because *"…what constitutes 'good' or 'less good' teaching are rarely examined and this calls for additional research"* (Raufelder et al., 2016, as cited in Fransson et al. 2018 p.2156).

In the current study, students' perceptions on best teaching practices in science classrooms are being investigated, and findings of which could well be of interest to educators worldwide.

The following section is a literature review on best practice as it relates to science teaching practice through the lenses of the teaching components of Danielson Model.

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Best practice has gained currency over the last decade as a driving force towards excellence in education (Zemelman & Daniels, 2012; Tileston, 2010; & Daniels, 2004). This expression has its historical origins in medicine and other fields like law, management, economics, etc... (McInerneyDennis & Liem, 2015). As a scientific approach, "best practice" in any field must be research-based and "scientifically" proven to be valid and reliable when negotiated and applied to other similar contexts because of the variations in multiple local factors (CERC.org). The question now is: how do best practices translate to the field of education and particularly science education? The field of education is complex due to its broad interdisciplinary, global, local and individual nature. There are indeed influences from economics, psychology, sociology, and technology on children education in the 21st century. Danielson's (2013) framework of effectively teaching any subject including science has been chosen over others because in its development and revision stages, it has been subject to validation by the Educational Testing Service (ETS.) and the Consortium for Policy Research in Education (CPRE) in USA. This validation found minor but reliable positive correlations between the framework ratings and student learning outcomes [4](Professional Growth and Effectiveness System, 2014). This framework is also widely accepted as it is evidence-based and tends to resonate with any educator. We find it comprehensive and the teaching components are well defined and had potential to be translated into easy statements (i.e teaching practices) to be used in the data gathering tool of this study. This model best classifies teacher's practices in four domains two of which are: "classroom (or learning) environment" and "instruction". These domains have been considered in this research as they are directly linked to the student's (1) learning environment, (2) roles in class, (3)activities and (4) assessment.

'Classroom environment" is an important area in teaching. Danielson (2013) argued that the learning environment should be organized appropriately for learners to learn. This organization needs to maximize instructional time as well as reinforce respect between learners when interacting with each other or with the instructor. The social aspect of learning science has been highlighted by many researchers including Mitchell (2008), Slavin (1996), and Johnosons & Johnson (1989). Bossert (1988, p.225) in this regard, argued that learning cooperatively is important in developing a skill that is *"…necessary for the accomplishment of learning activities and it is a general norm that should be learned"*. In their studyof dialogic teaching and learning of science, Kumpulainen and Rajala (2017)found how pivotal dialogic teaching is in providing equitable science learning for all students. Danielson (2013) further emphasized students' role in contributing to the effective functioning of the class by (1) having the opportunity to assist in classroom procedures, (2) maximizing the better use of physical space, and (3) helping peers in the learning process. The latter involves students with higher ability assisting those with lower ability (Dekhinet & Topping, 2010). Reviewed literature on this teaching approach revealed significant academic improvement of students and has been considered as *"…. One of the best evaluated methods in education…"* because it was found *"… effective across barriers of race, gender, race and social class"* (Topping & Thurston, 2005, p: 44).Added to that, Danielson (2013) clearly stated that students' behavior in the learning environment should be appropriate and handling misbehavior should be preventive and most importantly sensitive to students' dignity. She also highlighted the impact of a safe learning environment on students' positive risk-taking for intellectual growth. Though these measures are meant for teaching any subject, the current literature in science education emphasizes the 'safety' element in classrooms or laboratories. This is especially true because, science teachers and students are exposed to biological and physical hazards (Roy, 2015). There are standards of care that teachers (and even school principals) should respect to ensure quality education like maintaining a reasonable class size, informing students with safety practices and procedures, instructing and modeling safety, warning students of potential hazards and constantly enforcing safety regulations(Roy, 2015). It is indeed important to assess the risks of accidents in laboratories; a safer science experiment also requires students and teachers alike to wear personal protective equipment (Roy, 2015). Safety concerns have similarly been raised when students are on field trips in which they are exposed to practical and real world work of scientists (Roy, 2015).

As to best practices in terms of 'instruction', as advanced by Danielson (2013), they revolve around students being offered:(1) opportunities to be actively engaged in classroom tasks, (2) prospects to challenge their thinking through sharing ideas discussing issues with their peers and the teacher, (3) constructive feedback that is specific to learning goals, and (4) suggestions for improvements and intellectual growth. These practices in science classrooms are mirrored through authentic, real-life learning experiences and processes that are more meaningful to students.

[4](for more details on these validation studies, go to http://danielsongroup.org/research/)

This tends to highlight those teaching methods that set the student into active search for meaning and understanding of the world (Ramnarain, Nampota & Schuster, 2016) rather than passively accumulating information through the memorization of facts and definitions (Almadani, et al. 2011).

Indeed, "practical work" has been found to help students develop their procedural understanding needs. In this regard, Moeed and Easterbrook (2016) argue that for students to understand the nature of science investigation, they need to be involved in planning, gathering relevant data, reflecting, analyzing, interpreting, drawing evidence-based conclusions and communicating findings through reports. Similarly, Hackling and Prain (2005) in their synthesis of three relevant documentspresented six main characteristics of effective science teaching. These are quoted as follows:

"…(1) students experience a curriculum that is relevant to their lives and interests; (2) classroom science is linked with the broader community; (3) students are actively engaged with inquiry, ideas and evidence; (4) students are challenged to develop and extend meaningful conceptual understandings; (5) assessment facilitates learning and focuses on outcomes that contribute to scientific literacy; and (6) information and communication technologies are exploited to enhance learning of science with opportunities to interpret and construct multimodal representations (Hackling and Prain,p.19)."

Another important element in effective science teaching is the use of technology aided activities which were found toenhance students' engagement in exploring and learning scientific facts (Mihaldiz& Duran, 2014).In the same study, these kinds of technology-based tasks were alsofound to be one among the most enjoyable teaching methods of science when used for experimentation, problem solving, out of classroom activities and group work.

The best practices in assessing students have also been considered from the lenses of Danielson's model of teaching. Formative assessment or what is commonly addressed to as "assessment for learning" has increasingly became an integral part of instruction and classroom practice. This reflects how the teacher is monitoring students' understanding in class and how learning is taking place. The emphasis is more on gauging whether students' need further input to grasp significant content and whether feedback is timely, constructive and specific. Students in this process are also made responsible for monitoring their own learning and taking appropriate actions. This, of course is only possible if the teacher has already taught the students the skills of checking their work against well-defined criteria (Danielson, 2013).

Both Walsh (2011) & Anderson (2014) advance that students in science classrooms may be disadvantageous in experiencing a solid common understanding of not only the scientific knowledge but also the social dimension of science activity if their teachers' knowledge and views about how to teach science are different. Therefore, it is essential to listen to students in the self-selected schools in Bahrain about what they have to say with regard to their experiences in science classes. Their unexploited expertise and knowledge can bring newer relevance and authenticity to classrooms. It is also important to shed light on how the views of male students, who participated in this study, are different from their female counterparts.

Materials & Methods:

This study is geared towards answering the following two main questions:

(1) What are the most effective science teaching practices for cycle two[5] students in the self-selected schools?
(2) Are there any differences in opinion between male and female participant students?
As mentioned earlier *'science teaching practices'* in this research are investigated from four main dimensions namely:(1) classroom management, (2) student's role in class, (3) students' activities and (4) students' assessment.

Approach of this study: This study is descriptive in nature as it tends to provide insights on what teaching practices in science are believed to have a positive effect on students' learning. It is predominantly quantitative; only one open ended question was added to the questionnaire results of which have been classified into themes then quantified for a better interpretation of the data obtained quantitatively. In this paper, quotes extracted from students' accounts are used to substantiate the findings.

Sample of this study: A total of two hundred and nine students from nine public schools in Bahrain; these students and schools were randomly selected.

[5]'Cycle two students' means students in grades four, five & six.

Before this random selection, a call to participate in this research was sent to all primary schools in Bahrain, those which expressed the wish to participate, most of which were girls' schools, were included in the random sampling of the current research. This random sampling yielded to seven girls' schools and two boys' schools.

The random selection of the participating students in each of these self-selected schools led to 177 girls and 32 boys whose age ranges mostly between 10 and 11 years and who were from the fourth, fifth and sixth grades. The rationale behind the purposeful selection of these grades is to make sure that students understand the statements in the questionnaire and are able to accurately evaluate them.

Data gathering tool and its validity & reliability in this research: To answer the questions of this study, a questionnaire was used. It was developed from the Danieldson's (2013) framework for teaching components. There are four domains in this framework namely (1) Planning& Preparation, (2) Classroom Environment, (3) Instruction and (4) Professional Responsibilities. Only domains two and three were considered because they consist of those practices that are directly linked to the students. The other two remaining domains (first and fourth), however, are more concerned with the teacher's attitude towards their professionalism and content of which students won't be able to share their perceptions. From these two domains, fifty-six descriptors have been adopted and adapted to the objective and target population of this research. These descriptors of teaching practices were reworded into simple statements which were used as indicators of best teaching practice in science. Respondents were required to read these statements then evaluate these teaching practices as experienced in classrooms using the five likert-type scale approach where fixed choices response format are developed for the sake to gauge students' opinions(Bowling, 1997; Burns, & Grove, 1997, Likert, 1932). This frequency scale is from 'no effect', 'small effect', 'an average effect', 'a good effect' to 'a large effect'. This questionnaire was first written in English then translated in Arabic (students' first language). To ensure content validity, this questionnaire went through three steps. First, it was translated by two professional English-Arabic translators; the two translated versions were then cross checked for accuracy. Only a few items were found to be problematic; negotiation took place and an agreement was reached. Second, the newer version of the translated questionnaire was then translated back to English by a professional Arabic-English translator. This process yielded to a generally good agreement for most items; those found with some concerns went through some readjustments in terms of wording. Third, the questionnaire was given to research professionals at the center of measurement and evaluation in the ministry of education for feedback after piloting it on a sample of the target population. The results showed higher applicability and no issues were raised. The preliminary data collected from students during the pilot experiment led to the calculation of the questionnaire Cranach's Alpha. Table 2 shows that the overall instrument has high reliability (0.90 Cronbach alpha).

Procedure: Before the administration of the data gathering tool in schools, a research proposal of the current study with the required clearance documentation were issued and submitted to the MoE in the kingdom of Bahrain for approval. Once this latter has been granted, the developed questionnaire was administered to the target sample in the randomly chosen schools. Eight students from each of the fourth, fifth, and sixth grades of the female schools answered the questionnaire. A similar number of male students have answered the questionnaire but from the fourth and fifth grades only. Before answering the questionnaire, students were briefed on the objectives of the study including the importance and value of their answers to their schools and peer future science education.

*Data Analysis***:** The Statistical Package for the Social Sciences (SPSS) was used to analyze data. Descriptive statistics (Mean and Standard Deviations) were made for students' answers of each item in the questionnaire. MANOVA was also used to examine the differences between male and female answers in the four dimensions of the questionnaire combined. As to the open-ended question namely: Could you describe below what makes you learn better the science subject in this school?, students' answers were first classified and quantified into themes by two students supervised by the researcher. They were, then, used to fuel and nurture the discussion of some of the findings.

In the current study, answering the first question is processed through analyzing data obtained from the four teaching dimensions. Some of these discussions are substantiated with conclusions drawn from the qualitative analysis of students' accounts in the open-ended question.

As to the second question, its results are analyzed to find out gender differences in the students 'most perceived effective science teaching practices. The obtained data from each item in the questionnaire has been ranked from the most to the least effective teaching practice and only those three in the top have been considered in this paper. This applies as well to the themes classified in the analysis of students' accounts.

1. Results:

This section presents the findings obtained from the two main research questions. Data analysis revealed positive results in the four dimensions listed in the questionnaire with the highest Mn being 4.51 (related to what students do to learn science) and the lowest being 4.39(related to students' role in class). More details are in Table 3.1.1.

First Research Question:

What are the most effective science teaching practices for cycle two students in the self-selected schools?

a- The teaching practices in the domain of *"classroom management"* that students found effective in learning science are shown in Table 3.2. The top ranked best practices are as follows: (1) understanding classroom routines with a Mn of 4.54and SD of 0.95, (2) classroom as a social environment where students establish friends with a Mn of 4.50 and SD of 1.09, and (3) classroom as a safe and risk-free environment for learning with a Mn of 4.46and SD of 1.16.As to the least ranked effective classroom practice in this dimension, it is: "The teacher respects the dignity of students when responding to misbehavior' with a Mn of 4.26 and SD of 1.25.

In the qualitative analysis of students' accounts, the three main areas in classroom management believed to have positive effects on students' learning of science are shown in Table 3.3 and which cover: (1) student-teacher relationship, (2) student-student relationship, and (3) the supportive safe learning environment. These findings tend to correlate well with students' answers obtained quantitatively as shown in Table 3.2.

b- As to the teaching practices in the domain of*'students' role in class'*, the results are presented in Table 3.4. The ones with the highest degree of effect on students' learning of science, theyrevolve around:

(1) students expressing their opinions and actively listening to others with a Mn of 4.73 and SD of 0.63,

(2) students helping peers and assisting them with a Mn of 4.63 and SD of 0.87, and

(3) students having opportunities to interact with both peers and the teacher with a Mn of 4.61 and SD of 0.81.

As to the least effective student role as perceived by the participants, it is: "I make sure I don't get into trouble in the classroom" with a Mn of 4.13 and SD. of 1.40.

c- With regard toteaching practices in the domain of*"students' activities",*all the practices received high rates as shown in Table 3.5. The three top ranked practices as perceived by the participants are:

(1) individual assignment with a Mn of 4.66 and SD of 0.78,

(2)activities based on understanding rather than memorization with a Mn of 4.65 and SD of 0.84, and

(3) group work with a Mn of 4.63 and SD of 0.91.

With regard to the bottom ranked effective practice in "students' activities" dimension, it is: "I do tasks that help me look for more information and acquire new important knowledge" with a Mn of 4.34 and SD. of 1.15.

d- Last but not least, the teaching practices in the domain of*"students' assessment"* as perceived by the participating students are in Table 3.7. The three top ones which were highly perceived by students as being vital to help them learn Science are:

(1) assessingstudents on what they had in class rather than on something they have no knowledge about with a Mn of 4.60 and SD of 0.93,

(2) informing students on what they have retained and understood with a Mn of 4.57 and SD of 0.97, and

(3) indicating clearly the efficiency of the teacher in keeping accurate records of students' progress with a Mn of 4.53 and SD of 0.83.

Concerning the lowermost effective assessment practice as perceived by the participant students, it is "The assessment methods are adapted to my needs" with a Mn of 4.11 and SD. of 1.36.

Second Research Question:

Are there any differences in opinion between male and female participant students?

Table 3.8 shows that the Mn of the results between male and female with regard to the best science teaching practices in the four dimensions as portrayed in this research are almost the same. The calculation of MANOVA shows non-statistical significant differences between boys and girls' perceptions on these dimensions taken together. This is also revealed by Hotteling's Trace test (F= 0.136).

Similarly, the one-way ANOVA results revealed non-statistical significant differences on each of those four dimensions as shown in Table 3.9.These findings suggest that students in Bahrain, regardless of their gender, perceive the best science teaching practices in almost the same way.

4. Discussion

In this section, the above-mentioned results are discussed starting with the most effective teaching practices as perceived by students in the four dimensions. It, then, moves to discuss if there were any gender differences in these perceptions.

First Research Question:

Students' perceptions of science teaching practices in the participating schools in Bahrain overwhelmingly shows a positive effect on their learning of scientific facts or on their experience learning science in classrooms. The differences in results between each item as shown in all the tables of the results above is somehow insignificant that's why we will only be concerned discussing the three top ranked practices in each dimension.

a- Findings from Table 3.2imply that students value classroom rules and believe that when these are constantly operational in class they help them learn science better. This finding correlates well with Danielson (2013) argument that it is essential for the teacher to establish classroom rules that properly guide students' behavior to enable learning to take place. Findings also reveal that students highly value the importance of learning in a safe environment. Laboratories or classrooms where science facts are being experimented for a better understanding and retention of knowledge can bear certain threat to students' health. According to these results, it becomes apparent that teachers of science in the self-selected school of this study seem to be attentive to students' safety at their worksite. This is probably reflected in students' observation of their teachers when notifying them onsafety practices and procedures through instructing inspecting and enforcing regulations as it is advanced by Roy (2015).

Research findings in this area have also emphasizedthe social learning aspect of the classroom while students are experimenting/exploring scientific facts.By top-ranking this teaching practice, participant students appear to favor the tasks that are designed to be completed collectively to achieve academic goals over those that are meant to be done individually. This finding has interestingly been reinforced by the results of the qualitative analysis of students' accounts as shown in Table 3.3 in which they referred to student-teacher relationship (50 times), student-student relationship and the supportive and safe learning environment (25 times each). These findings imply that the participant elementary value by far the social interaction that is taking place during class time when they are busy completing tasks. This has already been emphasized in previous studies by Mitchell (2008);Slavin (1996); and Johnosons & Johnson (1989); Bossert (1988) and Kumpulainen and Rajala (2017).

b- With regard to findings from the second teaching dimension which is related to '*students' role in class*', Table 3.4 reveal that the participants have also top-ranked the social aspect of learning referring to the positive effect of learning together. Learning from peers, as an effective teaching strategy (Dekhinet& Topping, 2010), appears to have gained students' preference and beliefs in making them understand scientific facts better. Learning from a more able peer is more fun and less intimidating than learning from adults. In this learning dynamic, students ask questions, initiate topics, converse and commit fully to the task at hand. Such finding correlates with the reviewed literature on the effectiveness of these teaching practices in the learning process regardless with whom, how and where this has been implemented (Topping & Thurston, 2005).

c- As from the findings in Table 3.5 which revolve around the third dimension namely '*students' activities*', it becomes apparent that the participants also tend to learn science better if they are assigned to work on tasks individually. This is represented in the top rank of effective science teaching practices (Mn: 4.66, & SD: 0.78). Interestingly, this finding tells us that students in the self-selected schools in Bahrain favor as well working on assignments independently. However, this does not necessarily mean that working collaboratively in groups has not been emphasized in this set of teaching practices. On the contrary, it occupied the 3rd position of students' best perceived science teaching approaches (with a Mn of 4.63& SD of 0.91). This may imply that there are tasks where students prefer working alone than working with peers. This is particularly the case when in group work, individual roles and contribution to the assigned task are not clear for students. The second more appreciated teaching practice is when students are provided with activities geared towards learning scientific facts through understanding rather than memorization. It is evident here that the students in this study tend to appreciate better understanding scientific facts through demonstrations or experiments in labs rather than learning by rote. The analysis of the open question in this dimension, as illustrated in Table 3.6, reveals that the approaches to teach science through technology, field trips, school competitions and working on projects are the most effective teaching strategies of this subject with students referring to each 65, 32 and 28 times respectively.

Students favoring the use of technology, games and projects to learn science has also been noted in previous studies like the ones from Hacking and Pain (2005); Mihaldiz and Duran (2014); and Roy, (2015).

d- The best perceived practices with regard to "*student assessment*", fourth dimension of effective teaching practices in this research, show that students tend to welcome the type of assessments that are aligned to their curriculum. In other words, they prefer and believe to learn science better if their teacher assesses them on what they have previously covered in class rather than on facts they have not encountered before. The other aspect of assessment that students from the self-selected schools in Bahrain strongly pointed at is when this one is easily interpreted and indicative to learning progress. Students tend to do better as they become aware of their strengths and weakness and hence are able to work on well-defined learning goals either by themselves or with the help of the teacher. The third top-ranked best assessment practice is teacher's efficiency in keeping and monitoring well students' results and records.This latter has also been emphasized by Danielson's (2013).

Second Research Question:

As to the question of finding any significant differences between male and female students' perceived effective science teaching practices, results from MANOVA (as previously shown) clearly indicate no gender differences in the evaluation of the best teaching practices as adapted from Danielson's (2013) framework of teaching components in this study.

5. Conclusion

Summary: This study looked at students' perceptions on what makes them learn Science better in class. It also investigated if there are any significant statistical differences between male and female students' perceptions. Danielson's (2013) model of teaching has been adopted and used as a data gathering tool to answer the current research questions. Two teaching domains of this model have been considered namely: '*Classroom environment'* and '*Instruction*'. From these domains, four dimensions of best science teaching practices have been drawn. They are:(1) classroom management, (2) students' role in class, (3) students' activities, and (4) students' assessment. Findings from both the quantitative and qualitative analysis of data have revealed the following most effective science teaching practices as perceived by students from the self-selected schools in Bahrain elementary sector regardless of their gender. Students' most effective teaching practices in science with regard to "*classroom management*" are: (1) clarity and understanding of classroom/lab routines, (2) the social aspect of the learning environment, (3) the safety and supportive features of the classroom, and (4) the good rapport between the teacher and students, and between the students themselves. As to those effective teaching practices that concern "students' *role*" in class, they revolve around (1) being able to discuss scientific topics; in which expressing and exchanging ideas are possible, (2) having the opportunity to tutor students with learning difficulties and (3) being tutored by more able peers in class. With regard to "*students' activities*", the best science teaching practices have been noted as such: (1) independent learning, (2) experiential learning both through experiments and group projects as opposed to learning through memorization of scientific facts, (3) use of technology to demonstrate and search for scientific facts, and (4) field trips and competitions including games. Finally, in respect to *"students' assessment*", findings highlighted the following best practices in science assessment: (1) being assessed on what has been covered in class, (2) results of exams clearly reflect students' progress in different aspects of the curriculum and are indicative to what has been mastered, and what has not been learnt, and (3) teacher's effective way in keeping records of students' progress.

Limitations of the study:

It is important to highlight here some of the limitations of this study. The current study is an exploratory study which intends to lay the groundwork for a more comprehensive research study in the future. First of these limitations is the positively worded items of the questionnaire. Though this yielded to high reliability, it has been found to have acquiescence bias. This might explain why students of the current research rated positively all the statements. In future similar endeavors, it would be better to combine both positive and negative items in the questionnaire to ensure a more rigorous and valid results. Second, the results of this study should be taken into account with caution as the sample with regard to gender is not equal due to the unwillingness of boys' schools to participate in this study. Third, the findings of this study reflect only the perceptions of the students in the self-selected schools; hence they cannot be generalized or transferred. Fourth, because of time constraints, some statements which were top ranked like "working independently' and "working in groups" were not explored further through another means like interviews or focus groups.

Data from the latter could have been very insightful in understanding students' current perceptions on what makes them learn Science better. A suitable research design would have used at least two data gathering tools and involved more participants.

Recommendations: Findings from this research suggest that further investigations are needed especially with regard to looking at science teachers' perceptions and practices. Cross checking results from both students and teachers of Science would lead to more interesting findings. It would also be interesting if this research is duplicated on the other core subjects (i.e Math, English, and Arabic).

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Tables

Table 2.1 Questionnaire Cronbach's Alpha			
No.	**Questionnaire Themes**	**No. of Items**	**Cronbach's Alpha**
1	Classroom Management	11	0.94
2	Students' role in class	19	0.72
3	Students' activities	16	0.99
4	Student's assessment	9	0.70
Overall		**55**	**0.90**

Table 3.1.1 Descriptive Statistics on effective teaching practices in science classrooms.			
Teaching practices with regard to:	**Mean**	**Std. Deviation**	**N**
Classroom Management	4.41	1.11	209
Students' Role in Class	4.39	1.04	209
Students' Activities	4.51	0.95	209
Students' Assessment	4.44	1.02	209

Table 3.2. Effectiveness of classroom management practices in a Science classroom according to students.

No	Items	Total (N=209)		
		Rank	Mean	Std. D
1	**I and my classmates understand well classroom routines.**	**1**	**4.54**	**0.95**
2	**The classroom is a social environment where I have friends.**	**2**	**4.50**	**1.09**
3	**I feel safe to learn in the classroom.**	**3**	**4.46**	**1.16**
4	The teacher monitors the students' behavior in the classroom.	4	4.44	1.19
5	Teaching aids are used effectively including computer technology.	4	4.44	1.15
6	I and my classmates follow classroom rules from the beginning of the academic year.	6	4.43	1.03
7	I and my classmates interact with each other respectfully.	7	4.41	0.91
8	I have enough time to learn in class.	8	4.36	1.24
9	The structure of my classroom is appropriate for learning.	9	4.32	1.04
10	Learning in the classroom is accessible to every student including those with special needs.	10	4.31	1.21
11	**The teacher respects the dignity of students when responding to misbehavior.**	**11**	**4.26**	**1.25**

Table 3.3 Students' quotes on best science classroom management practices

'Learning Environment' students' best areas.	Frequency	Eg. Quotes from students' accounts (literally translated from Arabic)
Student-teacher relationship	50	- "…I collaborate with my teacher…" - "…what makes me learn is when I help my teacher in voluntary work…" - "…my teacher always listens carefully to me and helps me with many difficult tasks…"
Student-student relationship	25	- "…I don't fight with my friends in class…" - "…I learn from the lessons and have fun with my friends…"
Supportive and safe learningenvironment	25	- "…teacher takes care of me and teaches me well…' - "we receive good teaching and feel comfortable in class…." - "…we always wear overalls, gloves and masks when doing experiments… feels like we are real scientists…" - "…we have comfortable and mobile chairs…" - "…classroom is big, organized and beautiful…I learnt how to make fun tools…" - "…we have fun learning science while keeping safe…"

Table 3.4. Effective students' role practices in a Science classroom according to students

No.	Items	Total (N=209		
		Rank	Mean	Std. D
12	**In a discussion, I make sure I give my opinions and hear others.**	**1**	**4.73**	**0.63**
13	**In the classroom, I have opportunities to interact with my classmates and the teacher.**	**3**	**4.61**	**0.81**
14	**Once I finish completing a task in the classroom, I get involved in helping other students.**	**2**	**4.63**	**0.87**
15	I choose my own materials for my projects.	4	4.57	1.00
16	I self-reflect on my learning progress	5	4.52	1.00
17	I help in arranging the classroom.	6	4.50	1.02
18	I self-assess my performance.	7	4.47	1.06
19	I help in planning classroom activities.	8	4.46	0.82
20	I monitor my progress through setting learning goals for myself.	9	4.43	1.01
21	Teacher introduces the topic through what we know about it first.	10	4.38	1.09
22	I am asked a variety of questions by the teacher.	11	4.33	1.18
23	I choose my partners in group work/projects.	12	4.31	1.09
24	I ask many questions during class.	13	4.30	1.08
25	I help in setting how I am going to be assessed.	14	4.28	1.18
26	I help in setting classroom routines.	15	4.22	1.12
27	In the classroom, I initiate topics and make suggestions.	16	4.20	1.20
28	I make sure that my classmates don't get into trouble in the classroom.	17	4.14	1.24
29	I make sure I don't get into trouble in the classroom.	18	4.13	1.40
30	**Teacher asks us to suggest topics for classroom instruction.**	**19**	**4.12**	**1.05**

3.5. Effective activities in Science classrooms according to students				
No.	**Items**	**Total (N=209**		
		Rank	**Mean**	**Std. D**
31	**I work on individual assignments.**	**1**	**4.66**	**0.78**
32	**Teacher provides activities that are based on understanding rather than memorization.**	**2**	**4.65**	**0.84**
33	**I work collaboratively.**	**3**	**4.63**	**0.91**
34	Teacher provides activities that help develop my skills and abilities.	4	4.61	0.90
35	Teacher provides activities that help in many forms of self-expression of ideas like drama, presentation of knowledge, writing etc…	5	4.60	0.80
36	Teacher gives us hands on activities.	6	4.55	0.97
37	Teacher provides activities that help me self-reflect on what I have learnt to monitor my learning progress.	7	4.53	0.89
38	The tasks I do in classroom make sense.	8	4.50	0.93
39	Before the lesson starts, the teacher checks what I already know about the topic.	9	4.47	0.97
40	I work in small groups to come up with a common solution to a problem.	9	4.47	1.01
41	Teacher gives us tasks that I am interested in..	11	4.46	0.99
42	Teacher provides activities that help me develop/construct my own understanding.	12	4.45	0.91
43	I have time do challenging tasks that require thinking and reflection on one's learning.	13	4.42	0.99
45	I often work on projects that require at least one week to complete.	14	4.41	1.12
46	Teacher gives us tasks that reflect some complexities of the real world.	15	4.38	1.01
47	**I do tasks that help me look for more information and acquire new important knowledge.**	**16**	**4.34**	**1.15**

Table 3.6 Students' accounts on best activities in Science classrooms		
Students' best teaching approaches	**Frequency**	**Eg. Quotes from students' accounts** (literally translated from Arabic)
Use of ICT	65	"… I learn better when my science teacher uses the smartboard and provides examples…" "… learning science through games on smart board is fun and we all enjoy it…" "… using technology in science classrooms motivates me to learn…" "…I like when we use laptops to do some activities…" "… I enjoy very much taking pictures of animals in the zoo, then search about them online and share my findings to my classmates…"
Field trips and school competitions	32	"… I and my classmates enjoy field trips to Bahrain science center…" "… it is always fun to learn about animals in the Zoo rather than in the class through pictures or videos…" "…I remember when we went to AlAreenwild life park, I learnt many things about different animal habitats that I still know…" "…school competitions are really motivating because I become more interested in learning science to win…"
Working on projects	28	"… I like when we have projects in which I and my classmates in the group read and search for information to answer a specific question…" "… it is good to collaborate with classmates and experiment science in a lab while having a project…" "…answering specific questions by working with my friends on projects…"

3.7. Effective assessment practices in Science classrooms according to students				
No.	**Items**	**Total (N=209**		
		Rank	**Mean**	**Std. D**
48	**I am assessed about what I have been taught in classroom.**	**1**	**4.60**	**0.93**
49	**Results of my assessment tell me what I have learnt.**	**2**	**4.57**	**0.97**
50	**Teacher keeps the record of my progress very effectively.**	**3**	**4.53**	**0.83**
51	Feedback I receive from the teacher and peers is accurate, specific and helps in learning further.	4	4.52	0.93
52	I am given feedback regularly.	5	4.44	1.01
53	My growth goals are set by me, the teacher and my parents.	6	4.42	1.02
54	I know what I am assessed on.	7	4.40	1.07
55	The results of my assessment are intended to plan for what I need to be learning in the future.	8	4.36	1.07
56	**The assessment methods are adapted to my needs.**	**9**	**4.11**	**1.36**

Table 3.8 Descriptive Statistics of both male and female perceptions on best science teaching practices.				
Teaching Practices	**Gender**	**Mean**	**Std. Deviation**	**N**
1- Classroom Management	**Female**	4.42	1.10	177
	Male	4.36	1.15	32
2- Students' Role in Class	**Female**	4.38	1.05	177
	Male	4.39	1.01	32
3- Students' Activities	**Female**	4.51	0.96	177
	Male	4.50	0.90	32
4- Students' Assessment	**Female**	4.56	1.02	177
	Male	4.41	1.04	32

Table 3.9 Univariate Test Results comparing student gender differences with regard to their perceptions on effective science teaching practices.						
Source	**Dependent Variable**	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Gender	**Classroom Management**	10.670	1	10.670	**.174**	**.677**
	Students' role	.884	1	.884	**.009**	**.924**
	In Class Activities	1.218	1	1.218	**.014**	**.906**
	Learning progress	3.202	1	3.202	**.107**	**.744**
Error	**Classroom Management**	12703.378	207	61.369		
	Students' role	19920.274	207	96.233		
	In Class Activities	17969.183	207	86.808		
	Learning progress	6209.219	207	29.996		
Total	**Classroom Management**	503704.000	209			
	Students' role	1470699.000	209			
	In Class Activities	1105895.000	209			
	Learning progress	339733.000	209			