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Gender Differences in Omani Students' Perception of the Pedagogical Content Knowledge of Their Science Teachers as Appeared in Reality and Students' Preferences

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ABSTRACT
The purpose of this study was to investigate gender differences in Omani 10th-grade students' perception of their science teachers' Pedagogical Content Knowledge (PCK) in both realities and as they desired. Two versions of electronic questionnaires consisting of sixteen main items were designed to achieve the aims of this study. These two versions were administrated to 1445 randomly selected students from various schools at four educational governorates in Oman. For the first version, 46.7% of the participants were female students and 53.3% were male students; whereas, for the second version, 54.7% were female and 45.3% were male. The results showed that Omani male students gave a higher appreciation of "the actual PCK" in most elements compared to female students for "the actual pedagogical knowledge of their teachers" except for two elements which were "fun and simple in their personality" and "inform students' parents about their progress and achievement in science". This estimation seemed to be unrealistic for male students because it did not reflect their real achievement. The results also demonstrated variation in preferences related to the learning environment between male and female students. Male students preferred a competitive environment, while female students preferred a collaborative and open environment. In the light of current research's results, some recommendations were proposed such as conducting teacher training programs about supportive learning environments in their classroom and doing furthermore studies related to PCK in the science field.

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Introduction

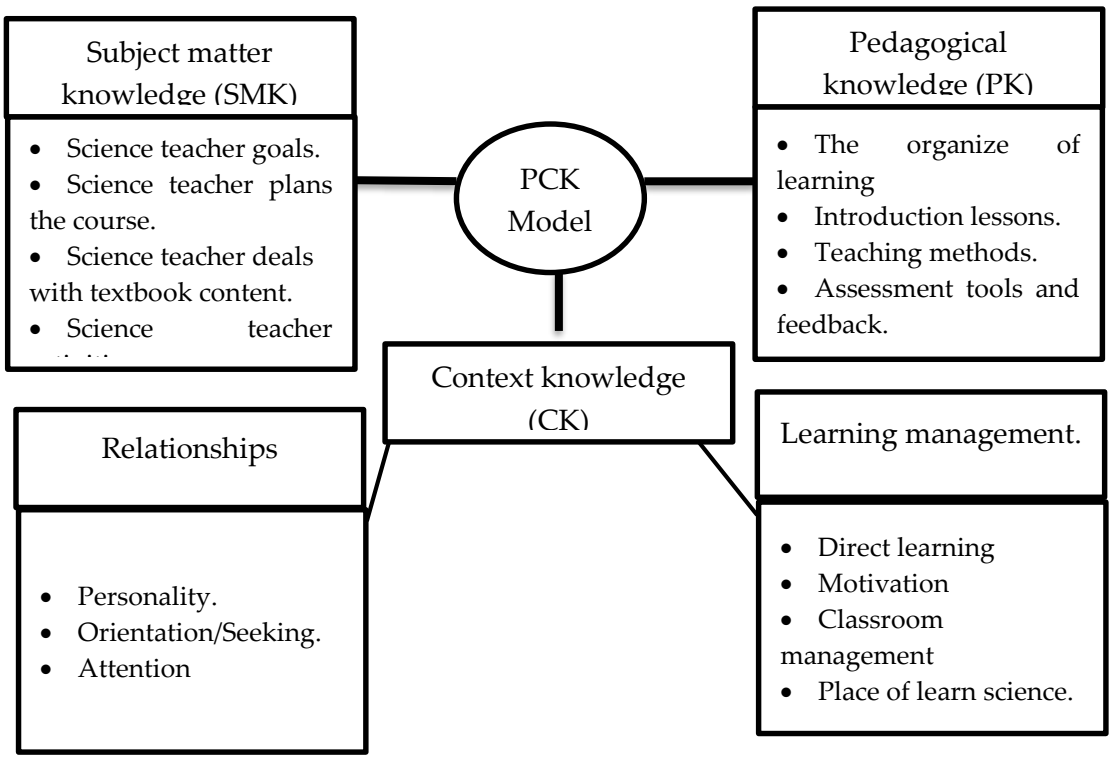
Diversity is part of life's beauty and society's richness as societies increase their ability to accept their multiplicity and integrate all their members as they indicate their progressing and continuity. Similarly, employing the diversity of students will generate effective learning by nurturing their potential and abilities especially responding to gender diversity. Science is usually considered a dominant area for males either at school or at work (Organization for Economic Coordination and Development [OECD], 2016; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2016; Scantlebury, 2012). The disparity in performance and empowerment between males and females in the field of science is called "the gender gap" (Bailey & Graves, 2016; Scantlebury, 2012; Sinnes, 2006; Slater et al., 2007; Ziegler et al., 2014). Studies have indicated that part of the gender gap is due to social factors such as the stereotype of both genders which affects the attention of each

gender (OECD, 2016). Male students are directed by home socializing towards mobilization, mechanical games, and activities outside the home which are close to what is taught in physics (Haroun et al., 2016). On contrary, home socializing leads females to another direction being less interested in physics subjects (Scantlebury, 2012; Quinn & Cooc, 2015). Likewise, the gender gap appears in the confidence of the ability to learn. For example, Nigerian male students are more confident in learning science than Nigerian female students (Igbo et al., 2015). Smith et al. (2014) assured this fact by analyzing the results of American students in Trends in International Mathematics and Science Study [TIMSS]-2011 in which female students showed less desire and trust in learning science. Moreover, a similar fact reoccurred in South Korean students' results in the Program for International Student Assessment [PISA] in 2006 (Shin et al., 2015). On the other hand, it shows a divergence in male and female interests about future careers. Female students are more interested in medical professions, whereas male students are more inclined to engineering and computer science careers (OECD, 2016). International studies such as PISA and TIMSS show diversity in science performance indicators for both males and females. For example, the PISA study showed male students outperformed females in the results of science scientific literacy tests in previous cycles in 2006, 2009, 2012, and 2015 (OECD, 2016). While in the 2018 cycle, female students slightly outperformed males by two score points (OECD, 2020). Although, the result of [TIMSS] showed a continuous rise in the average grade of female achievement during the past four cycles in 2007, 2011, and 2015. The average difference was six in favor of females during the 2007 and 2011 cycles, but this difference reached ten during the 2015 cycle (Martin, et al, 2016) and it has remained relatively stable in the 2019 cycle (Mullis et al., 2020). In other words, recent studies in science achievement have shown that the gender gap had been reduced or on its way towards vanishing (Scantlebury, 2012). Recently, the term "the gender gap" has been changed into "the gender differences", which includes differences in capabilities, perceptions, interests, and desires for each gender. In this regard, (Bailey & Graves, 2016; Sinnes, 2006; Slater et al., 2007; Scantlebury, 2012; Ziegler et al., 2014) addressed the differences between the two genders in learning science and identified these differences. Halpern et al. (2007) reviewed the studies that inquired gender differences in learning science and found that males outperformed females in visual thinking, mathematic and logical thinking, while females performed better in linguistic and communication abilities. The study by Istiyono et al. (2020) demonstrated the existence of male superiority in some aspects of creative thinking skills, while females excel in other skills. For the critical thinking skills, which were considered traditionally as an element of male superiority, only a few skills that male students outperform, the remaining are male and female performance is almost the same (Marni et al., 2020). According to Al-Balushi & Al-Battashi (2013), Omani male students outperformed Omani female students in visual thinking, while Omani female students were better in working memory capacity. Another study reported that females outperformed in social aspects such as acceptance, attention, control of effort, ability to develop personality, capability to develop themselves earlier than males and early and middle adolescence (Hatti, 2008). Erinosho (1999) showed strong differences in science preferences between males and females in Nigeria. Males prefer activities that are technical in kind, while females prefer dealing with issues related to nature and community. In addition, girls are usually affected by the humanitarian consequences of science, while boys pay greater importance to the practical value of science. To improve female achievement in science, some researchers had suggested an attractive science education environment for girls characterized by developing a non-competitive environment in a classroom and focusing on physical health, and societal and environmental issues. In addition, it can help to link science education to females' out-of-school experiences and highlighting their special contributions to science (Sinnes, 2006). Teachers could mend the gap between males and females in science education because they are considered as the basic engine to cause change, develop the achievement of students, and increase their integration within the learning process (Cho, 2012; Scantlebury, 2012). Both Sinnes (2006) and Cho (2012) suggested that a teacher assigned for the same gender group may positively influence students' outcomes via communicating with them more effectively as they show high expectations to enhance performance or being a good role model.

Previous studies showed various and diversified conclusions regarding the effects of teachers' genders on the achievements and performance of students' gender types during the learning process. Zeeuw et al. (2014) proved that there was no significant difference in teaching performance between Swedish math male and female teachers. However, male students continued scoring higher in mathematics even if they were taught by female teachers. A study by Hastedt et al. (2021) confirmed this result and showed that students (male or female) taught by female teachers performed better in science compared to their peers who were taught by male teachers. Nevertheless, a significant number of recent studies have confirmed the supremacy of female teachers in teaching science. In 2009, a report from OECD has asserted that female teachers were less likely to see teaching as the direct transmission of knowledge than male teachers. Moreover, they were more likely to adopt structuring and student-oriented practices as well as to cooperate more with colleagues. The report concluded that female teachers were better than their male colleagues in the aspect of teaching performances as female teachers endorsed direct transmission beliefs less strongly than male teachers did. They also mentioned greater use of structuring and student-oriented practices, and they were more often involved in cooperative activities. Scantlebury (2012) suggested that female teachers exhibited greater professionalism and motivation than male teachers. However, in Australia, Watt et al. (2012) explained that female teachers were more motivated and more interested in using an active learning style than male teachers. In Holland it was found that female teachers were superior in terms of ability to provide support and good relationship with students (Spilt, et al., 2012). In this context, students were more motivated to learn when they received their education from female teachers. Moreover, Eliasson et al. (2016) investigated the patterns of interaction within the classroom in Sweden and showed that female teachers were more able to interact fairly between both genders of students in mixed classes. Sinnes (2006) proposed that teachers assigned for the same gender might positively influence students' achievement. This may help in reducing the gender differences leading teachers teaching methods suiting the gender of students whom they were teaching. Not only this, but even the way of dealing with curriculum, female teachers could teach by including or emphasizing the contributions of women in the field of science (Scantlebury, 2012). In the end, there is a need to reduce the gender differences not only in science but also in education, and this is emphasized by United Nations through Sustainable Development Goals (SDG 2030) in goals 4 (quality of education) and 5 (achieving gender equality) (United Nations, 2015). The PISA's report provided three reasons for studying gender differences in learning environments that are: identifying inequalities, examining student performance, and increasing an understanding of how students learn (OECD, 2009). The current study addresses the third reason which is related to understand how students learn, how they receive their learning, and the expectations they develop during their learning process with each gender. Additionally, it requires science teachers' PCK listening deeper to students' voices which would provide a closer and more specific picture of the educational environment (Booth, 2014). In this study, the researchers benefited from several previous studies especially the model PCK established by Ambusaidi et al. (2020). Here, the PCK is regarded as a core component of the teaching profession. According to Gess-Newsome (1999) and Magnusson et al. (1999), the three components of an integrative model are CK, SMK, and PK. In the utilized model, the context knowledge (CK) includes two parts: the teacher's relationships with students and their managing of the learning process. The subject matter knowledge (SMK) consists of the goals of teaching science, how the science teacher plans the lesson, how the teacher deals with textbooks, and how science teachers conduct the science activities. Finally, the pedagogical knowledge (PK) consists of teaching methods and assessments tools. The model, provided below as figure 1, is based on students' perceptions of their science teachers' PCK in terms of (1) students' relationships with teachers (Darby, 2005), and (2) teachers' personalities (Shadreck & Isaac, 2012). The model, (Figure 1), combines the categories of PCK.

Figure 1

The PCK Model



Note. (Adopted from Ambusaidi, et al, 2020)

Problem Statement

The Omani female students still outperformed male students according to the results of the international studies in Math and Science TIMSS 2019 (Mullis et al., 2020), as the average difference between males and females is 54 degrees, which is still large. In general, the biggest achievement differences in favor of girls in both fourth and eighth grades were in Arabic-speaking countries from the Middle East (Martin et al., 2016). In Oman, male and female students' study in the basic education stage (grades 1-4) in mixed classes under female administrative and teaching staff, while during the rest of the stages (grades 5-12) the two genders study separately. In grades 5-12, school staffs are from the same gender of students, but with the same curriculum. In this context, each gender has created a unique learning environment, which requires a study to show the educational features of these environments, by studying the perceptions of students, and aspirations for PCK elements of their teachers, by focusing on gender differences. Some of the studies, which were conducted in Arabic-speaking countries, confirmed the supremacy of female teachers' knowledge compared to male teachers. Al Khatib (2007) conducted a study on general educational knowledge among Jordanian teachers, which shows that female teachers were more knowledgeable than male teachers in PCK elements. Similarly, in Saudi Arabia, Haroun et al. (2016) mentioned that female math teachers were much better at implementing PCK than male math teachers. Therefore, we can say that the PCK of each science teacher defines their teaching exercises, makes their decisions. Van Driel et al. (1998) pointed out that the teacher's PCK is highly related to students' learning; it represents a vision of good teaching (Fernandez-Balboa & Stieh, 1995). Thus, it could provide a reasonable explanation of differences in the achievement of both genders. The current study attempts to answer the two following questions:

RQ1. Do PCK elements practiced by science teachers as perceived by 10th-grade Omani students differ by teacher gender?

RQ2. Do PCK elements favored or preferred by 10th-grade Omani students differ by gender?

Method

The current study comes as a continuation of a project to investigate Omani science teachers' PCK from the perception of their students. It began with studying science teachers' PCK and PCK as preferred by students (Ambusaidi et al., 2020). This study investigates gender differences in students' perception of PCK of their Omani science teachers, and it used descriptive quantitative methodology based on questionnaire. This method seems to be the most suitable to achieve the study aims as it can survey large number of students. As described in Ambusaidi et al. (2020), two electronic versions of the questionnaire were designed: the first version was used to identify the real PCK practiced by science teachers inside the classroom, which was used to answer Research Question (1). The second version was used to identify students' preferences regarding how their science teachers should practice PCK, which was used to answer Research Question (2).

Participants

The study sample was selected from grade ten, which is the last grade in the second cycle of the Omani basic education system. The average age of the participants was 16 years. The students at this grade are more mature so we expect to give impartial opinions about their science teachers (Fisher & Fraser, 1983; Fraser, 1998). They were selected using a convenient sampling method from four Omani educational governorates: Muscat, Ad Dakhiliyah, Ash Sharqiyah North, and Ad Dhahirah, which were representative of the educational governorates across the country. Table (1) shows detail of the number of participants of each version of the study instrument.

Table 1

Number of Participants of Each Version

Questionnaire Version	Male	Female	Total
1st version	697	610	1307
2nd version	613	726	1352

Instrument

The current study used a questionnaire as a tool to identify students' perceptions about the reality of science teachers' PCK and students' desired or preferred teacher. The two versions of the questionnaire were conducted online via SurveyMonkey. The data obtained by Ambusaidi et al. (2020) were used, but they were treated differently by comparing male and female students' perceptions in the current study. The questionnaire categories were derived from many studies such as Jang (2010), Halim et al. (2014), Kaya et al. (2012) and Magnusson et al., (1999). It consisted of items distributed among three categories closely related to PCK. These categories are (1) CK (Relationships and Learning Management), (2) SMK, and (3) PK. The first version of the questionnaire, which targeted the reality of science teachers' PCK, used a Likert-type scale, consisting of three categories (always, sometimes, and seldom). On the other hand, the second version of the questionnaire, which focused on desired practices, adopted an ordinary scale asking students to rearrange given items in each domain, from preferable to less preferable. The researchers translated these two versions into Arabic and modified them (adding, removing, and rewording) to suit the Omani context. Then, they were converted into electronic formats utilizing SurveyMonkey. Ten experts from two local universities, who are science educators, science teachers, and school science supervisors checked the content validity of both versions, which showed a great agreement between them. In addition, back translation (from Arabic to English) was applied. The reliability of both versions was checked by

calculating the internal consistency using Cronbach's alpha reliability coefficient as shown in (Table 2).

Table 2

Alpha Reliability Coefficient for the Two Versions of the Questionnaire

Categories of PCK	1st Version (The Reality)		2nd Version (The Desirability)	
	For the Domain	For the Items in the Domain	For the Domain	For the Items in the Domain
Context knowledge	0.91	0.90–0.91	0.86	0.84–0.86
Subject Matter Knowledge	0.92	0.91–0.92	0.85	0.84–0.86
Pedagogical Knowledge	0.93	0.92–0.96	0.84	0.81–0.87
The Questionnaire as whole	0.92	0.90–0.96	0.85	0.84–0.87

Data Analysis

For the first research question, the percentage of male and female students' selections for each item was calculated in the three rating categories (always, sometimes, and seldom). Then Chi-square was used to determine whether there is a statistically significant difference between female and male responses in each item. For the second research question, the percentage of male and female students who rate each item as the first choice was calculated to identify the students' preferences. Then Chi-square was used to determine whether there is a statistically significant difference between the responses from each gender in each item The Statistical Packages for the Social Sciences (SPSS) version 21was used to calculate the percentages and Chi-square.

Findings

To answer the two research questions, the researchers divided the results according to each domain. It included both the actual situation (reality) (research Question one) and the preferred situation (desirable) (Research Question Two) from male and female students' points of view. The purpose of merging the two research questions to allow the reader to compare easily between the two genders in both the actual situation and preferred situation. The tables below present items with significant differences either for both versions and only one of them. The first domain is the "CK" which includes two parts, which are the relationships and the learning context. Part 1 consists of students' perceptions relating to teachers' personalities, their interests in and relationships with students. Part 2 is dealing with the contained learning context; how science teachers direct and motivate the students, how they manage the classroom, and finally, the place where students learn science.

CK: The relationships. Table (3) indicates PCK elements that are utilized by science teachers and the preferred situation according to their 10th-grade male and female students' perceptions.

Table 3

The Percentage of PCK Items in "Context Knowledge: The Relationships"

No.	Item	Always (%)		Seldom (%)		Sig.	Desirable (%)		Sig.
		M	F	M	F		M	F	
1	*Personal Characteristic*								
1a	Fun and Simple	29.8	43.6	28.5	33.5	*	27	24	-
1b	seriousness	58.7	51.2	12.8	17.1	-	14	20	**
1d	Sympathy	37.6	36.3	25.9	31.1	-	13	16.8	*
1e	Enthusiasm	38.1	36.7	30.5	34.9	-	15.5	18.2	*
2	*Orientation*								
2a	Develop their performance	38.7	36.4	22.8	28.8	*	34.0	31.4	*
2c	Simplify content	46.3	44.4	22.6	26.3	-	24.1	34.8	*
2d	Solve previous tests	57.9	46.5	15.5	22.8	**	10.6	8.5	*
2e	Connect textbook content with society	30.6	25.2	34.8	38.0	-	8.2	4.3	**
3	*Attention*								
3a	All students	54.9	49.5	18.6	20.6	-	54.3	62.5	**
3b	Students who need of assistance	39.8	37.0	20.2	25.2	-	21.7	23.5	**
3c	Students who request attention	34.3	29.8	32.8	37.1	-	11.3	4.7	**

Note. **Significant difference at 0.01 level; * significant difference at 0.05.

The results for Research Question 1 (RQ1), as in Table 3, demonstrated that there is only one difference between male and female students in the actual practice of teacher personal characteristics in favor of females, which is "fun and simple". In this item, female students perceived their teachers to be funnier and simple to deal with compared to male students. Male students had a statistically higher estimate of the Orientation of their teachers in two items, which are training them to solve previous tests and develop their own performances. In terms of students' preferences in Research Question 2 (RQ2), the results in Table 3 show the difference between the two genders; it showed that female students preferred their science teachers to be serious in work, sympathetic to their students, and raise enthusiasm.

Regarding what science teachers seek to do with students; male students preferred that their teachers continue developing themselves to be better teachers. Female students, on the other hand, preferred their teachers to simplify the scientific content. Students generally agreed on the importance of the science teacher having a standardized relationship with all students. Female students preferred to focus on those students, who need assistance or have asked for help. On the other hand, male students preferred their teachers to restrict their attention to the students who request that.

CK: Learning Management. Table (4) indicates PCK elements that are utilized by science teachers and the preferred situation according to their 10th-grade male and female students' perceptions.

Table 4

The Percentage of PCK items in "Context Knowledge: Learning Management"

No.	Item	Always (%)		Seldom (%)		Sig.	Desirable (%)		Sig.
		M	F	M	F		M	F	
4				*Directs learning*					
4.a	Addressing me directly	45.1	39.3	20.5	24.8	-	52.0	51.6	**
4.b	Informing my parents	32.5	34.6	29.5	35.2	*	25.2	32.4	**
5				*Motivation*					
5.a	Diverse activities	53	47.4	19.5	22.5	-	44.9	31.5	**
5.b	Present information attractively	37.9	33.9	27.8	30.4	-	24.3	44.6	**
6				*Management*					
6.a	Fully control	46.8	41.4	20.6	25.1	-	45.7	36.0	**
6.b	Allow for suggestions	37.7	33.2	23.1	29.0	*	30.5	46.1	**
7				*Place of learning*					
7.a	Classroom	73.3	67.7	10.5	14.3	-	36.3	30.7	**
7.c	Outdoors	16.3	15.0	70.8	71.1	-	20.0	40.3	**

Note. **significant difference at 0.01 level

The results in Table 4 showed that male and female students had similar perceptions in most items of this part of the PCK domain except for two items. The first item was related to female students perceiving their teachers more contact with their parents. The second item appeared in the perceptions of male students giving higher estimates for teachers' attention to their suggestions in their classroom management. In terms of students' preferences (RQ2), the results in Table 4 demonstrated that male students preferred their teachers to direct their learning addressing the student themselves, while female students preferred their teachers to inform their parents about their progress and achievement. In the elicitation of students' motivation, male students preferred their teachers to use different types of classroom activities, whereas female students preferred their teachers to use attractive methods of presenting the information. Regarding classroom management, male students preferred their teachers to have full control in the classroom compared to female students who preferred their teachers to allow students' interference and implement their suggestions. Finally, regarding students' preferences to the place in which they learn science, male students preferred to learn inside the classroom compared to female students who preferred to learn outdoors (outside the classroom).

Subject Matter Knowledge (SMK). Table (5) below shows the percentage of PCK items in the "SMK" domain, which includes goals, plans, dealing with the textbook, and designing activities according to their 10th-grade male and female students' perceptions.

Table 5

The Percentage of PCK Items in the "Subject Matter Knowledge "Domain

No.	Item	Always (%)		Seldom (%)		Sig.	Desirable (%)		Sig.
		M	F	M	F		M	F	
5	*Goals*								
5.a	Developing thinking	48.7	51.1	17.2	20.1	-	48.2	40.6	**
5.b	Successfully pass tests	46.9	37.1	18.3	25.4	**	27.9	37.6	**
5.c	Effective citizenship	32.8	28.4	29.2	28.9	-	7.0	10.3	**
6	*Plans*								
6.a	Present tasks at the beginning semester	68.4	61.8	11.1	15.9	*	59.5	74.2	**
6.b	Determines roles in the class	29.6	29.9	27.9	29.2	-	23.5	14.7	**
7	*Textbook*								
7.a	Information	47.8	47.8	19.4	18.9	-	45.5	28.5	**
7.b	Inquiries and experiments	40.5	32.7	22.1	25.0	*	12.8	12.5	-
7.c	Organized summaries	51.0	46.6	20.1	26.3	*	12.4	37.6	**
7.e	Questions and exercises	70.6	63.6	11.9	15.6	*	11.4	7.7	**
8	*Activities*								
8.a	Easy and clarify	53.1	46.2	17.1	18.4	-	55.1	41.7	**
8.b	Innovative	40.0	40.4	20.1	25.2	-	17.9	28.9	**
8.d	Break the routine	34.7	35.9	36.3	36.8	-	12.8	23.4	**

Note. ∗∗Significant difference at 0.01 level; ∗ significant difference at 0.05.

The results for (RQ1) as in Table 5, for goals, planning, and how science teachers deal with science content, showed that male students perceived their teachers' main goal is to help them to pass the tests and get high scores compared to female students. Regarding teacher planning, male students perceived their science teachers to illustrate the goals and types of assessment at the beginning of the semester. The results in Table 5 also showed that male students perceived their teachers when dealing with the textbook as 1) provide them with problems that require scientific thinking, 2) provide organized summaries of content knowledge, and 3) focusing on questions and exercises. For the RQ2, the results in Table 4 showed those male students preferred their teachers to develop students' different types of thinking and problem-solving. However, female students preferred their teachers to help them succeed in passing the tests, get high scores, and prepare them for future careers and be effective citizenship in their society. Regarding teachers' planning, male students preferred teachers who determine the type of work required from each student and their role in that work at the beginning of the class and give commands to students to carry out tasks during the class. Female students preferred teachers who illustrate the goals and types of assessment at the beginning of the semester. Male students preferred to add new information by their teachers and expand on it. In addition, they preferred teachers who focus on questions and exercises in order to prepare them for the final examination. On the other hand, female students preferred teachers who provide them with organized summaries of the science textbook. Finally, for educational activities, male students preferred the activities to be easy and clear; whereas female students preferred activities that stimulate innovative thinking and break the routine of the school day.

Pedagogical knowledge (PK) domain. Table (6) shows the percentage of PCK items in the "PK" domain, which includes teaching and learning methods, feedbacks, and assessments tools according to their 10th-grade male and female students' perceptions.

Table 6

The Percentage of PCK Items in the "Subject Matter Knowledge "Domain

No.	Item	Always (%)		Seldom (%)		Sig.	Desirable (%)		Sig.
		M	F	M	F		M	F	
9	*Organize of Learning*								
9.a	Collective learning	59.7	47.3	17.9	22.8	**	48.2	44.2	**
9.b	small groups (4-6)	26.7	22.7	35.7	41.8	-	20	23.7	**
9.c	Work with a peer.	24.5	22.6	50.4	46.6	*	14.4	11.4	**
9.d	Work independently.	43.6	41.3	27.6	29.4	-	10.5	17.6	**
10	*Introduces lesson*								
10.b	Worksheets	41.2	34.3	18.2	25.2	-	38.2	22.0	**
10.c	Video or presentation	32.0	32.8	33.1	33.9	-	32.1	44.6	**
10.d	Asking questions	58.2	55.2	14.3	18.0	-	8.1	11.4	**
10.e	Short experiments demonstrations	40.5	35.2	24.5	28.3	-	5.9	10.1	**
10.f	Interactive simulations	24.3	22.0	46.3	49.3	-	5.4	7.7	**
11	*Teaching methods*								
11.a	Lectures	50.8	45.6	15.4	25.2	**	40.8	24.0	**
11.b	Solving questions	63.0	56.2	11.8	15.7		18.7	21.6	**
11.c	Show samples and models	37.6	33.0	23.0	30.3	*	11.6	24.4	**
11.d	Demonstration experiment	44.0	36.6	21.7	18.7	-	21.4	28.1	**
11.e	Interactive simulations	34.5	30.7	33.1	37.5	-	40.3	24.2	**
11.f	Video and slides	34.5	30.7	33.1	37.5	-	24.0	41.3	**
11.g	Interactive E-board	24.8	26.2	46.3	50.6	*	17.5	25.3	**
11.h	Researching through the Internet	22.1	18.2	50	56.2	-	9.5	7.2	**
11.i	Gather samples	19.6	15.8	62.1	65.1	-	43.0	21.9	**
11.k	Design concepts maps	40.6	38.8	27.0	33.9	-	9.8	23.6	**
11.l	Project based learning	34.3	27.4	31.1	33.5	-	9.2	7.0	**
11.m	Field trips	19.2	16.4	63.7	67.4	-	16.8	32.8	**
11.o	Posters, comics and caricatures	22.2	20.2	58.1	60.5	-	16.8	2.2	**
14	*Feedback*								
14.a	Sticking to the answer	53.2	42.2	18.1	24.3	**	43.8	27.3	**
14.b	Showing the progress	46.3	40.4	20	27.2	*	28.7	42.8	**
14.c	Explaining strengths &weaknesses	45.8	39.7	26.6	27.9	-	17.8	26.2	**
15	*Assessment tools*								
15.a	Variety of difficulty	48.6	43.4	20.2	25.2	-	45.6	33.9	**
15.b	Accuracy	46.8	39.3	20.0	25.7	*	27.8	33.6	**
15.c	Have new ideas	42.8	34.3	29.5	32.7	*	17.0	29.2	**

Note. ** Significant difference at 0.01 level; * significant difference at 0.05.

In relation to the results for RQ1, shown in Table 6, male students stated that their teachers used collective learning as the main way of organizing learning compared to female students. Working with a peer seems not practiced too much by both male and female science teachers. Nevertheless, female students stated that their teachers used peer groups more than male students did. For teaching methods used by science teachers, there is a significant difference between male and

female students in terms of their views on three items. Male students indicated that their teachers used lectures, and presented samples and models, however, female students pointed that their teachers used interactive E-board. In terms of students' preferences (RQ2), the results in Table 6 showed that male students preferred their science teachers to use lectures and working with a peer as a way of organized learning. On the other hand, female students preferred their teachers to let them work in small groups (consisting of four or six students) and sometimes work independently. Male students preferred their teachers to introduce science lessons in the form of worksheets, whereas female students preferred it in the form of video or presentations. The three main teaching methods preferred by male students to be used by science teachers are 1) lectures, 2) interactive simulations and 3) scientific inquiry by asking students to gather samples or conduct field surveys. Female students, on the other hand, preferred: 1) Video and slides, 2) field trips or interviews with specialists, and 3) demonstration of a scientific experiment by a teacher. Regarding feedback that science teachers provide to their students, male teachers used it more than female teachers did in a way to ensure the accuracy and precise adherence to requirements in the best or model answer, welcoming the progress of work and students perceive appreciation of the efforts as it. For assessment tools, male teachers used tools that have accuracy in determining the level of achievement of each student and presenting new ideas to assess how students deal with unfamiliar situations. This is in alignment with what is found above those male teachers focused more on getting their students successfully pass tests and get high scores.

Figure 2

Summary of RQ1 Results

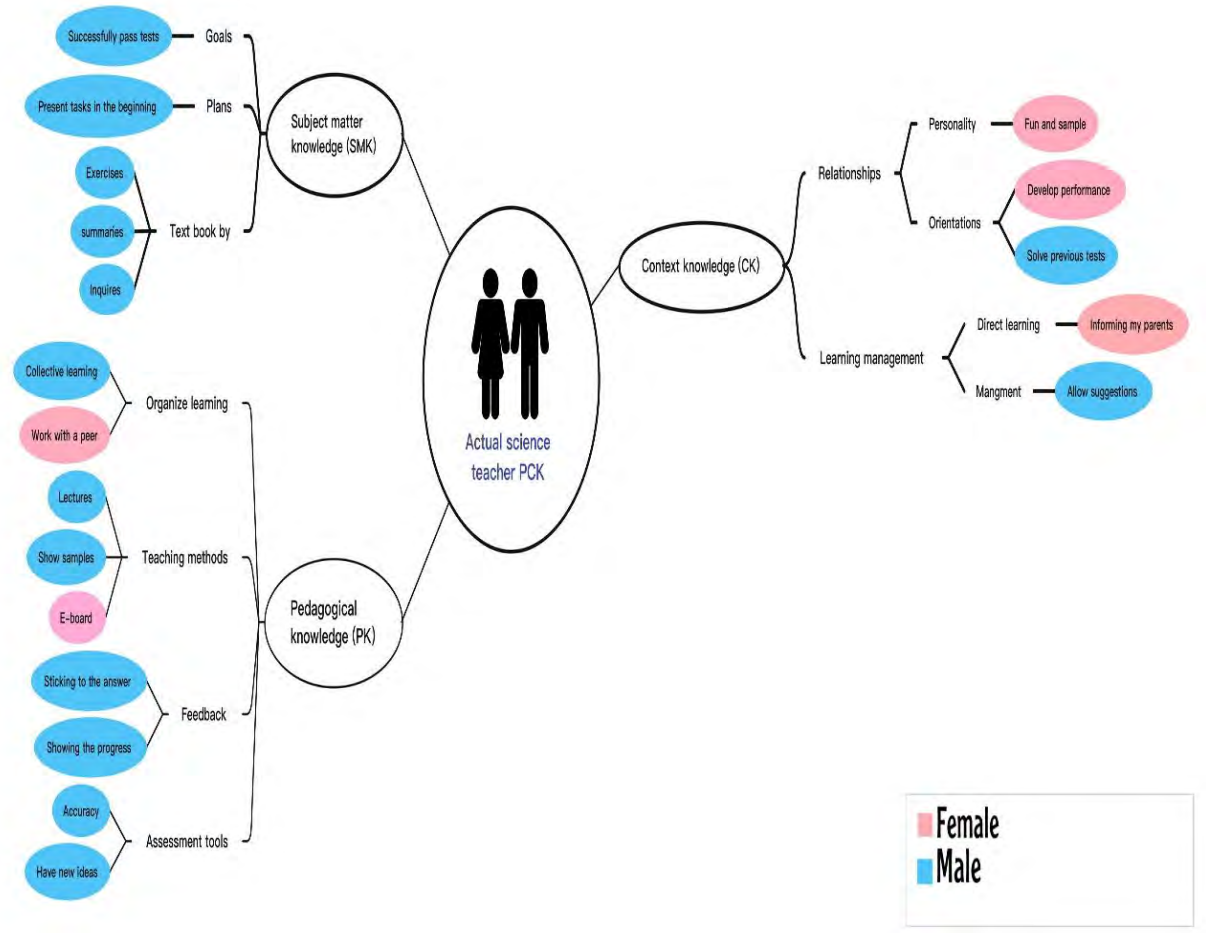
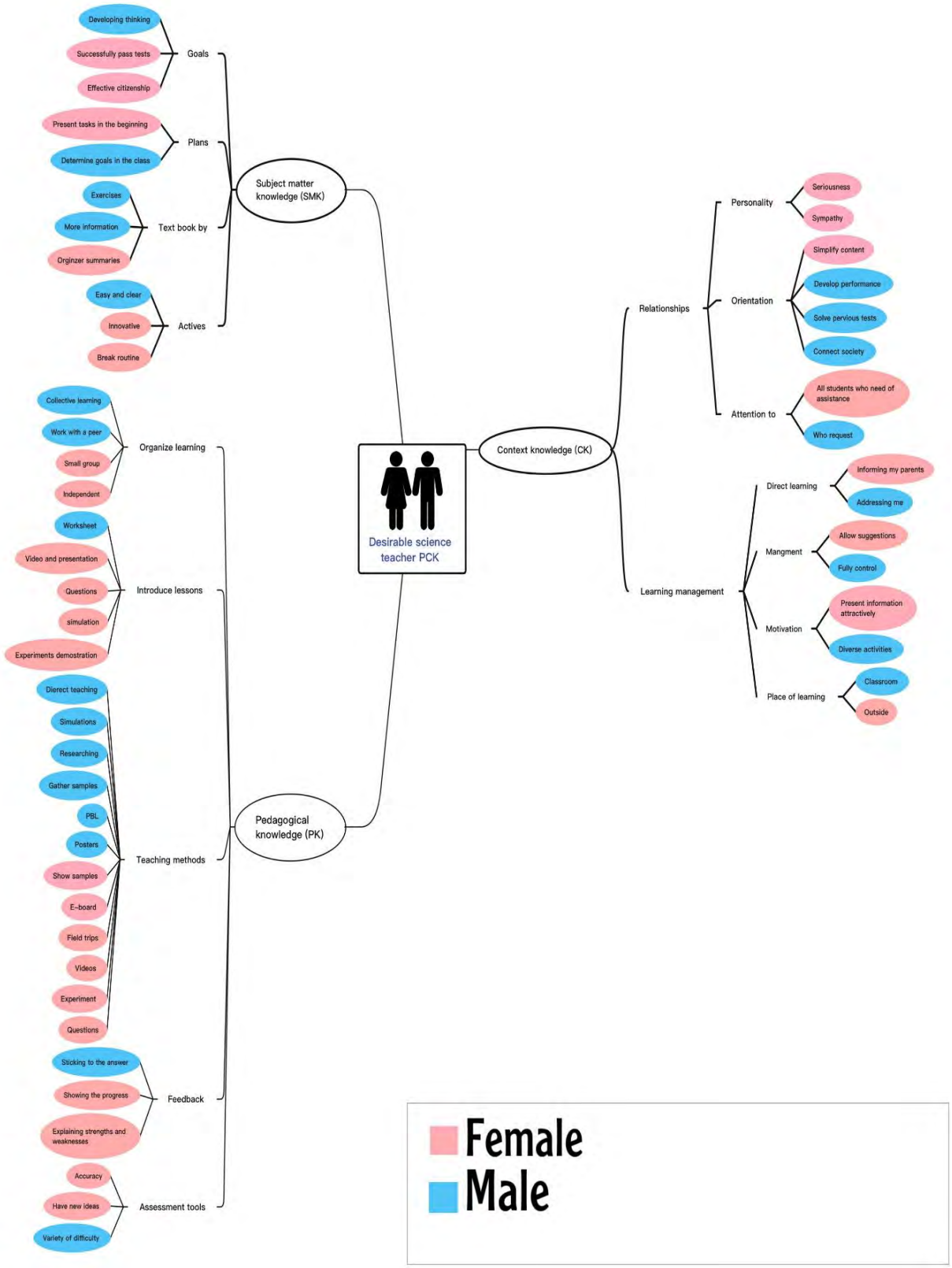


Figure 3

Summary of RQ2 Results



Discussion

This study investigated the differences between male and female students in their perception regarding the actual (reality) and preferred practices of their science teachers' PCK. The result of this study revealed that there are some gender differences in actual practices of their science teachers' PCK and an abundance of these differences regard to what students' preferred practices**.** The obtained results showed some indicators about learning science in Oman and the desired learning environment of each gender that make the science-learning environment more attractive for both genders. In the following, the discussion of female and male students' perceptions about their science teachers' PCK is presented. The perceptions of female students scored highest than males in four items; two of these items are related to the relationships between students and teachers. Female students described their science teachers' personalities as fun and simple. Moreover, their teachers directed the learning by connecting with students' families. In their favorite PCK elements, females emphasized the importance of good relations within an environment of learning, such as sympathy of the teachers, enthusiasm in teaching, give attention to the students who need to help, contact with students' parents, and responding to students' suggestions. Conforming to what were concluded in the current study, (Laird *et al*., 2010; Watt *et al*., 2012; Spilt *et al*., 2012; Booth, 2014; & Eliasson *et al*., 2016) showed that female teachers are more considerate of relationship with students. As stated in Al-Sibi (2009) girl schools have more educational management that promotes students' leadership practices that are specially related to enhancing communication and building up the relationship. Relate to pedagogical practices two items of actual science teachers' PCK that females scored higher than males, are work with a peer as a way of organizing learning and using interactive E-board. Female teachers are keener on using technicality media in science classes, such as using the interactive E-board. In this context, female desire match with actual science teachers' PCK. They preferred to work in small groups, and they look forward to employing advanced technology as an interactive E-board. Furthermore, female students have advanced aspirations, to learn outside the classroom, to focus on effective citizenship as a goal of learning science. Female students' like to determine tasks at the begging of the semester, and they wish to get classroom activates that characterize innovation and break routine. The teaching method they desire is that use presentations and demonstrations, they care to receive meaningful feedback, have new ideas in using the assessment tools. This is consistent with what was obtained in Scantlebury (2012) study that female teachers are more inclined towards create an environment that are more towards student-centered learning On other hand, there is a trend of traditional pedagogical practices represented in centralize of acquisition the science content knowledge in their consideration, as appear in many items as simplify content, present content knowledge attractively, present organized summaries. There is another trend, learning for examination, which is represented in the female desire to make "successfully pass tests' be the first goal of science teachers. Comparing to males, the females prefer having a more serious science teacher, which reflects a traditional stereotype of science teachers. Perceptions of male students demonstrated higher appreciation for their actual science teachers' PCK more than female students did. In pedagogical practices, male students give high scores for some traditional practices of their teachers. Examples of these are they are keen on training to pass the test, and get a high mark, organize learning as a collective, teaching by lectures. Otherwise, male students are manifest of advanced pedagogical practices, like informing them of what is required according to a long-term plan for the subject, experimenting, inquires and show samples, taking students' suggestions in classroom management. In addition, most science teachers' PCK preference by male students looked traditional in different ways, as they preferred collective learning, do not welcome working in small groups and direct teaching through lecturing and asking questions, as focusing on the preparation to pass tests. They trained students on how to solve the previous test, summarized content in the science textbook, and focused on questions and exercises. Male students do not show special interest in the personal characteristics of their teacher, preferred that the teacher deals with them individually, and not communicate with their parents. However, they have high aspirations for their science teachers' PCK as they favor using worksheets in introducing lessons and apply advanced technology such as interactive simulations. Moreover, male students

preferred to gather samples or conduct field surveys. The general features of the classroom environment in Omani schools that could be concluded are the supportive learning environment in female schools; female teachers are more considerate of relationships with students (Booth, 2014; Eliasson *et al*. 2016; Spilt *et al*. 2012; Watt *et al*., 2012). Darby (2005) stated that students learned better when teachers provided a supportive learning environment and made them feel comfortable. Where gender is an important factor in determining their success or failure (Al-Shabibi & Silvennoinen, 2018), there is multi evidence in the Omani context that female students received better pedagogical practices compared to male students (Ambusaidi, 2013; Ambusaidi & Al-Hajri, 2013; Al-Busaidi &Al-Jazari, 2010; Al Jabri *et al*., 2018). Male students in the current research reported that they received better support from their teachers compared to what female students declared. This is in line with Hastedt *et al*.'s (2021) study, which found that there was a tendency among female teachers and students to underestimate their effort to teach and learn science. On the other hand, male students' actual and preferences perceptions of science associated with previous studies (Al-Saidi, 2010; Al-Bahrani *et al*., 2009) which found that male schools are messier because students go through adolescence, which is often characterized by a refusal to censor them and their love to show their personality (Hattie, 2008). However, students' preferences wish their teachers to determine their roles at the beginning of class and have full control of actions in the classroom. In addition, students' choice of direct teaching and collective learning inside the classroom is another indicator. In these types of teaching methods, students may have a more stable learning environment and reduce any intra-class conflicts. Though, both female and male students have a common tendency for traditional pedagogical practices, especially the centralization of acquisition of the science content knowledge and preparation to pass examinations. Studies continue to confirm this tendency presence both locally (Ambusaidi & Al-Balushi; 2012; Ambusaidi et al., 2020; Al-Balushi *et al*. 2020; Al-Bloushi & Al-Rowahi, 2011; Al-Harthi, 2011) and internationally (Halim *et al*., 2014; OECD, 2009; Scantlebury, 2012). Finally, the study clarified the differences in students' preferences between males and females, the diversity that should be considered during classroom activities OECD (2016). Female students' desired social activities, watch presentations like videos and PowerPoint slides, and demonstrations of experiments. On the other hand, male students aspired to conduct practical activities, scientific investigation (Jang & Chang 2016; Slater *et al*.; 2007), and to employ advanced technologies (Reychav & McHaney, 2017).

Implications and Recommendations

Consequently, it is very important to encourage Omani teachers especially males to provide a supportive learning environment in their classrooms. For female teachers, they should put more effort to utilize new technology while teaching science. To achieve these recommendations, a training program or a workshop should be conducted for them. Professional development is another issue to be considered by the Ministry of Education (MoE) in Oman. MoE has well-designed professional development programs designed for science teachers especially for fresh science teachers, but there is a need for linking these programs to promote. This may help them deliver teaching that suits the desire of students. Another point that should be considering in the evaluation of the teaching process of teachers, which should not only be done through senior teachers or their principals or supervisors because it is not enough to develop their teaching skills. Thus, different perspectives are needed with one of them is the voice of students. Teachers should listen to their students by asking for their views and feedback about the teaching process. This can be done by a questionnaire or dissuasion in a sort of focus group. Finally, more future research are needed in the area of teachers' PCK, such as investigating the relationship between teachers' PCK and their attitudes to teach science or their perception about science. Moreover, another study can investigate students' attitudes towards science and their perceptions about their teachers' PCK.

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