Moderating the Relationship Between Student's Gender and Science Motivation

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Abstract
Researchers are interested in students' motivation to learn science as it impacts other aspects of students' learning. One aspect of this motivation is the gender issue, how it impacts student's motivation and how it is mediated and moderated by other educational variables. The issue of gender impact on motivation has been studied for more than two decades, which makes the present research interested in studying how background variables as student's ability, school level and teacher's gender moderate the relationship between student's gender and the different components of science motivation. The research design is that of moderation design through multiple regression. The sampling was a cluster sampling. The instrument used was the social-cognitive motivation questionnaire, and data analysis was done using regression and moderation analysis in SPSS 25 Statistical Package. Eight hundred, thirty-seven students, from the primary, middle and secondary schools participated in the research. The research results indicated that each of the three variables moderated between student's gender and part of the components of science motivation. The research concludes that the science teaching methods need to be diverse to fit both male and female science students, which could assist the learning of science in the secondary school from the two genders. Moreover, utilizing different teaching methods would support all ability -level students. In addition, holding workshops for teachers that discuss the gender issue in science education can help address this issue.

Keywords: science motivation, student's gender, teacher's gender, student's ability, school level, moderation of science motivation

INTRODUCTION

Researchers are interested in different constructs of students' learning, especially the affective and psychological constructs (Daher, 2011; Daher, Anabousy, & Jabarin, 2018). One such construct is students' motivation, where different aspects of this construct have attracted researchers' attention. One such aspect is the constructs that influence students' motivation, while a second aspect is the variables that are affected by motivation. Researchers who were interested in the first aspect pointed at the context or environment as influencing students' motivation. One such environment is e-learning (e.g., Lin, Chen, & Liu, 2017), while another is game-based learning (Say & Bag, 2017). Researchers who were interested in the second aspect reported the different constructs affected by motivation (e.g., Bal-Taştan et al., 2018). Such constructs are academic outcomes and achievement (e.g., Areepattamannil, Freeman, & Klinger, 2011), students' processing style (e.g., Nolen & Haladyna, 1990), performance and success (Obrentz, 2011), self-regulation in science learning (Velayutham, Aldridge, & Fraser, 2012), participation in science fairs (Dionne, Reis, Trudel, Guillet, Kleine, & Hancianu, 2012), the preferred academic subject (Lee, 2017) and future career- related choices (Taskinen, Schütte, & Prenzel, 2013). In addition, motivation affects the relationships between variables by being a mediating or moderating variable. Bonney et al. (2005), in considering the relation between motivation

Contribution to the literature
- The study investigates student's ability, school level and teacher's gender as moderators of the relationship between student's gender and the different components of science motivation.
- The study considers students' motivation in three school levels: primary, middle and high.
- The study concludes the need for diverse teaching methods to be implemented in the science classroom.

and achievement, proposed two possible ways. The first way is that motivational beliefs can mediate the relation between the instructional strategy and achievement. The second way is that the instructional strategy fits students with specific motivational beliefs and thus impact the relationship between instructional strategy and achievement. Here, motivational beliefs play the role of a moderating variable rather than a mediating one.

Motivational Constructs

Researchers described different motivational constructs that could impact students' learning of science. These factors are: efficacy, task value or science learning value, interest to learn science, attitudes towards learning science, and achievement goals (Bonney et al., 2005; Eccles, Wigfield, & Schiefele, 1998; Ng, Soon, & Fong, 2010; Tuan, Chin, & Shieh, 2005). Self-efficacy refers to students' beliefs and social cognitive judgments of one's capabilities to do the tasks in the classroom (Bandura, 1997), which impact how students are engaged with science learning or activities. Task value beliefs are concerned with the utility of the subject matter domain, in this case science, and are related to the extent to which the task is useful, enjoyable, or relates to one's self-image of value (Glynn, Taasoobshirazi, & Brickman, 2009; Palmer, 2007). Interest to learn science refers to an individual's attraction to a specific activity or domain, including emotional constructs (Pintrich & Schunk, 2002). Finally, students' achievement goals could be mastery goals (goals focused on learning and understanding), performance goals (goals focused on outperforming others) or achievement goals (goals focused on getting high marks).

In addition, Tuan et al. (2005), in a review of learning motivation studies, reported a variety of motivation constructs, such as active learning strategies, self-perceptions of ability, effort, intrinsic goal orientation, task value, self-efficacy, test anxiety, self-regulated learning, task orientation and learning strategies. Ng, Soon and Fong (2010) considered attributions as a motivational factor. According to the attribution theory (Weiner, 1979), students who believe that success is related to effort will be more likely to use effort than those who believe that success is due to inherent ability. In the present paper we used the motivational constructs in Glynn, Brickman, Armstrong, and Taasoobshirazi (2011), which included intrinsic motivation and personal relevance, self-efficacy and assessment anxiety, self-determination, career motivation, and grade motivation.

Glynn et al. (2011) describe intrinsic motivation as involving the satisfaction in learning science for its own sake; self-determination as referring to the control students believe they have over their learning of science, self-efficacy as referring to students' belief that they can accomplish well in science and extrinsic motivation as involving learning science to an end, such as a career or a grade. Glynn et al. say that these components constitute a componential model of motivation derived from social cognitive theory and that they contribute positively to the arousal, direction, and sustainment of students' science-learning behaviour.

Factors that Influence Science Motivation

Empirical research has been interested in different aspects of motivation to learn science as the context. Here, researchers reported that the teacher influences the motivation level of science students (Aktan, 2019). In addition, researchers were interested in how background variables, such as gender, affect this level (e.g., Debacker & Nelson, 2000). Chow and Yong (2013) used a similar questionnaire to the present study (Glynn, Taasoobshirazi, & Brickman, 2009) to investigate secondary school students' motivation and achievement in combined science. Results indicated that the participants showed a moderate level of intrinsic motivation, personal relevance, self-determination and self-efficacy and a high level of extrinsic motivation and assessment anxiety in learning-combined science. Furthermore, the results showed significant positive correlations between students' motivational orientations and science achievement.

Below, we will describe studies that examined how student's ability, school level and teacher's gender, as background variables, affect students' motivation to learn science. Relatively little research has studied the moderation of background or educational variables on the relation between gender and motivation to learn science, which points at the need to do so. We will first describe the literature that studied how each of the variables (gender, ability, school level, teacher's gender) affect motivation in science, and then describe previous attempts to study variables that moderate or mediate the relationship between student's gender and his/her motivation to learn science.

The literature about gender in motivation in general and science motivation in particular is combined. Meece, Glienke, and Burg (2006) reviewed the literature to examine how gender shaped achievement motivation.

They concluded that boys reported stronger ability and interest beliefs in mathematics and science, whereas girls had more confidence and interest in language arts and writing. Debacker and Nelson (2000) found that girls had higher scores on perceived instrumentality and pleasing the teacher than did boys. Obrentz (2011) found that females reported lower intrinsic motivation, personal relevance, self-efficacy and critical thinking, and higher assessment anxiety, rehearsal and organization. Self-efficacy predicted performance for males and females, while self-determination, help-seeking and study environment also predicted female success.

More recent results are also combined. Chow and Yong (2013) found a significant difference between boys and girls in assessment anxiety, while there were no other differences in motivational beliefs due to gender. Chumbley, Haynes, and Stofer (2015) found no significant correlations between gender and motivation to learn science. At the same time, they found that females generally had higher self-determination and grade motivation than males. Thomas (2017) examined how teachers' implicit science-is-male stereotypes influence students' motivation to learn science. They found that these stereotypes are positively related with males' self-concept and intrinsic value but negatively associated with females' motivational beliefs.

Glynn, Taasoobshirazi, and Brickman (2009) used the first version of the questionnaire used in the present study to examine differences in science and non-science majors' motivation that could be attributed to gender. They reported that there were no significant differences in total scores of science motivation due to gender; however, the scores of the self-efficacy and assessment anxiety scale were higher among the men than the women, suggesting that the men had more confidence and less anxiety than the women. The scores on the self-determination scale, however, were higher among the women than the men, suggesting that the women believed they had more control over their learning than the men. The scores on the career motivation scale were slightly higher among the women than the men, but the effect size was below the criterion of 0.20. There were no significant differences due to gender on scores on the intrinsic motivation and personal relevance scale or the grade motivation scale.

The above combined results about the effect of gender on science motivational beliefs could indicate that some variables moderate between gender and motivation, which indicates the necessity of studying this moderation. In the present paper we study the moderation of ability, school level and teacher's gender between students' gender and their motivational beliefs.

Some research has paid attention to the impact of ability on science motivation, the literature shows positive relationship between ability and performance in science subjects. Debacker and Nelson (2000) say that

along with goals, students' perceptions of their ability to perform science tasks affect motivation to learn. Obrentz (2011) found that high course performers reported the highest levels of motivation and learning strategy use. Chow and Yong (2013) also found significant differences in motivational beliefs towards learning science between high ability and low ability students in favor of high ability students.

School level has been studied as impacting science motivation. Generally, researchers found that students' motivation decline over time. Freeman and Anderman (2005) reviewed the motivation research to emphasize that students' personal goals can change over time, with many students showing a decline in mastery goal orientation. They also emphasize that research has also shown a tendency for students' mastery goal orientation to decrease following the transition from primary into middle school. Specifically, Jacobs, Lanza, Osgood, Eccles, and Wigfield (2002) found that grade is a significant factor in motivation and engagement, where the transition from junior high to middle high can result in declines in motivation. Martin (2007) found that although both boys' and girls' motivation is lower in middle high school, only girls' motivation is relatively higher in senior high school. On the other hand, Chumbley, Haynes, and Stofer (2015) found no significant correlations between gender or grade level and motivation to learn science The previous results indicate that the grade issue is an important element to include in research on academic motivation and engagement (Martin, 2007), which the present research intends to follow up. Here, we consider the impact of the grade on the relation between gender and science motivation; i.e., as a moderating variable.

Little research has been done regarding the issue of teacher's gender in science motivation. Martin and Marsh (2005) targeted the gender-stereotypic model that states that boys fare better academically in classes taught by males, while girls fare better in classes taught by females. Their results proved otherwise; they found that, in support of the gender-invariant model, academic motivation does not significantly vary as a function of the teacher's gender, and in terms of academic motivation and engagement, boys do not fare any better with male teachers than female teachers.

Moderation and Mediation of Gender Differences in Science Motivation

Trying to explain gender differences in science motivation, researchers looked at the moderation and mediation of these differences. Meece and Jones (1996) reported that differences in science motivation are moderated by ability, race, and classroom context. As to the ability level, they found that in the low ability group only; boys reported a stronger mastery goal orientation than did girls. Middleton and Midgley (1997) found that ethnicity moderates between gender and science

motivation, where African American girls reported a stronger learning goal orientation than African American boys. No differences in goal orientations were found for European American students. Moreover, King (2016) found that gender differences in science motivation were mediated by peers' attitude toward school. Boys perceived their friends to have more negative attitudes toward science, where these perceptions were associated with boys' lower levels of motivation. In addition, Chung and Chang (2017) found that educational games reduce the effect of gender on learning achievement and motivation.

Research Rationale and Goals

Researchers have been interested in students' motivation in general (Meece et al., 2006) and students' motivation to learn science in particular (Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011) as it influences students' learning of science and success in their learning. One of the issues to which researchers paid attention in science motivation is the issue of gender. Trying to understand this issue in students' motivation to learn science helps understand how to affect positively students' motivation to learn science from the two genders. Research related to the gender issue in science motivation is combined, as there is no clear trend regarding this relation, which indicates the need to study variables that could mediate or moderate the relation. In the present research, we consider student's ability, grade level and teacher's gender, as moderators of the relation between gender and motivation. Little research has focused on the previous variables as moderators between student gender and motivation. Thus, the present research will shed more light on the gender issue in science motivation, enabling educators to deepen their understanding of this issue and of the role of the studied moderators in this issue. This would provide science teachers with means to attempt to affect positively students' motivation to learn science from the two genders. This could be done, for example, by taking into consideration the undesired impact of the moderators, and thus trying to lessen it.

Studies in motivation were based on different theories, where one such theory is the social cognitive theory, developed by Bandura (1986) and extended by others (e.g., Pajares & Schunk, 2001). This theory considers human activity as reciprocal interactions among personal characteristics, environmental contexts, and behaviors (Glynn et al., 2011). This consideration makes it appropriate for considering relations and moderation of relations between variables related to personal characteristics, as the student's gender, and environmental variables as grade and teacher's gender. Thus, in the present study, we adopt this theory to study the moderation between gender and motivation to learn science.

Research Question

Do student's background variables (student's ability, school level and teacher's gender) moderate between student's gender and motivation to learn science?

METHODOLOGY

Data Sample

The sampling was a cluster one. The population was first divided into three clusters: primary school students, middle school students and high school students. Afterwards, random sampling was applied to each cluster of population.

Table 1 describes the frequencies of the research sample regarding the four background variables: Student gender (SGender), ability, teacher gender (Tgender) and school level (ScLevel).

Data Collecting Tools

In the present study, we used the questionnaire which Glynn et al. (2011) developed to assess five social-cognitive motivation components: intrinsic motivation and personal relevance, self-efficacy and assessment anxiety, self-determination, career motivation, and grade motivation. The questionnaire distributed to the participants is composed of two parts. The first part gathers background information about the respondent: Student gender, ability in science and teacher's gender. Each of the gender variables has two values, while the variable ability in science has three values: weak, medium and strong. The second part of the questionnaire is composed of 25 items that represent the five components of science motivation, where each component is composed of 5 items. Following are examples on each component: intrinsic motivation (e.g., I am curious about discoveries in science), self-determination (e.g., I study hard to learn science), self-efficacy (e.g., I am sure I can learn science), career motivation (e.g., My career will involve science), and grade motivation (e.g., I think about the grade I will get in science). Students respond to each item on a rating scale of temporal frequency: never (1), rarely (2), sometimes (3), often (4), or always (5). Exploratory factor analysis performed by Glynn et al. (2011) showed All of the items met the criterion of loading at least 0.35 on their respective factor (Tabachnick & Fidell, 2000). The eigenvalue and percent of variance explained by each factor were: intrinsic motivation (8.83, 35.33%), career motivation (2.83, 11.31%), self-determination (2.21, 8.84%), self-efficacy (1.78, 7.13%), and grade motivation (1.26, 5.03%). The cumulative percent of variance explained by the factors was 67.64%. The confirmatory factor analysis yielded fit indices of $\chi 2/df=2.77$, SRMR = 0.04, GFI = 0.93, CFI = 0.91, RMSEA = 0.07, which indicates that the measurement model fits the data well,

Table 1. Frequencies of the research sample according to the background variables

				primary	middle	high	
male	low	Teacher gender	male	2	1	6	9
			female	2	6	8	16
		Total		4	7	14	25
	middle	Teacher gender	male	2	3	19	24
			female	35	36	31	102
		Total		37	39	50	126
	high	Teacher gender	male	1	11	18	30
			female	58	65	32	155
		Total		59	76	50	185
	Total	Teacher gender	male	5	15	43	63
			female	95	107	71	273
		Total		100	122	114	336
female	low	Teacher gender	male	1	1	3	5
			female	1	2	7	10
		Total		2	3	10	15
	middle	Teacher gender	male	1	10	8	19
			female	36	41	69	146
		Total		37	51	77	165
	high	Teacher gender	male	1	7	28	36
			female	149	66	70	285
		Total		150	73	98	321
	Total	Teacher gender	male	3	18	39	60
			female	186	109	146	441
		Total		189	127	185	501
Total	low	Teacher gender	male	3	2	9	14
			female	3	8	15	26
		Total		6	10	24	40
	middle	Teacher gender	male	3	13	27	43
			female	71	77	100	248
		Total		74	90	127	291
	high	Teacher gender	male	2	18	46	66
			female	207	131	102	440
		Total		209	149	148	506
	Total	Teacher gender	male	8	33	82	123
			female	281	216	217	714
		Total		289	249	299	837

and thus provides evidence of questionnaire construct validity.

Face validity was performed through requesting 30 students, 10 from each school level, to answer the questionnaire and ask for clarification if needed. Formulation of 4 items was changed to make them clearer. Content validity was performed by requesting university lectures in education and psychology to assess the items in each construct in the questionnaire regarding their measuring of the construct. The experts agreed that the items in each construct are relevant and clear. The reliabilities (internal consistencies) of the scales, assessed by Cronbach's alphas, according to Glynn et al. (2011), were: career motivation (0.92), intrinsic motivation (0.89), self-determination (0.88), self-efficacy (0.83), and grade motivation (0.81). The Cronbach's alpha of all 25 items was 0.92. These values are very good according to DeVellis (2003).

Data Analysis Tools

To examine for moderation we followed Statistics Solutions (2013) who recommended that a multiple linear regression needs to be conducted in order to analyze moderation effects. The independent variables of the regression are the independent variables of the research (in our case student's gender), moderator (in our case one of the background variables: student's ability, the school level or the teacher's gender), and the interaction between independent variable and moderator. The interaction is created by multiplying independent variable and moderator after both have been centered to have a mean of 0. The dependent variable of the regression is dependent variable (in our case the type of motivational belief). If the interaction is significant, then moderation is supported.

Table 2. Means, standard deviations and t values for the components of science motivation according to student gender

	Student gender	N	Mean	SD	t value	p value
Intrinsic Motivation	male	336	3.815	.691	-4.825	.000
	female	500	4.048	.682		
Self-efficacy	male	336	3.422	.709	-2.613	.009
	female	500	3.556	.739		
Self-determination	male	335	3.817	.876	-5.221	.000
	female	502	4.128	.660		
Career motivation	male	336	3.627	1.131	-4.628	.000
	female	502	3.976	1.030		
Grade motivation	male	336	3.844	.716	-5.337	.000
	female	501	4.096	.640		
General motivation	male	335	3.708	.606	-6.298	.000
	female	498	3.964	.532		

Table 3. Significant moderation of ability between gender and the motivation components

Motivation component	B	SE B	β	t	95% CI For B
Intrinsic motivation	-0.169	0.078	-0.399	-2.170*	-0.322, -0.016
Self-determination	-0.286	0.084	-0.611	-3.405**	-0.451, -0.121

* $p < 0.05$, ** $p < 0.001$

FINDINGS AND DISCUSSION

We first computed means and standard deviations of the components of the science motivation. In addition we computed t-values to examine the significance of the differences of the components scores between males and females. Table 2 shows means and standard deviations of the components of science motivation according to gender. It also shows t-value for comparing means of each motivation component according to gender and the significance of the difference between the means.

Table 2 shows that female students had significantly higher scores in all the components of science motivation as well as the general motivation. These results are in contrast to researches that found that boys have higher scores for science motivation as Meece et al. (2006) who concluded that in general boys show more positive achievement-related beliefs in mathematics, science, and sports while girls show more positive beliefs in language arts and reading. The present research results are also in contrast to the results in Miller, Blessing and Schwartz (2006) who reported that females generally found science uninteresting and the scientific lifestyle (as perceived by them) unattractive. Glynn et al. (2011) also reported that men had higher self-efficacy than women. The present study results agree with studies that found that girls had higher scores in some components of science motivation than boys. One of these studies is that of Glynn et al. (2011) who reported that women had higher self-determination than men.

The present research results indicate that girls find science a subject in which they can realize themselves as learners, and that they are aware of science importance for their careers. Part of previous studies reported this direction of science motivation. Britner (2008) reported that in Earth Science classes, girls earned higher grades and reported stronger science self-efficacy. Moreover, the present research results could be due to the change in parents' attitudes about girls' ability in science and mathematics. Parents are a main factor in their children's values, practices, choices and academic effort (Adamuti-Trache & Andre, 2008; Lyons, 2006). In addition, according to the social cognitive model of academic choice developed by Eccles et al. (1983), both parents and teachers contribute to gender differences in motivation by different means as communicating different expectations and goals for boys and girls. It seems that parents' and teachers' attitudes and behaviours have developed into more favourable ones towards girls, which encouraged girls to develop positive inclination to and stronger motivation towards science.

The previous results were the basis for our verification of moderators between student's gender and science motivation.

Student's Ability as a Moderator between Gender and Science Motivation Components

To find whether student's ability moderates the relationship between gender and each one of the components of science motivation, we ran regression analysis which showed that student's ability moderates significantly the relationships between student's gender and each of the following motivation components: intrinsic motivation ($R^2 = 0.005$, $F(832,1) = 4.709$, $p < 0.001$) and self-determination ($R^2 = 0.012$, $F(833,1) = 11.592$, $p < 0.01$). Table 3 shows the results of the moderation computations for each one of the above motivation components. These results are related to the interaction between student gender and ability (Gender*Ability) in step 2 of the regression analysis.
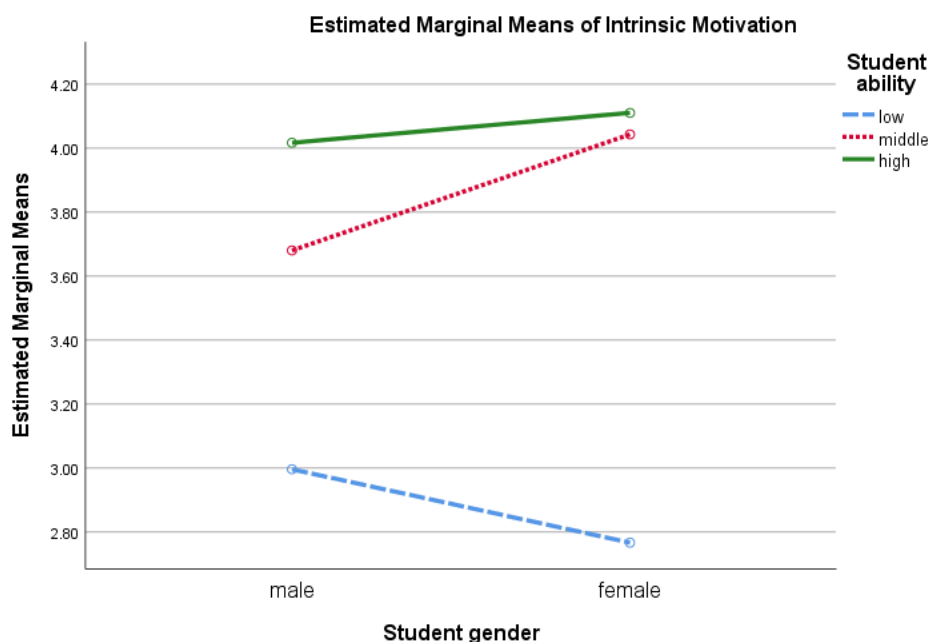
Figure 1. Ability as moderator between gender and student's intrinsic motivation

In addition, the regression equation for intrinsic motivation was: Intrinsic motivation=2.127 + .617*gender + 0.602*ability - 0.169*gender*ability (See appendix 1 for the appropriate regression table from the SPSS output). We plotted the effect of the interaction to understand its dynamics. Figure 1 shows this interaction.

We see that the trend is different for middle-ability and high-ability students; where the slope of the high-ability students' motivation is less steep than the slope of the middle-ability students' motivation. Thus, the graphs in Figure 1 indicate that the motivation difference between females and males is higher in the case of the middle-ability students. In addition, in the case of the low-ability students, males reported more motivation than males. The previous results confirm previous researches that reported that gender effects were moderated by the students' ability level, where in the low ability group only; boys reported a stronger mastery goal orientation than did girls (Meece & Jones, 1996). Here, the high-ability, as well as the middle-ability, females reported a stronger intrinsic motivation than males. At the same time, the difference in the intrinsic motivation scores between female and male students is lower in the case of high-ability students than in the case of middle-ability students, which could indicate insignificant difference between high-ability females and males in intrinsic motivation. Computations showed that this is indeed the case: t=-1.614, p=.107.

A similar trend for the middle and high ability was found for self-determination regarding middle and high levels but different regarding the low level. Figure 2 shows the interaction in case of self-determination.

The same analysis above for intrinsic motivation applies here for self-determination, though here females have higher self-determination than males. The regression equation was: Self-determination=1.384 + .977*gender + .875* ability - .286*gender*ability (See appendix 2 for the appropriate regression table from the SPSS output). In all the scores of the components of science motivation, where student's ability moderates significantly between gender and motivation, the difference between female and male students was lower for high-achieving students than for middle- ability students.

In addition to the above significant moderations, the results of moderation analysis showed that ability does not moderate significantly between gender and each of the following motivation components: self-efficacy (β=0.308, t(832)=1.747, p=0.081), career motivation (β=-0.106, t(834)= -0.846, p=0.398), grade motivation (β=-0.125, t(833)= -1.591, p=0.112) and general motivation (β=-0.315, t(833)= -1.801, p=0.072). This means that for both middle- ability and high- ability students, motivation scores of females are higher than motivation scores of males, for three motivation components: self-efficacy, career motivation and grade motivation. These results point at the need to apply different methods to make both male and female science students motivated, in the previous components, to learn science. Researchers suggested science-motivating methods such as those suggested by Butler (2009, p. 1-2); namely making the science real (through working with themes and phenomena from the real world), making the science relevant (connected to student's age-appropriate lived experience and studied through encouraging posing questions by students), and making the science rigorous (through clarity and detailed instructions, as well as
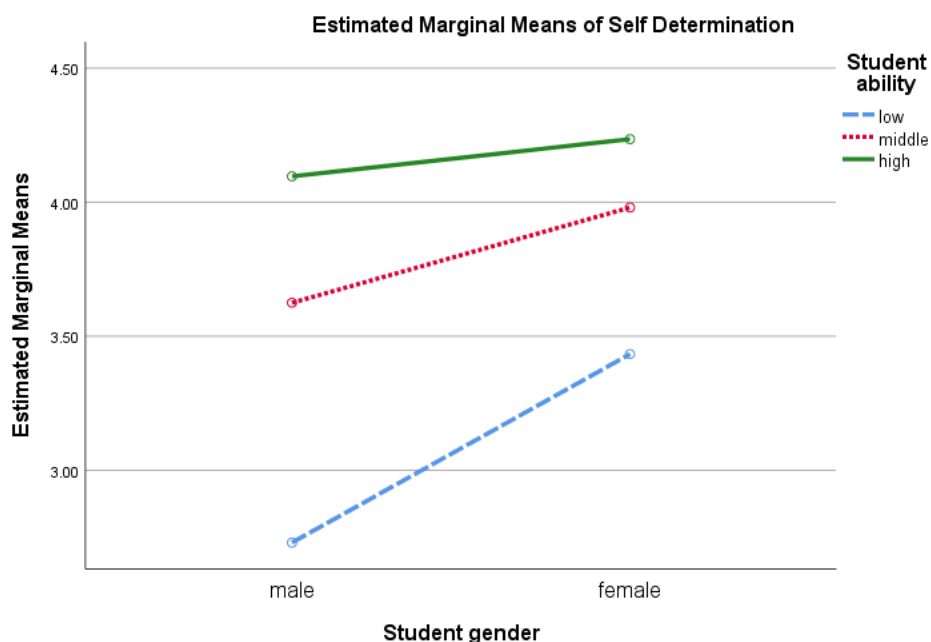
Figure 2. Ability as moderator between gender and student's self-determination

Table 4. Significant moderation results for the moderation of school level between gender and motivation components

Motivation component	B	SE B	β	t	95% CI For B
Intrinsic motivation	-0.155	0.061	-0.365	-2.560*	-0.274, -0.036
Self-determination	-0.185	0.091	-0.293	-2.028*	-0.364, -0.006

* $p<0.05$, ** $p<0.001$

through assessment on multiple levels, as classroom tests and quizzes, and district, state, national and international standardized assessment).

School Level as a Moderator between Gender and Science Motivation Components

Regression analysis was run to examine whether school level moderates the relationship between gender and each one of the components of science motivation. The results showed that school level moderates significantly the relationships between student's gender and the motivation components: Self efficacy ($R^2=0.007$, $F_{(832,1)}=6.552$, $p<0.05$), and career motivation ($R^2=0.005$, $F_{(834,1)}=4.112$, $p<0.05$). Table 4 shows the results of the moderation computations for each of the previous motivation component. These results are related to the interaction between student gender and school level (Gender*school level) in step 2 of the regression analysis.

In addition, the regression equation for self-efficacy was: self-efficacy=3.178 + 0.438*gender + 0.060*school-level - 0.155*gender*school-level (See appendix 3 for the appropriate regression table from the SPSS output). We plotted the effect of the interaction to understand its dynamics. Figure 3 shows this interaction.

Figure 3 shows that the trend is not the same for students at primary, middle and high school levels. At middle school level, self-efficacy is almost the same for males and females; i.e., no significant differences in self-

efficacy exist, where the computations showed t=0.317, p=.751. The same thing could be said about self-efficacy at high school, where computations showed: t=-0.533, p=.595. At the same time at primary, females have significantly higher self-efficacy than males, where the computations showed t=-3.866, p<.00l.

Furthermore, the regression equation for career motivation was: 2.990 + 0.716*gender + 0.146*school-level - 0.185*gender* ability (See Appendix 4 for the appropriate regression table from the SPSS output). Plotting the effect of the interaction to understand its dynamics, it gave the interaction in this case, as in Figure 4.

Examining significance of the difference in career motivation between males and females in the different school levels, computations showed significant difference for high school: t=-2.206, p<.05 for high school, and insignificant differences for the other two school levels: t=-4.943, p<.001 for primary school, t=-0.827, p=.409 for middle school and.

The previous results indicate that teachers and other educational agents like principals need to try to keep the motivation level of students at the middle school and high school as that at the primary school. Doing that, they should attempt to increase the motivation of males. In addition, the insignificant differences in self-efficacy motivation between males and females at the middle school means that efforts could be done to make these
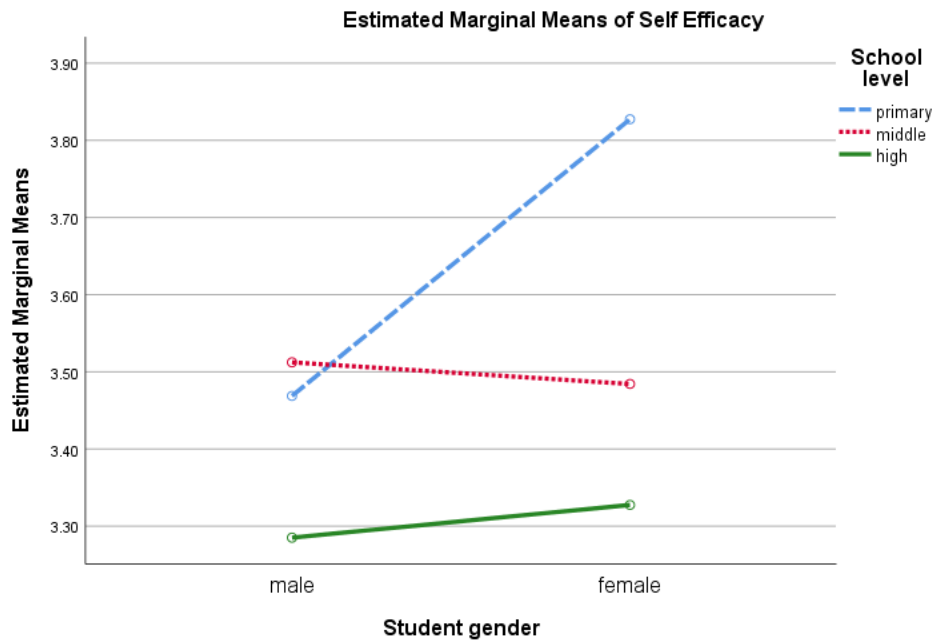
Figure 3. School level as moderator between gender and student's self-efficacy
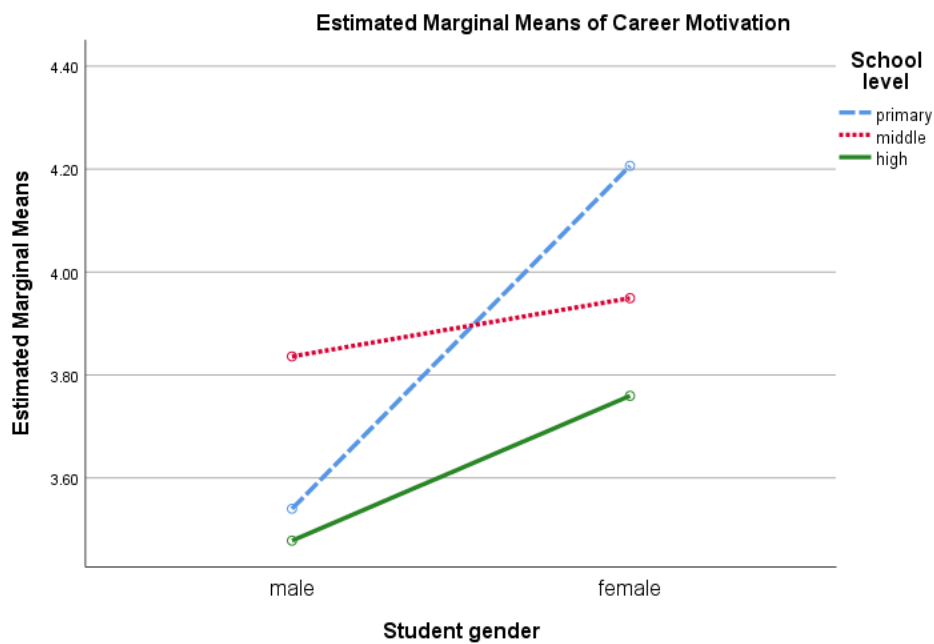

Figure 4. School level as moderator between gender and career motivation

differences stay insignificant also at the high school. What strengthen this claim are the findings of Britner (2008) that there were no gender differences in self-efficacy in Life Science or Physical Science.

The results of moderation analysis also showed that school level does not moderate significantly between gender and each of the following motivation components: intrinsic motivation (β=-0.05, t(832)=-0.39, p=0.70), self-determination (β=-0.04, t(833)=-0.36, p=0.72), grade-motivation (β=-0.15, t(833)=-1.25, p=0.213) and general-motivation (β=-0.20, t(832)=-1.74, p=0.081). It could be concluded that students' motivation to learn science weakens with the advancement of school

level, which points at the need to adopt different motivating science-teaching methods as authentic science experiences that would result in the strengthening of some motivation components (Hellgren & Lindberg, 2017).

Teacher's Gender as a Moderator between Student's Gender and Science Motivation

Regression analysis was run to examine whether teacher's gender moderates the relationship between gender and each one of the components of science motivation. The results showed that teacher's gender moderates significantly the relationships between

Table 5. Significant moderation results for the moderation of teacher's gender between student's gender and motivation components

Motivation component	B	SE B	β	t	95% CI For B
Intrinsic motivation	0.297	0.133	0.475	2.238*	0.037, 0.558
Self-determination	0.483	0.209	0.493	2.315*	0.073, 0.892

* $p < 0.05$

Figure 5. Teacher's gender as moderator between student's gender and her intrinsic motivation

student's gender and the motivation components: intrinsic motivation ($R^2=0.006$, $F(831,1)=5.010$, $p<0.05$) and career motivation ($R^2=0.006$, $F(833,1)=5.359$, $p<0.05$). Table 5 shows the results of the moderation computations for each of the previous motivation component. These results are related to the interaction between student gender and school level (Gender*teacher's gender) in step 2 of the regression analysis.

In addition, the regression equation for intrinsic motivation was: Intrinsic motivation=3.88 + .18*student's gender -0.12*teacher's gender + 0.31*student's gender*teacher's gender (See Appendix 5 for the appropriate regression table from the SPSS output). We plotted the effect of the interaction to understand its dynamics. Figure 5 shows this interaction.

Looking at the four combinations of student's gender and teacher's gender, Figure 3 shows that the combination 'female student'-'male teacher' resulted in the lowest intrinsic motivation between the four combinations, while the combination 'female student'-'female teacher' resulted in the highest motivation between the four.

Moreover, the regression equation for career motivation was: Career motivation=4.014 + .564*student's gender -0.386*teacher's gender +

0.483*student's gender*teacher's gender (See appendix 6 for the appropriate regression table from the SPSS output). Plotting the effect of the interaction to understand its dynamics, it gave the interaction in Figure 6.

Figure 6 shows the same trend as in the case of intrinsic motivation, so the argument in that case applies here too. In addition to the significant moderations above, teacher's gender was not found to moderate significantly between student's gender and each one of the motivation components: self-efficacy (β=-0.075, t(831)=-0.346, p=0.729), self-determination (β=0.038, t(832)=182, p=0.856), grade motivation (β=0.111, t(832)=848, p=0.397), general motivation (β=0.177, t(828)=1.220, p=0.095).

These results in the case of intrinsic motivation and career motivation are in contrast with other researches' results which indicated that male and female students exhibit higher levels of motivation when taught by male teachers (Varughese, 2017). More research is needed as the results of Varughese (2017) address science motivation in online environments. Moreover, the results in the present research are in contrast with the gender-invariant model which hypothesizes that academic motivation does not significantly vary as a function of teacher's gender. The present research results indicate that female teachers contribute to higher levels
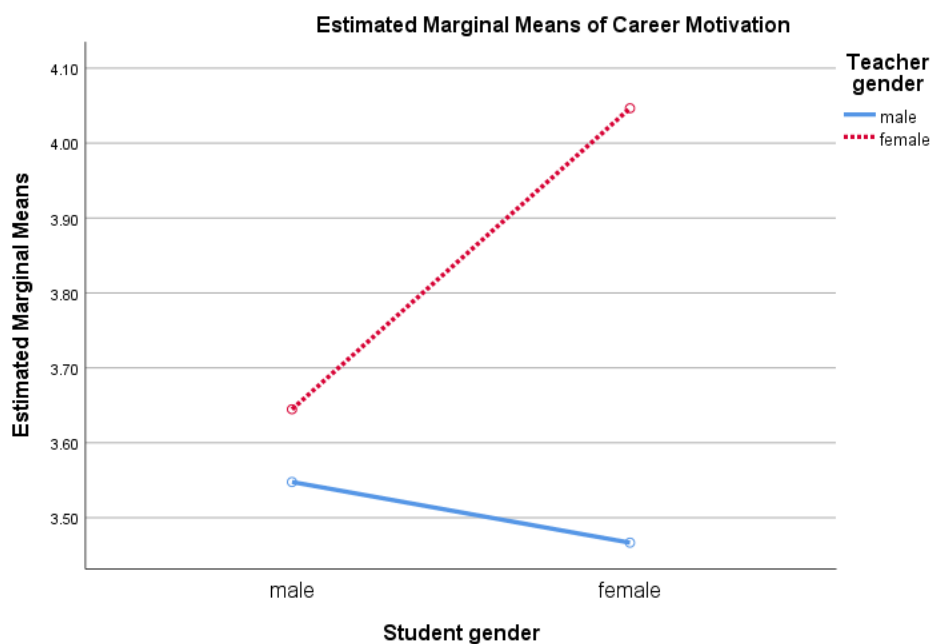
Figure 6. Teacher's gender as moderator between student's gender and her career motivation

of motivation for male as well as female students, but more for female students. In addition, the results in the case of the other three motivation components agree with gender-invariant model.

CONCLUSIONS, RECOMMENDATIONS, AND LIMITATIONS

The present research intended to study the moderation of ability, school level and teacher's gender between student's gender and science motivation. The research results indicated that each of the three variables moderated between student's gender and part of the components of science motivation. Ability moderated significantly between student's gender and each of intrinsic motivation, self-determination and general motivation, while school level moderated significantly between student's gender and each of self-efficacy and career motivation. At the same time, teacher's gender moderated significantly between student's gender and each of intrinsic motivation and career motivation. These results indicate that we need to take into consideration the three variables, as moderators between gender and student's motivation, when we come to take decisions regarding the science classroom. Taking into consideration the school level, we need to integrate different teaching methods in the science classroom, especially in the secondary school to make the learning of science in this school more appealing to the students from the five motivation aspects in which the present research is interested. These methods need to be diverse in order to fit both male and female science students, which could assist the learning of science in the secondary school for the two genders. Moreover, utilizing different teaching methods would support all

ability -level students, and thus contribute to the ability issue for both genders. These different teaching methods could be achieved through applying them in different activities, as described above, or through a sequence of activities, as those suggested by Loukomies (2013, p. i): "The results of the research reveal that a teaching sequence that combines inquiry activities, industry site visits and writing tasks contains the potential to enhance students' feeling of relevance of their science studies and promote motivation and interest in school science". Such sequences would encourage science learning by students from different abilities and in different school levels due to their variance and relevance to students' life. The previous argument reminds of Dewey's focus on experience and inquiry as means for students' learning. Wong and Pughb (2014, p. 1) argue that "Dewey proposed that the mind evolved in response to problem-solving situations and, consequently, the mind functions best in practical, problem-solving situations". Hence, focusing on science experiences in problem-solving situation would result in positive consequences (Daher, 2009). Particularly, it would motivate students to learn science, and thus lessen the negative influence of the moderation of teachers' gender between educational predictors and science motivation as an outcome variable.

Furthermore, addressing the issue teacher's gender could be done through holding workshops for teachers to discuss the gender issue in science education and how to attempt to address this issue. The workshop should focus on the experiential aspect of science learning, where learning by experience lessens the effect of teacher's gender on students' learning as experience motivates students to learn (Albrecht & Karabenick, 2018). Students' experience in learning science needs to

broaden their understanding of the role of education in their lives (ibid).

In addition to the previous argument, we considered motivation depending on the social cognitive theory. This consideration, as argued before, makes it appropriate for considering relations and moderation of relations between variables related to personal characteristics, as the student's gender, and environmental variables as grade and teacher's gender. Here lies the advantages of the theoretical framework that the present study adopted. The limitations could be in the aspects that the theoretical framework did not or had little addressed, as autonomy in self-determination theory (Ryan & Deci, 2000). Present research could address the present issue discussed in the research when it takes care of motivational factors that are not part of the present research.

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APPENDIX 1

Moderation of Ability between Student's Gender and Intrinsic Motivation

	Coefficients[a]							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	2.777	.120		23.201	.000	2.542	3.012
Gender	.187	.047	.132	4.022	.000	.096	.279
Ability	.343	.039	.290	8.804	.000	.267	.420
2 (Constant)	2.127	.323		6.595	.000	1.494	2.760
Gender	.617	.203	.436	3.034	.002	.218	1.016
Ability	.602	.125	.507	4.805	.000	.356	.847
Gender * Ability	-.169	.078	-.399	-2.170	.030	-.322	-.016

a. Dependent Variable: Intrinsic motivation

APPENDIX 2

Moderation of Ability between Student's Gender and Self Determination

	Coefficients[a]							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	2.484	.129		19.186	.000	2.230	2.739
Gender	.250	.050	.160	4.966	.000	.151	.349
Ability	.437	.042	.333	10.358	.000	.354	.520
2 (Constant)	1.384	.348		3.979	.000	.701	2.067
Gender	.977	.219	.623	4.457	.000	.547	1.407
Ability	.875	.135	.666	6.474	.000	.609	1.140
Gender * Ability	-.286	.084	-.611	-3.405	.001	-.451	-.121

a. Dependent Variable: Self determination

APPENDIX 3

Moderation of School Level between Student's Gender and Self-Efficacy

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	3.694	.104		35.638	.000	3.490	3.897
	Gender	.124	.050	.083	2.478	.013	.026	.222
	School level	-.194	.029	-.223	-6.619	.000	-.251	-.136
2	(Constant)	3.178	.226		14.040	.000	2.734	3.623
	Gender	.438	.132	.295	3.308	.001	.178	.698
	School level	.060	.103	.069	.582	.561	-.143	.263
	Gender * school level	-.155	.061	-.365	-2.560	.011	-.274	-.036

a. Dependent Variable: Self efficacy

APPENDIX 4

Moderation of School Level between Student's Gender and Career Motivation

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	3.604	.155		23.180	.000	3.299	3.909
	Gender	.342	.075	.155	4.555	.000	.195	.489
	School level	-.156	.044	-.121	-3.562	.000	-.243	-.070
2	(Constant)	2.990	.340		8.786	.000	2.322	3.658
	Gender	.716	.199	.324	3.596	.000	.325	1.106
	School level	.146	.155	.113	.939	.348	-.159	.451
	Gender * School level	-.185	.091	-.293	-2.028	.043	-.364	-.006

a. Dependent Variable: Career Motivation

APPENDIX 5

Moderation of Teacher's Gender between Student's Gender and Intrinsic Motivation

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	2.959	.141		21.057	.000	2.684	3.235
	Student gender	.206	.048	.146	4.310	.000	.112	.300
	Teacher gender	.358	.067	.182	5.380	.000	.227	.489
2	(Constant)	3.779	.392		9.642	.000	3.009	4.548
	Student gender	-.343	.250	-.243	-1.374	.170	-.834	.147
	Teacher gender	-.088	.210	-.045	-.418	.676	-.500	.324
	Student gender * Teacher gender	.297	.133	.475	2.238	.025	.037	.558

a. Dependent Variable: Intrinsic Motivation

APPENDIX 6

Moderation of Teacher's Gender between Student's Gender and Career Motivation

	Coefficients[a]						
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	2.679	.221		12.095	.000	2.244	3.114
Student gender	.327	.075	.148	4.336	.000	.179	.476
Teacher gender	.342	.105	.112	3.274	.001	.137	.547
2 (Constant)	4.014	.618		6.499	.000	2.802	5.227
Student gender	-.564	.392	-.255	-1.437	.151	-1.334	.206
Teacher gender	-.386	.331	-.126	-1.164	.245	-1.036	.265
Student gender * Teacher gender	.483	.209	.493	2.315	.021	.073	.892

a. Dependent Variable: Career Motivation

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