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Students' motivation to study science: The case of Arab students in Israel

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Abstract

The current study investigates the level of students' motivation in Arab schools in Israel to study science subjects. In addition, we examined whether there was a difference in motivation: (1) between students in different types of schools (elementary, middle, and secondary schools), (2) between boys and girls, (3) between students according to the educational achievement, and (4) between students studying with male or female teachers. The study included 838 students from the different schools. The convenience sample method was used in which 25 items assessed five motivational categories: intrinsic, career, self-determination, self-efficacy, and achievement. The findings of the study showed that the motivation level among students to study science subjects was significantly high in all Arab schools ($p \leq 0.05$), but there were significant differences between the three types of schools ($p \leq 0.05$). In addition, the study revealed that the motivation level to study science was significantly higher: (1) among girls than among boys ($p \leq 0.05$), (2) among students with a high level of achievement than among students with medium/low levels ($p \leq 0.05$), and (3) among students whose teachers are females than among students whose teachers are males ($p \leq 0.05$).

Keywords: motivation, science students, Arab schools, school type, gender

INTRODUCTION

Assessing the motivation of students to study science subjects has an important role because it can affect other educational aspects such as achievements (Bonney et al., 2005), accomplishments (Obrentz, 2011) and understanding (Daher, 2021). Motivation is influenced by the teacher and achievement and, in turn motivation of the student can directly influence teaching and achievement. It should be noted that both are of great importance to motivation of students to learn in schools. Researchers (ex., Bonney et al., 2005; Eccles et al., 1998; Ng et al., 2010) pointed out that the motivation of students to study science in schools are enhanced by

(1) self-efficacy,
(2) value in learning science,
(3) interest in studying science,
(4) attitudes towards learning science, and
(5) achievement goals.

Hammoudi and Grira (2023) described two models that explain motivation in the mathematics classroom, which could refer to those in the science classroom. In the first model, self-concept, represented by it cognitive and affective components, had the highest predictive effect on students' intrinsic motivation for success. Students' projected careers came next, followed by the number of mathematics courses finished by the student, and finally students' age. In the second model, three variables explained motivation: the need for the courses, perception of the success, and delight of the courses. Self-efficacy refers to the students' confidence in the classroom (Bandura, 1997), and affects the way students feel, think, and behave. A high level of self-confidence motivates students to persevere until the task is completed (Ng et al., 2010).

Another important motivational component is task's value. This value deals with the potential benefits of the subject and the degree of the task's usefulness, enjoyment or the person's self-image (Glynn et al., 2009).

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Contribution to the literature

- The paper addresses an issue that is basic to students' learning of science, which is their motivation to do so. It does that based on a framework that considers motivation as related to social-cognitive learning.
- The paper would add to the existent literature on students' motivation to learn science as little research has been carried out in the Arab community in Israel.
- The paper addresses differences of students' motivation to learn science due to different background variables, namely type of school, student's gender, achievement, and teacher's gender.

Personal interest refers to the attraction of the individual to a specific activity or to a specific field, and includes emotional connections (Pintrich & Schunk, 2002). Moreover, student achievement goals are possible mediators of motivation (Bonney et al., 2005), where the goals are proficiency (related to understanding), performance (related to better performance) and achievement (related to better grades). Another aspect related to the motivation to study science is attributions (Ng et al., 2010). Weiner (1979), in the attribution theory, argues that students who consider effort to determine success would work harder than those who consider ability to determine success. Another component related to motivation is active learning strategies (Tuan et al., 2005).

The above description shows the ways in which researchers in science education approached motivation. One framework for science motivation is that of Glynn et al. (2011). This framework is based on the social cognitive theory of Bandura (1997). According to Glynn et al. (2011), the social cognitive theory considers human functioning as a sequence of interactions among different personal and social factors. In the frame of these interactions, students' learning is considered effective when it is self-regulated, which happens when students understand, monitor, and control their motivation and behavior, leading to optimal learning outcomes. The previous framework originated in the science education context, and it is adopted in the present research. We chose this framework as it originated in the science education context, in addition to being used by different science education researchers (e.g., Chow & Yong, 2013).

LEVEL OF MOTIVATION AND BACKGROUND VARIABLES THAT AFFECT IT

Several studies examined students' motivation to study science, as well as how background variables, such as gender, affect students' motivation (ex., Daher et al., 2021). The same questionnaire utilized in the current study served Chow and Yong (2013) to assess the motivation and achievement of students studying science in eight government high schools. The students had a moderate level of the motivational constructs: intrinsic motivation, self-determination, and self-efficacy. At the same time, they had a high level of external motivation and anxiety. Strong correlation existed between motivation and achievement in science.

Researchers examined gender differences in science motivation. Fia et al. (2022) reported that there is science anxiety in both males and females in the field of science, and it can even occur while a lesson is being taught. Some studies have revealed that female students generally experience higher level of science anxiety than male students (Udo et al., 2004). A study that examined the differences in motivation of non-science students enrolled in core science studies (Glynn et al., 2009) showed that no significant difference exists in the overall motivation scores due to gender, but it showed small significant differences, where boys had a higher level of self-efficacy, confidence and anxiety while girls had a higher level of career motivation. No significant gender difference was found in internal motivation and personal importance.

Matvienko et al. (2022) studied whether the country of the participants influenced students' motivation to learn science. They found that Kazakhstan and Russian university students differed in science motivation levels. The authors explained this difference by students' prior experiences and the diversity in the learning settings.

Obrentz (2011) examined the motivation's influence on student performance in chemistry. The results showed that girls had a lower level of self-efficacy, personal relevance, intrinsic motivation and critical thinking but higher levels of anxiety and organizational skills. In addition, the findings demonstrated that self-efficacy predicts the performance of boys and girls. The search for help and the environment characteristics also predicted the success of girls.

Moreover, studies reported that students' ability to perform scientific activities affected their learning motivation and vice versa. Motivation improves students' ability to solve problems (Kotu & Weldeyesus, 2022). On the other hand, a positive relationship was found between the two constructs (Debacker & Nelson, 2000). Obrentz (2011) examined the effect of motivation on student performance in chemistry, finding that students with the highest levels of performance had the highest motivation level. In addition, significant differences were found between male and female students in motivation for learning science and between students of high and low achieving (Chow & Yong, 2013).

Motivation Studies in the Arab Countries

Educational researchers in the Arab countries have paid attention to students' motivation to learn in general and to learn science in particular. Google and Google Scholar searches revealed that most of the studies were related to students' motivation to learn science were about the impact of educational programs on motivation to learn science. For example, Ambusaidi and Al-Hosani (2018) studied the impact of flipped classroom teaching method on motivation towards science learning and academic achievements among ninth-grade female students. Their findings showed a significant difference between the two research groups in favor of the flipped classroom group in both motivation towards learning science and academic achievement. In addition, AlGendi et al. (2021) found that an enrichment program based on scientific stations improved students' science motivation. Little research was conduction concerning motivation in the Arab schools in Israel regarding the motivational aspect of learning, where the present research attempts to do so.

Arab Schools in Israel

The following history of the Arab education in Israel is based on Zeedan and Hogan, 2022). Education budgets in Israel are generally settled by the government and allocated to the municipalities. This way of settling budgets could result in discrimination in budgets' allocation, especially not in the favor of minorities as the Arabs in Israel. Specifically, in 1998, Ministry of Education approved Resolution No. 3292, which employed budgeting for education in accordance national priority (Adalah, 2010). Thus, the Arab schools were not prioritizing, which resulted in the budget allocation being a potential factor for inequity in the Israeli education system. Israeli Government reconsidered this policy multiple times. In 2006, an Israeli court decided that the 1998 decision allowed for illegal discrimination against Arabs. In 2009, the government approved Resolution No. 1060, which extended the national priority areas, such as 40% of the recipients were Arab citizens (Adalah, 2010). The actual implementation of the allocation started only after 2016 (Zeedan & Hogan, 2022).

Research Questions

1. What is students' motivation level to study scientific subjects in the Arab schools in Israel?
2. Are there differences in in students' motivation level to study scientific subjects between male and female students?
3. Are there differences in students' motivation level to study scientific subjects between the different schools (elementary, middle and secondary schools)?
4. Does the level of academic achievement affect students' motivation to study science subjects?
5. Does the gender of the teacher affect in students' motivation level to study scientific subjects?

Table 1. Sample distribution by gender & school

School	Gender		Total
	Boys	Girls	
Elementary	99	189	288
Middle school	123	128	251
High school	114	185	299
Total	336	502	838

Research Sample

The sampling procedure was that of multistage cluster sampling. First, we addressed the types of schools, and then gender of teacher, and afterwards the gender of students. We did that to ensure that our participants vary across background variables in which present study is interested. We targeted heterogenous classrooms in which different-achievement students studied. Research sample consisted of 838 students from different schools (elementary, middle and high schools) in the Arab schools in four districts in Israel: South, Central, Haifa, and North. A convenience sampling was followed, where the questionnaire was distributed to the most accessible schools. This method was considered most appropriate for a pioneering study in Arab schools in Israel.

Table 1 presents participating students' distribution by gender and school type. The distribution of the boys and girls, where the number of girls, in total, is approximately 1.5 of the number of boys, which could be a result of the fact that the number of female students in the Arab schools are more than the number of male students in these schools (Haj-Yahya Hadad et al., 2021).

Research Instrument

The original questionnaire was adopted from Glynn et al. (2011). It consisted of two parts; the first part requested the participant's background that included student gender, gender of teacher, student's achievement level in science, and the type of school (elementary, middle school, and high school). Here, the student's achievement is a reported one, which could be used to consider achievement in educational research (Daher et al., 2021).

The second part consisted of 25 items describing student motivation in studying science subjects in five categories, namely intrinsic motivation (learning science makes my life more meaningful), self-efficacy (I believe I can master science knowledge and skills), self-determination (I put enough effort into learning science), career motivation (learning science will help me get a good job) and achievement motivation (getting a good science grade is important to me).

Table 2. Reliability coefficients (RCs) for each of motivational variables examined by questionnaire

Motivational component	RC (Cronbach's alpha)
Intrinsic motivation	0.84
Self-efficacy	0.76
Self-determination	0.70
Career motivation	0.79
Achievement motivation	0.55
General	0.87

Table 3. Model fit indices of questionnaire

CMIN/df	GFI	AGFI	TLI	CFI	RMSEA
1.96	.98	.97	.96	.97	.02

The questionnaire was written for university students, but the formulation of its items fits school students too, which indicates that it could be used with school students. For example, Chumbley et al. (2015) used the questionnaire of Glynn et al. (2011) to study the motivation of secondary school students. In addition, it was used by Erviana et al. (2019) to study students' motivation in the elementary school.

The questionnaire was translated into Arabic and sent to academics in the field to check whether it was easily understood and its appropriateness to the target population of the study. Doing that, the academics gave their opinion whether the items of each domain were appropriate, and relevant to the respondents who would fill questionnaires. This ensured face validity (Holden, 2010).

Moreover, the initial translation was back-translated into English by an expert in Arabic and English languages to ensure the initial translation. Changes were made to the initial translation as a result of the back-translation. Moreover, we distributed the questionnaire to a pilot sample that consisted of 25 students and requested them to say what each item and their response to the item mean. Changes were made to the initial translation as a result of the students' response. This gave validity to the translated questionnaire (Tsang et al., 2017).

The coefficient of reliability (Cronbach's alpha) for each of the motivational variables was computed to test the reliability of the variable (**Table 2**).

In addition to the above, Pearson's correlation coefficient for each item with its scale and other scales was calculated to assess the convergent and discriminant validity related to the questionnaire items (Kang, 2015). The computations showed that each item was strongly correlated with its subscale (r=.72-.81), showing acceptable convergent validity. The computations also showed that each item was weakly correlated with the other subscales (r=.21-37), showing acceptable discriminant validity. In addition, computations of the model fit indices of the questionnaire showed acceptable values, as **Table 3** shows.

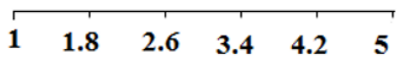

Figure 1. Motivation critical points

Table 3 shows acceptable model fit indices for the questionnaire used in present research at school level.

Data Analysis

SPSS (version 21) program was used to calculate means, standard deviations, t-tests, and F values. All items were ranked one to five, with one the lowest and five the highest. The scores 2.6 to 3.4 were considered to be normal and the good scores respectively.

The calculation of the levels of motivation was done by dividing four (four units between one and five, the lowest and highest score of each item) by five (intending to have five levels) and receiving 0.8 units. This gave us the following levels: The very low level (between one and 1.8), the low level (between 1.8 and 2.6), the normal level (between 2.6 and 3.4), the good level (between 3.4 and 4.2), and the very good level (between 4.2 and five). **Figure 1** shows the critical points of motivation. This use of grouped frequency distributions (Stockburger, 2016) was used in other studies as Daher and Saifi (2018).

In comparing means with the critical motivation points, the one-sample t-test was used. Investigating whether gender influences significantly the level of the motivational components of students, we performed independent sample t-test. Coming to investigate whether school type influences significantly the level of the motivational components of students, we computed first Levene's statistic for the motivational components. We performed ANOVA, when homogeneity of variance was fulfilled regarding a motivational component over the school type variable, while we performed the Welch and Brown-Forsythe versions of one-way ANOVA when the homogeneity of variance was not satisfied.

Table 4 shows the results of Levene's statistic. **Table 4** shows that the components 'intrinsic motivation' and 'self-efficacy' do not have homogeneity of variance over school type variable but had such homogeneity of variance over school type variable for the rest of the motivational variables. The previous results made the Brown-Forsythe test appropriate to investigate the differences between levels of the 'intrinsic motivation' and 'self-efficacy' according to school type, while ANOVA test was appropriate for rest of components.

Table 4. Levene's statistic for motivational components

	Levene's statistic	Sig.
Intrinsic motivation	9.218	.000
Self-efficacy	4.642	.010
Self determination	.931	.395
Career motivation	.250	.779
Grade motivation	.059	.943
General motivation	1.453	.234

Table 5. Mean, standard deviation, & one-sample t-tests for motivation components among science students

Motivational category	Mean	Standard deviation	n	t-good	p
Intrinsic motivation	3.95	.69	836	22.98	.000
Self-efficacy	3.50	.73	836	4.00	.000
Self-determination	4.00	.77	837	22.48	.000
Career motivation	3.83	1.09	838	11.36	.000
Achievement motivation	3.99	.69	837	24.96	.000
General	3.80	.54	833	21.29	.000

Table 6. Mean, standard deviation, & independent-sample t-tests for motivation components among male & female science students

	Student gender	n	Mean	Standard deviation	t
Intrinsic motivation	Male	336	3.815	.691	-4.825***
	Female	500	4.048	.682	
Self-efficacy	Male	336	3.422	.709	-2.613**
	Female	500	3.556	.736	
Self-determination	Male	335	3.817	.876	-5.521***
	Female	502	4.128	.660	
Career motivation	Male	336	3.627	1.131	-4.544***
	Female	502	3.977	1.030	
Grade motivation	Male	336	3.844	.716	-5.337***
	Female	501	4.096	.640	
General motivation	Male	335	3.708	.606	-6.298***
	Female	498	3.964	.532	

RESULTS

The present research utilized the theoretical framework and questionnaire developed by Glynn et al. (2011). Doing that, we answered the research questions by performing statistical exams in SPSS.

Motivation Components' Level Among Science Students

The first research question was: "What is students' motivation level to study scientific subjects in the Arab schools in Israel?"

To verify the motivation components level among science students, means and standard deviations were computed the for each component and then verified the level by performing one-sample t-test. **Table 5** presents the computations.

Table 5 shows that the level of the different components of motivation (intrinsic motivation, self-efficacy, self-determination, career motivation and achievement motivation) to learn science were 'good' among students.

Level of Motivational Components Among Different Student Gender

The second research question was: "Are there differences in in students' motivation level to study scientific subjects between male and female students?"

To examine the level of motivational components in the different genders and whether there are significant differences between them, means and standard deviations of the motivational components were computed. In addition, we performed independent sample t-test to verify the significance of the differences between the genders. **Table 6** displays computations' results. **Table 6** shows significant differences between male and female students in the level of all the motivational components in favor of the female students.

Level of Motivational Components in Different Schools

The third research question was: "Are there differences in students' motivation level to study scientific subjects between the different schools (elementary, middle and secondary schools)?"

To examine the level of motivational components in the different schools and whether there are significant differences between them, means and standard deviations of the motivational components were computed. In addition, we performed Brown-Forsythe test for intrinsic motivation, self-efficacy, and F test for the rest of the motivational components. **Table 7** show the results.

We carried out post hoc comparisons for intrinsic motivation and self-efficacy to verify the source of the significance difference due to type of school. To do that, we performed Games-Howell test as the homogeneity of variance is not satisfied. **Table 8** shows the results of the computations.

Table 8 shows that students' intrinsic motivation is significantly different between high school students and each of middle school and elementary school students. This difference is in favor of primary and middle school

Table 7. Mean, standard deviation, & F values for intrinsic motivation & self-efficacy of science students in different schools

Motivational category	Elementary school		Middle school		High school		Statistic
	Mean	SD	Mean	SD	Mean	SD	
Intrinsic motivation	4.13	0.60	4.04	0.64	3.68	0.72	33.691***
Self-efficacy	3.70	0.76	3.48	0.69	3.31	0.66	22.305***

Note. SD: Standard deviation; *p<.05; **p<.01; & ***p<.001

Table 8. Post-hoc comparisons for intrinsic motivation & self-efficacy variables over school level

Dependent variable	(I) School level	(J) School level	Mean difference (I-J)	Sig.	95% confidence interval	
					Lower bound	Upper bound
Intrinsic motivation	Primary	Middle	.09369	.200	-.0346	.2220
		High	.43125*	.000	.3007	.5618
	Middle	Primary	-.09369	.200	-.2220	.0346
		High	.33756*	.000	.1975	.4776
	High	Primary	-.43125*	.000	-.5618	-.3007
		Middle	-.33756*	.000	-.4776	-.1975
Self-efficacy	Primary	Middle	.20530*	.003	.0569	.3537
		High	.39205*	.000	.2524	.5317
	Middle	Primary	-.20530*	.003	-.3537	-.0569
		High	.18675*	.004	.0490	.3245
	High	Primary	-.39205*	.000	-.5317	-.2524
		Middle	-.18675*	.004	-.3245	-.0490

Table 9. Mean, standard deviation, & F values for self-determination, career motivation, achievement motivation, & general motivation of science students in different schools

Motivational category	Elementary school		Middle school		High school		F test
	Mean	SD	Mean	SD	Mean	SD	
Self-determination	4.16	0.78	4.07	0.72	3.77	0.73	22.08***
Career motivation	3.95	1.08	3.88	1.08	3.65	1.07	6.39**
Achievement motivation	4.03	0.68	4.10	0.67	3.85	0.68	9.49***
General	3.95	0.52	3.85	0.49	3.59	0.52	37.88***

Note. SD: Standard deviation; *p<.05; **p<.01; & ***p<.001

students. Also, students' self-efficacy is significantly different between each two types of schools in favor of elementary school in the case of the middle and high school, and in favor of the middle school in the case of the high school.

Table 9 shows the means, standard deviations, and F values for self-determination, career motivation, achievement motivation, and general motivation of science students in the different schools.

We carried out post hoc comparisons for intrinsic motivation and self-efficacy to verify the source of the significance difference due to type of school. To do that, we performed Scheffe test. **Table 10** shows the results of the computations.

Table 10 shows that the four motivational components (students' self-determination, career motivation, grade motivation, and general motivation) are similar to intrinsic motivation in that they are significantly different between high school students and each of middle school and elementary school students. This difference is in favor of primary and middle school students.

Level of Motivational Components Among Students of Different Academic Achievement

The fourth research question was: "Does the level of academic achievement affect students' motivation to study science subjects?".

To examine the level of motivational components among students of different academic achievement and whether there are significant differences between them, means and standard deviations of the motivational components were computed. In addition, we performed independent sample t-test to verify the significance of the differences between students of low/middle achievement and students of high achievement. **Table 11** displays the results of the computations.

Table 11 shows that students with higher achievement had higher motivation than students with lower and middle achievement.

Level of Motivational Components Among Students with Different Gender of Teacher

The fifth research question was: "Does the gender of the teacher affect in students' motivation level to study scientific subjects?"

Table 10. Post-hoc comparisons for intrinsic motivation & self-efficacy variables over type of school

Dependent variable	(I) School level	(J) School level	Mean difference (I-J)	Sig.	95% confidence interval	
					Lower bound	Upper bound
Self-determination	Primary	Middle	.08459	.430	-.0749	.2441
		High	.37077*	.000	.2186	.5229
	Middle	Primary	-.08459	.430	-.2441	.0749
		High	.28617*	.000	.1279	.4444
	High	Primary	-.37077*	.000	-.5229	-.2186
		Middle	-.28617*	.000	-.4444	-.1279
Career motivation	Primary	Middle	.08178	.679	-.1463	.3098
		High	.32360*	.001	.1058	.5414
	Middle	Primary	-.08178	.679	-.3098	.1463
		High	.24183*	.033	.0155	.4681
	High	Primary	-.32360*	.001	-.5414	-.1058
		Middle	-.24183*	.033	-.4681	-.0155
Grade motivation	Primary	Middle	-.07616	.429	-.2195	.0672
		High	.15950*	.017	.0227	.2963
	Middle	Primary	.07616	.429	-.0672	.2195
		High	.23566*	.000	.0934	.3779
	High	Primary	-.15950*	.017	-.2963	-.0227
		Middle	-.23566*	.000	-.3779	-.0934
General motivation	Primary	Middle	.07228	.328	-.0463	.1909
		High	.33218*	.000	.2191	.4453
	Middle	Primary	-.07228	.328	-.1909	.0463
		High	.25990*	.000	.1420	.3778
	High	Primary	-.33218*	.000	-.4453	-.2191
		Middle	-.25990*	.000	-.3778	-.1420

Note. *p<.05; **p<.01; & ***p<.001

Table 11. Mean, standard deviation, & independent sample t-tests for motivational components over achievement levels

Motivational category	Level of achievement	Mean	Standard deviation	t-value
Intrinsic motivation	Low/medium	3.74	0.73	-6.63***
	High	4.07	0.62	
Self-efficacy	Low/medium	3.12	0.59	3.72***
	High	3.74	0.69	
Self-determination	Low/medium	3.70	0.81	-8.78***
	High	4.18	0.67	
Career motivation	Low/medium	3.62	1.12	-4.55***
	High	3.96	1.04	
Achievement motivation	Low/medium	3.84	0.72	-4.95***
	High	4.08	0.64	
General	Low/medium	3.53	0.51	12.05***
	High	3.96	0.47	

Note. *p<.05; **p<.01; & ***p<.001

To examine the level of motivational components among students of different teacher's gender and whether there are significant differences between them, means and standard deviations of the motivational components were computed. In addition, we performed independent sample t-test to verify the significance of the differences between students of different teacher's gender. **Table 12** displays results of the computations.

Table 12 shows that students with female teachers had a higher level in all the motivational components than those with male teachers.

DISCUSSION

Researchers in science education have been interested in the different aspects of motivation, including its precedents and consequences (Daher, 2022a, 2022b). To answer the research questions, we utilized the cognitive motivation framework and questionnaire suggested by Glynn et al. (2011). The first research question in the current study intended to examine the level of science motivation among school students. The study results demonstrated that the level of motivation of students in Arab schools to study science subjects was 'good' in all types of schools.

Table 12. Mean, standard deviation, & independent sample t-tests for motivational components over teacher's gender (n for male teacher=714, n for male teachers=121)

	Teacher gender	n	Mean	Standard deviation	t
Intrinsic motivation	Male	121	3.622	.723	-5.776***
	Female	714	4.009	.674	
Self-efficacy	Male	121	3.260	.69252	-3.995***
	Female	714	3.544	.728	
Self determination	Male	123	3.722	.909	-3.815***
	Female	713	4.052	.732	
Career motivation	Male	123	3.508	1.233	-3.263**
	Female	714	3.893	1.048	
Grade motivation	Male	123	3.777	.796	-3.840***
	Female	713	4.031	.654	
General motivation	Male	120	3.579	.642	-5.289***
	Female	712	3.908	.551	

Note. *p<.05; **p<.01; & ***p<.001

Chumbley et al. (2015) reported that high school students recorded the highest levels in achievement motivation and in self-efficacy, and the lowest level in self-determination. In the present study, the highest levels of motivation were in intrinsic motivation, achievement motivation and self-determination. Therefore, the findings in the present study were in general agreement with Chumbley et al. (2015), except for self-determination.

One explanation for the 'good' level of all the motivational components could be that the participating students were aware of the importance of studying science subjects for their future education. This resulted in the high level of motivation in all types of schools. In addition, employment in the field of science is considered prestigious in the society and in the eyes of students and parents (Burke et al., 1985; Mann et al., 2020), and, consequently, students with support and encouragement from parents are interested in the field of science at an early age within schools. The effect of parental support on various aspects of student learning has been researched. Daniels (2008, in Lazarides et al., 2015), suggested that parents discussing learning, personal problems, future programs and careers with their children had a positive effect on seventh graders in mathematics. Moreover, Gottfried et al. (2009) found that parental involvement can enhance enjoyment, curiosity, involvement, and learning in students.

An interesting finding in the present study was that the lowest motivation for studying science subjects was recorded by high school students and the highest level by elementary school students. This finding could be due to that the teachers who teach in elementary and middle schools graduated from colleges that emphasize the pedagogical field; whereas high school teachers graduate from universities that emphasize general knowledge. The pedagogical field stresses that teaching material should be presented to students in an interesting and challenging way, which can contribute greatly to raising the level of motivation in the students. This is in line with Daher et al. (2022) who point at college training as enabling the prospective teachers to develop their didactical knowledge.

The second research question examined whether there were differences between male and female students in in students' motivation level to study scientific subjects. The study results indicated that the level of motivation to study science subjects was higher in girls than in boys, which was also reported by in some previous studies (ex., Chan & Norlizah, 2017). In addition, Glynn et al. (2009) reported that no significant differences between males and females exist in the overall motivation scores, though small significant differences were found in favor of males in self-efficacy, confidence and anxiety, while females had a higher level of career motivation. Furthermore, Glynn et al. (2009) reported no significant differences between males and females in internal motivation and personal importance.

Explaining the differences due to gender in the in the Arab society, girls in this society are interested in prestigious employment positions because they are limited in options of employment. Arab girls cannot accept many positions in Israeli society for reasons related to Arab society and culture. Therefore, girls invest more effort than boys in studies, especially in the field of science. This explanation is consistent with the conclusion of Brickhouse et al. (2000) that to study science, it is necessary for students to see that their identities are compatible with the study of science. In addition, traditional Arab society does not allow girls to be away from home after school, and, therefore, girls spend more time studying and understanding the material. This can lead to an increase in the level of motivation, including in the field of science in girls.

The third research question examined whether there were differences in students' motivation level to study scientific subjects between the different schools (elementary, middle, and secondary school). The research results indicated that students' intrinsic motivation is significantly lower among high school

students than among middle school or elementary school students. Moreover, the research results indicated that students' self-efficacy is significantly higher among elementary school students than among middle school students or high school students, and significantly higher among middle school students tan among high school students. The research results indicated that the four motivational components (students' self-determination, career motivation, grade motivation and general motivation) are similar to the trend of intrinsic motivation. The previous results indicate that students' motivation to learn science may decrease over the school years. One reason for this decrease could be due to the new interests of the students as they grow up. Growing up, the students vary their interest over the school subjects, and become interested in few subjects that they consider important for their future studies. In addition, the parental influence on the students decreases over the school years. Shinn (2002) argues that the parental involvement in their children education is most present in the childhood and decreases over the school years.

The fourth research question examined whether the level of academic achievement affects students' motivation to study science subjects. The study results indicated that students with a high level of achievement had a higher level of motivation to study science subjects than students with medium/low levels of achievement. Apparently, when students understand the material better, this can heighten their interest and thus enhance their level of motivation to study the subject. This explanation was supported by studies demonstrating a relationship between achievement and motivation (Chan & Norlizah, 2017).

The fifth research question examined whether the gender of the teacher affected students' motivation level to study scientific subjects. The study results indicated that students with female teachers were more motivated to study sciences than students with male teacher. A possible explanation for these findings is that female teachers have more patience than male teacher in explaining material, especially to adolescent students. It should be noted that education systems need to make many changes to improve the quality of learning and the attitude of the students **(**Weinstock, 2014**)**. In addition, Female teachers can communicate better with students than male teacher since they use these skills often with their children. This explanation supported the conclusions of Kirillova (2005, in Akhmetova et al., 2017), who found that the teaching style of women is characterized by dialogues and interviews. One might expect these traits would encourage students to study science.

CONCLUSIONS & RECOMMENDATIONS

Motivation can greatly contribute to the ability of teachers to promote optimal learning and development of students in schools (Johnson, 2017). In recent times, the education system has made many changes in schools to advance the learning quality and the attitude of students. The most important change that has occurred in recent years in the education systems is the implementation of "meaningful learning" (Barreiro, 2022), which requires teachers to change pedagogy in the schools. The love of learning and in-depth and meaningful learning became central goals of schools. Teachers play a decisive role in the success of the program, and therefore, it is essential to train teachers in the pedagogical field. Such training would help the teachers obtain effective methods for encouraging their students affective learning, especially encouraging their motivation to learn.

Students with a high level of achievement have a higher motivation level to study scientific subjects than students with moderate/low levels of achievement. Therefore, we recommend an increase in the number of hours studying science subjects, which can improve the level of academic achievement and, thus, the level of motivation.

The level of motivation of students to study the science subjects was higher with women than male teacher. Our recommendation is the participation of teachers, especially from high schools, in workshops and courses on pedagogical topics related to teaching processes–learning how to implement meaningful learning in schools. Improving the pedagogical field of high school teachers can greatly contribute to in-depth and meaningful learning by students in high schools. This recommendation is in line with previous studies that showed the positive impact of workshops on teachers and preservice teachers' practices (ex., Daher et al., 2020).

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REFERENCES

Adalah (2010). *On the Israel government's new decision classifying communities as national priority areas*. https://www.adalah.org/uploads/oldfiles/newsletter/eng/feb10/docs/english%20layout.pdf

Akhmetova, G., Seitova, D., & Mynbayeva, A. (2017). Gender differences in teachers' pedagogical communication styles. *European Proceedings of Social*

& Behavioral Sciences, 20, 54-63. https://doi.org/10.15405/epsbs.2017.01.02.7

AlGendi, O, AlAshkar, S., AlTahan, R., & Ibrahim, M. (2021). The effectiveness of an enrichment program by using scientific stations in developing motivation to learn science among middle school students. *The Egyptian Journal of Scientific Education, 24*(2), 36-60.

Ambusaidi, A., & Al-Hosani, H. (2018). The impact of flipped classroom approach in acquiring motivation towards science learning and academic achievements on ninth-grade female students. *An-Najah University Journal for Research: Humanities, 32*(8), 1569-1604. https://doi.org/10.35552/0247-032-008-006

Bandura, A. (1997). *Self-efficacy: The exercise of control*. Freeman.

Barreiro, A. V. S. (2022). Education 4.0 and its impact on the educational system during the pandemic and post pandemic COVID-19 in Ecuador. *Sinergias Educativas* [*Educational Synergies*], *7*(1), 110-123.

Bonney, C., Klemper, T., Zusho, A., Coppola, B. P., & Pintrich, P. R. (2005). Student learning in science classrooms: What role does motivation play? In S. Alsop (Ed.), *Beyond Cartesian dualism: Encountering affect in the teaching and learning of science* (pp. 83-97). Springer.https://doi.org/10.1007/1-4020-3808-9_7

Brickhouse, N. W., Lowery, P., & Schultz, K. (2000). What kind of girl does science? The construction of school science identities. *Journal of Research in Science Teaching, 37*, 441-458. https://doi.org/10.1002/(SICI)1098-2736(200005)37:5<441::AID-TEA4>3.0.CO;2-3

Burke, J., Bergman, J., & Asimov, I. (1985). *The impact of science on society*. NASA.

Chan, Y. L., & Norlizah, C. H. (2017). Students' motivation towards science learning and students' science achievement. *International Journal of Academic Research in Progressive Education and Development, 6*(4), 2226-6348. https://doi.org/10.6007/IJARPED/v6-i4/3716

Chow, S. J., & Yong, B. C. (2013). Secondary school students' motivation and achievement in combined science. *US-China Education Review, 3*(4), 213-228.

Chumbley, S. B., Haynes, C., & Stofer, K. A. (2015). A measure of students' motivation to learn science through agricultural STEM emphasis. *Journal of Agricultural Education, 56*(4), 107-122. https://doi.org/10.5032/jae.2015.04107

Daher, W. (2021). Middle school students' motivation in solving modelling activities with technology. *EURASIA Journal of Mathematics, Science and Technology Education, 17*(9), em1999. https://doi.org/10.29333/ejmste/11127

Daher, W. (2022a). Students' motivation to learn mathematics in the robotics environment. *Computers in the Schools, 39*(3), 230-251. https://doi.org/10.1080/07380569.2022.2071227

Daher, W. (2022b). Teachers' classroom management for motivating students' creativity. *Middle School Journal, 53*(4), 28-39. https://doi.org/10.1080/00940771.2022.2096818

Daher, W., & Saifi, A. G. (2018). Democratic practices in a constructivist science classroom. *International Journal of Science and Mathematics Education, 16*, 221-236. https://doi.org/10.1007/s10763-016-9772-4

Daher, W., Alfahel, E., & Anabousy, A. (2021). Moderating the relationship between student's gender and science motivation. *EURASIA Journal of Mathematics, Science and Technology Education, 17*(5), em1956. https://doi.org/10.29333/ejmste/10829

Daher, W., Baya'a, N., & Jaber, O. (2022). Understanding prospective teachers' task design considerations through the lens of the theory of didactical situations. *Mathematics, 10*(3), 417. https://doi.org/10.3390/math10030417

Daher, W., Baya'a, N., Jaber, O., & Awawdeh Shahbari, J. (2020). A trajectory for advancing the meta-cognitive solving of mathematics-based programming problems with Scratch. *Symmetry, 12*(10), 1627. https://doi.org/10.3390/sym12101627

Debacker, T. K., & Nelson, R. M. (2000). Motivation to learn science: Differences related to gender, class type, and ability. *The Journal of Educational Research, 93*(4), 245-254. https://doi.org/10.1080/00220670009598713

Eccles, J. S., Wigfield, A., & Schiefele, U. (1998). Motivation to succeed. In W. Damon & N. Eisenberg (Eds.), *Handbook of child psychology: Social, emotional, and personality development* (pp. 1017-1095). John Wiley & Sons, Inc.

Erviana, N., Roshayanti, F., & Priyanto, H. (2019). Science motivation analysis of elementary students. *Journal of Psychology and Instruction, 3*(2), 37-44.

Fia, S. D., Fosu-Ayarkwah, C., & Obuobi-Ayim, T. (2022). Causes, effects and management of science anxiety among senior high school students in Old Tafo Municipality of Ghana. *Open Journal of Psychology, 2*, 46-57. https://doi.org/10.31586/ojp.2022.384

Glynn, S. M., Brickman, P., Armstrong, N., & Taasoobshirazi, G. (2011). Science motivation questionnaire II: Validation with science majors and nonscience majors. *Journal of Research in Science Teaching, 48*(10), 1159-1176. https://doi.org/10.1002/tea.20442

Glynn, S. M., Taasoobshirazi, G., & Brickman, P. (2009). Science motivation questionnaire: Construct validation with nonscience majors. *Journal of*

Research in Science Teaching, 46(2), 127-146. https://doi.org/10.1002/tea.20267

Gottfried, A. E., Marcoulides, G. A., Gottfried, A. W., & Oliver, P. H. (2009). A latent curve model of parental motivational practices and developmental decline in math and science academic intrinsic motivation. *Journal of Educational Psychology, 101*(3), 729-739. https://doi.org/10.1037/a0015084

Haj-Yahya Hadad, N., Saif, A., Kasir, N., & Fargepm. B. (2021). *Education in the Arab society: Disparity and signs of change*. The Israeli Institute of Democracy.

Hammoudi, M. M., & Grira, S. (2023). Improving students' motivation in calculus courses at institutions of higher education: Evidence from graph-based visualization of two models. *EURASIA Journal of Mathematics, Science and Technology Education, 19*(1), em2209. https://doi.org/10.29333/ejmste/12771

Holden, R. R. (2010) Face validity. *The Corsini Encyclopedia of Psychology*. https://doi.org/10.1002/9780470479216.corpsy0341

Johnson, D. (2017). The role of teachers in motivating students to learn. *BU Journal of Graduate Studies in Education, 9*(1), 46-49.

Kang, Y. (2015). Validation of the Korean language version of the incontinence-quality of life scale. *International Journal of Urological Nursing, 9*(2), 78-83. https://doi.org/10.1111/ijun.12057

Kotu, A., & Weldeyesus, K. M. (2022). Instructional use of geometer's Sketchpad and students geometry learning motivation and problem-solving ability. *EURASIA Journal of Mathematics, Science and Technology Education, 18*(12), em2201. https://doi.org/10.29333/ejmste/12710

Lazarides, R., Harackiewicz, J. M., Canning, E., Pesu, L., & Viljaranta, J. (2015). The role of parents in students' motivational beliefs and values. In C. M. Rubie-Davies, J. M. Stephens, & P. Watson (Eds.), *The Routledge international handbook of social psychology of the classroom* (pp. 53-66). Routledge.

Mann, A., Denis, V., Schleicher, A., Ekhtiari, H., Forsyth, T., Liu, E., & Chambers, N. (2020). *Teenagers' career aspirations and the future of work*. OECD.

Matvienko, V. V., Almas, A., Gur, T., Nugumanova, L. N., Prokopyev, A. I., Shindryaeva, N. N., & Ibragimov, G. I. (2022). Comparison of Kazakhstan and Russian university students in learning science motivation. *EURASIA Journal of Mathematics, Science and Technology Education, 18*(11), em2173. https://doi.org/10.29333/ejmste/12497

Ng, K. T., Soon, S. T., & Fong, S. F. (2010). Development of a questionnaire to evaluate students' perceived motivation towards science learning incorporating ICT tool. *Malaysian Journal of Educational Technology, 10*(1), 39-55.

Obrentz, S. B. (2011). *Predictors of science success: The impact of motivation and learning strategies on college chemistry performance* [Unpublished doctoral dissertation]. Georgia State University.

Pintrich, P. R., & Schunk, D. H. (2002). *Motivation in education*. Prentice Hall.

Shinn, K. (2002). Luring high school parents onto our turf. *The Education Digest, 67*(3) 34-36.

Stockburger, D. W. (2016). *Introductory statistics: Concepts, models and applications*. Atomic Dog Pub.

Tsang, S., Royse, C. F., & Terkawi, A. S. (2017). Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine. *Saudi Journal of Anaesthesia, 11*(Suppl 1), S80–S89. https://doi.org/10.4103/sja.SJA_203_17

Tuan, H. L., Chin, C. C., & Shieh, S. H. (2005). The development of a questionnaire to measure students' motivation towards science learning. *International Journal of Science Education, 27*, 634-659. https://doi.org/10.1080/0950069042000323737

Udo, M. K., Ramsey, G. P., & Mallow, J. V. (2004). Science anxiety and gender in students taking general education science courses. *Journal of Science Education and Technology, 13*(4), 435-446. https://doi.org/10.1007/s10956-004-1465-z

Weiner, B. (1979). A theory of motivation for some classroom experiences. *Journal of Educational Psychology, 71*, 3-25. https://doi.org/10.1037/0022-0663.71.1.3

Weinstock, M. (2014). *The significant learning experience in learning and teaching from leading values*. Director of Society and Youth and Pedagogical Secretariat.

Zeedan, R., & Hogan, R. E. (2022). The correlation between budgets and matriculation exams: The case of Jewish and Arab schools in Israel. *Education Sciences, 12*(8), 545. https://doi.org/10.3390/educsci12080545