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The Impacts of Teacher's Efficacy and Motivation on Student's Academic Achievement in Science Education among Secondary and High School Students

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ABSTRACT

In the 21st century, we observe an increasingly aware of a series of global, technological and scientific advancement that create a need of good performance in science education at all levels of schooling. These challenges, among them rapid science and technological changes, a rise of information technology use, and continuing movement towards a knowledge-based society all highlight the need for deep education in science including biology, chemistry, environmental science, physics, and sustainability. In fact, the impact of teacher characteristics of self-efficacy level is important for science education and students' learning outcomes in science. In an effort to highlight this, this study investigated the impacts of teacher efficacy and motivation on students' academic achievement in science education in secondary and high schools located in Iran and Russia using motivation for academic performance scale ($\alpha = 0.89$) and teacher self-efficacy scale ($\alpha = 0.91$) as measuring instruments and achievement test in science education. Two hypotheses were tested using the statistical programme. For evaluating the demographical differences of the students in terms of their academic achievement, comparative analyses were performed using t-test. Results showed that gender difference was not significant but nationality difference was significant in terms of students' academic achievement in science education. Also other findings reported significant impact of teacher self-efficacy and motivation on academic achievement in science education. Implications, suggestions and recommendations for students, teachers, school administrators, parents, government, education counselors, etc. were discussed and presented.

Keywords: teacher self-efficacy, learning motivation, academic achievement, learning outcome, science education

Contribution of this paper to the literature

- This research considers teacher's efficacy and students' learning motivation on their academic achievement in science education which have been missed in earlier studies.
- The current study bolds the role of student's learning motivation in science education.
- The results of the current study provide further insights for managers of schools, teachers, policy makers, etc. in improving student's academic achievement by proposing new effective factors combining both teacher and student's motivation.

INTRODUCTION

In the contemporary nations, there has been an increasing emphasis on industrial, scientific and technological advancements because of the obvious effects of science and technology on today's world and the future. It is observed that scientific methods influence all human interaction and has a fundamental role in all countries' national growth and economic and scientific development. Thus, science education has been regarded as being central for knowledge economy and intellectual development especially in emerging societies. Due to greater importance of science and technology, schools have been encouraging students to learn science related subjects. Specific subjects that are studied within all types of sciences are biology, chemistry, physics, sustainability and environmental science. Accordingly, we suggest that scientific and technological advancement in a country can be initially achieved through the high performance of students in science education and the efforts of schools for establishing efficient science education. Besides, it is thought that one of the greatest challenges of this century is to motivate students for maintaining their learning and success in science education. However, as mentioned by the studies of Tella (2007) and Ochonogor (2011), students' performance in science classes in secondary and high school education was not found adequate and couldn't improve in the last decade. In previous researches, various background indices and a set of complex variables have been referred to impacting students' achievement in science subjects in schools at all levels. The students' performance and interest in science subjects have been related to several contextual, emotional and motivational factors, including volume of the subjects, workload, students' task orientation and personal abilities, instructional design and materials for effective teaching, teacher's efficacy and teaching skills, students' motivation and personality, class size, etc. (Abbasi et al., 2018; Ale, 1989; Armstrong, 2009; Bietenbeck, 2011; Ehrenberg, Brewer, Gamoran, & Willms, 2001; Harris & Sass, 2008; Kirillova et al., 2017; Kwon, 2016; Odogwu, 1994; Ohuche, 1978; Rus, Radu & Vanvu, 2016; Say & Bag, 2017; Shcherbakov et al., 2017; Wang & Hsieh, 2015).

In fact, science education is usually abstract and complicated, thus, teaching science may require special attention and efficacy of teachers in order to better attract students and teach the subjects through contrete and clear methods. As Ruby (2001) emphasized, teachers may use hands-on science and laboratory studies for providing students much more concrete illustrations of the science knowledge and increase their analytical skills in science. It is argued that clarifying these process skills and developing efficient teaching methods affect achievement in science education. Another concern regarding students' learning and achievement in science is enhancing students' ability to evaluate and measure the scientific knowledge through the use of individual problem solving skills and to promote them to execute scientific examinations on their own. Actually, this goal requires teachers' skills and efficacy, students' motivation for learning in science and high quality instructional approaches for interpreting scientific knowledge. Such an argument has been maintained by Bietenbeck (2011) who stated that "teachers matter" (p.1) and characteristics of the teacher establish the learning motivation of the science students. This is also the consensus from a wide range of studies which investigate the impact of teachers on students' academic performance (Rockstroh, 2013; Armstrong, 2009; Clotfelter et al., 2007; Harris & Sass, 2008; Wayne & Youngs, 2003). An empirical support comes from the study of Clotfelter, Ladd, & Vigdor (2007) in which they found significant strong positive relationship between teacher experience and efficacy and student achievement while. Rockstroh (2013) also indicated that teachers are among the predominant school-based factors in impacting student's achievement at all branches of science education.

Thus, it is suggested that knowing what teacher characteristics in terms of teaching skills of science and self-efficacy influence student achievement in science education may help school administrators and governmental officers to understand the importance of priority of hiring and assigning appropriate teachers to science classes. Based on that view, the purpose of this study is to find answers for two basic questions. The first question is whether teacher's self-efficacy as one of the teacher characteristics is related to student achievement in science education; the second is whether students' learning motivation is related to their achievement in science education. Another question of the study is whether there are differences in student achievement in science based on student gender and nationality. A review of teacher self-efficacy, student motivation, and differences in national backgrounds provides some background of the relationship among teacher self-efficacy, motivation and student achievement in

science. Based on the presupposed relationships, the literature review for the concepts of the study and previous theoretical and empirical perspectives on the issue were introduced in the following parts for elucidating the theoretical background of the study.

LITERATURE REVIEW AND DEVELOPMENT OF THE HYPOTHESES

We find requisite to describe the concepts of teacher self-efficacy, motivation for learning science, and academic achievement of students conceptually and to provide knowledge for the relevant background theories comprising the context of this study. Therefore, a brief review of each of these concepts and their interactional relations can reveal similar predictions about how the students achieve in science education in secondary and high schools. As a result of the examination on theoretical foundations, to elicit more comprehension for the individual differences and contextual factors in science-related achievement, we examined the relationship between these individual differences (learning motivation, gender and nationality) and contextual factor (teacher self-efficacy). Thus, this section will define the variables used in this study; teacher self-efficacy, motivation and academic achievement in science. Following the conceptual definitions of the variables and the suggested associations among these variables, the generated hypotheses for the aim of this study will be provided.

Learning Motivation and Science Education

In making instruction interesting in learning science, there is need to use methods, strategies, materials, equipments, laboratory and visual aids which make the learning of science, active, investigative and adventurous for the students as much as possible. Such methods also must be ones that take into account, student's differences, backgrounds, and motivational attitudes towards science as a subject. It is known that to destine a a student to reach his/her goals is the internal drive which is called as motivation. As Singh (2011) indicated, motivation creates a self determination and a feeling of enthusiasm that leads a student to realize greater meaning and objectives in personal and academic processes. In fact, the issue of learning and achievement motivation is still a relevant topic in psychology and educational research. As implied by Poledňová, Stranska and Niedobová (2014), social-psychological approach considers a person's interactions in social relationships and denotes how these relationships enable the person's achievement orientation.

As known from the motivation literature, the drive may be internal or external and the factors that motivate a student may change depending on the change in age and social development. Motivation is generally described as internal condition that stimulates, directs and sustains human behavior. Besides, as Maslow (1955) indicated, the goal that has been achieved sets the situation for achieving another goal. Further, both content and process theories of motivation mainly focus on the factors that direct human behavior and they are essential for the evolvement and achievement of personal goals. Maslow's (1955) hierarchy of needs, Alderfer's ERG theory, McClelland's (1995) learned needs theory, and Herzeberg's motivator-hygiene theory are among the content theories. Thus, motivation is a constant need that leads a student to act towards a goal since motivation enables a behavior to be energized towards a goal. There is permanent literature that demonstrates a strong association between student motivation and learning. As Mazumder (2014) addressed, the motivation level is important to effectuate in challenging conditions, stay focused on goals and to accomplish difficult tasks. It is obvious that for each student the type of driving force is different, and usually it is not only one factor, but a combination of factors that lead students to achieve their goals. Even though, to succeed in science education, a student must have a higher level of motivation towards learning and developing skills to achieve performance in science.

There are several approaches to the subject of achievement and learning motivation. Spence and Helmreich (1983) defined achievements as task-oriented behavior. The pioneering definition of achievement motivation is from Atkinson (1964) and he defined it as the comparison of one's performance with other's performance in certain activities. Bigge and Hunt (1980) described achievement motivation as the drive to work with vigor, to focus on goals, to come over challenging tasks and finally to develop learning and achievement. Another considerable perspective in student motivation research is goal orientation theory. According to the assertion of achievement goal orientation theory (Elliot and McGregor, 2001), when students hold academic tasks, they set various personal goals and the types of their goals directly impact their academic achievement. In their research, Noar, Anderman, Zimmerman and Cupp (2005) demonstrated that the students who had mastery goals engaged in more effective cognitive processing strategies. Another research reported that achievement motivation and self concept were significantly associated with academic achievement of students in mathematics (Awan, Noureen, & Naz, 2011). Further, it is assumed that the assessment of implicit motives of students might help to evaluate the appropriateness of students' long-term goals and their academic achievement in science education. Supporting this assumption, Ward (1997) argued that individuals with high achievement motivation are focused on achievement goals and are generally proactive. According to Zenzen (2002), the students are effected by a need to achieve to a certain level and the students having a high desire of success, work harder to succeed (p.10). Steinmayr and Spinath (2009)

performed a research and reported the significant relation between need for achievement and student performance. Besides, Murray's (1938) famous theory of "manifest needs" postulated the need for achievement as a fundamental one in his taxonomy of needs. In such, according to the above literature, it is senn that achievement motivation is a subjective and internal psychological state which enables students to value their school tasks, to focus on their targets, and to carry out the challenging requirements of science classes. Based on the quoted research review, the achievement motivation has essential role in predicting achievement or failure of students in science education. Thereby, achievement motivation for science education seems to be a very important issue owing to today's society's focus on development and success.

Instantly, it is assumed that academic achievement of the student in science is not solely influenced by the achievement motivation but is shaped by other factors such as teacher's self-efficacy. Since it has been addressed that the students are impacted by achievement motivation, they may also be infleunced by the motivation of their teachers. Through efficient training method, the teacher can motivate and lead students to concentrate on the accomplishment of the science related tasks. It is suggested that teachers are able to increase the perceived value of the science classes and may guide the students to gain effective learning outcomes. Thereby, the impact of teacher characteristics of self-efficacy is important for education and learning of students. Along with this view, Wayne and Youngs (2003) told that a large body of literature about teacher self-efficacy and education outcomes exists. Ensuring that teachers with high self-efficacy are most able to enhance student achievement, the following part will provide insights for understanding the relation of teacher self-efficacy with student achievement.

Teacher's Self Efficacy and Student Academic Achievement

Derived from Bandura's (1997) socio-cognitive model, self-efficacy is defined as one's belief about his/her ability and capacity to do a task or cope with environmental demands. In the work context, self-efficacy is measured as a person's self-evaluation of his/her ability to come over the demands of work conditions (Bandura, 1997). Based on the perspective of social cognitive theory, human agency is mediated by an individual's level of self-efficacy and such a belief impacts the person's emotional state, choices, efforts and resilience when the person faces any challenging situation (Pajares, 1996). The self-efficacy literature indicated that self-efficacy belief also has an important role in psychological and physical health outcomes. For instance, people with high self-efficacy reported lower levels of perceived work stress and strain, and reported les physiologic stress response (O'Leary, 1992). Within the occupational literature, it was stated that low self-efficacy had significant relation with high levels of stress, anxiety and depression (Ghaderi & Salehi, 2011; DeWitz, Woolsey, & Walsh, 2009; Jex & Dudanowski, 1992; Ehrenberg, Cox, & Koopman, 1991). Moreover, high self-efficacy influenced job satisfaction and well-being positively but had negative influence on turnover rates (Nielsen, Yarker, Randall, & Munir, 2009; Stetz, Stetz & Bliese, 2006; Zellars, Hochwarter, Perrewe, Miles, & Kiewitz, 2001). A research performed by Caroli and Sagone (2014) has revealed that there was a positive association between perceived generalized self-efficacy and psychological well-being.

The studies examining self-efficacy beliefs in educational settings have demonstrated that people with high self-efficacy are more likely to undertake a proactive approach when faced with stressful situations and perform more role responsibilities than the people with low self-efficacy (Le, Casillas, Robbins, & Langley, 2005; Chemers, Hu, & Garcia, 2001; Pajares & Valiante, 1999). Educationally, self-efficacy belief was investigated in the context of academic performance and self-regulated learning (Henson, 2001; Pajares, 1996; Zimmerman, 1995; Hackett, 1995). The literature confirms the association between students' self-efficacy beliefs for academic works and their academic achievement. The researchers have explored the academic self-efficacy beliefs' role in school success of the students. For example, the study of Gore (2006) found that self-efficacy beliefs moderated the relationship between academic self-efficacy beliefs of the students and their school success.

Consistent with the general conceptual definition of self-efficacy, teacher self-efficacy has been defined as a teacher's evaluation of his/her capabilities to enable desired outcomes of student engagement learning and performance (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Based on the implications of social cognitive theory, teachers' self-efficacy beliefs have been related with effective teaching behaviors and performance levels of students. Bandura's (1997) research studies concluded that a teacher's belief about his/her competency and potential to teach students had significant impact on the achievement of the students. We also suggest that the teacher's self beliefs including self-efficacy have crucial roles in the classroom environment and the effectiveness of student learning. On the other side, we argue that self-efficacy of the teachers will not only impact students but the entire school organizational system. Supporting this argument, Ball (2010) identified that teachers' self-efficacy create collective efficacy, which influence the whole school system. Further, as claimed by Porter and Brophy (1988), the teacher having high self-efficacy would be more efficient in providing a climate for learning. It was also noted that the teacher has important roles in managing the classroom, in enhancing the students to find the tasks more meaningful and in implementing effective learning strategies (Cardenas & Cerado, 2016). Ultimately, teachers with high self-efficacy tend to use more interactive teaching methods and utilize contemporary instructional methods.

Researchers agreed in suggesting that the core element of pedagogy is the amount and intensity of student engagement in classroom activities and in learning tasks (Cardenas & Cerado, 2016; Rink, 2013; Rivkin, Hanushek & Kain, 2005; Gusthart & Springings, 1989). Further, it was stated that teachers' self-efficacy impacted student achievement positively, enabled the teachers to perform better planning and organization facilities (Gowrie & Ramdass, 2014). Based on Rotter's (1966) locus of control theory, it was argued that student learning and motivation were the outcomes of teacher's self-evaluations. Students of efficacious teachers generally have outperformed students in other classes; Teacher self-efficacy was predictive of achievement on the Iowa Test of Basic Skills (Moore & Esselman, 1992), the Canadian Achievement Tests (Anderson, Greene, & Loewen, 1988), and the Ontario Assessment Instrument Pool (Ross, 1992). Teacher self-efficacy was also related to students' own sense of efficacy (Anderson et al., 1988) and student motivation (Midgley, Feldlaufer, & Eccles, 1989). Furthermore, teacher self-efficacy was found to be associated to positive teaching behaviors and strong student achievement since teachers having high self-efficacy used open-ended questions, interactive learning, inquiry methods, and group learning activities in the classroom (Gavora, 2010). More specifically, it is stated that such teachers are more resiliant and had tendency to take risks and to use newly adoptted methods, and are more innovative in teaching science, mathematics and technology (Schunk & Pajares, 2001; Ross, 1992; Midgley et al., 1989). Other researchers also indicated that teachers with high self-efficacy are more open to adopt new opinions and innovative techniques, support students' initiation and autonomy, and to improve the interest of the students towards science (Brouwers & Tomic, 2003; Ross & Bruce, 2007). As Gavora (2010) stated, teacher self-efficacy can be seen as a strong self-regulatory characteristic that enables teachers to use their potentials to enhance students' learning. Further, previous research has found that teacher self-efficacy had impact on the students' motivation and achievement (Mojavezi & Tamiz, 2012; Stipek, Givvin, Salmon, & MacGyvers, 1998; Wentzel, 1998). Alvares-Nunez (2012) confirmed that teacher self-efficacy was the predictor of primary school students' achievement in mathematics. Accordingly, it is suggested that teacher self-efficacy is an important characteristic of the teacher that is strongly related to success in teaching challenging academic tasks such as science education.

THE PURPOSE AND HYPOTHESES OF THE STUDY

This study sought to explain achievement outcomes of secondary level and high school students in science education in terms of teachers' self-efficacy and motivating students towards academic gains in the subject. Based on the review of literature, the following hypothesized relationships including the study variables are suggested.

H1: Teacher's self-efficacy has a positive impact on students' academic achievement in science education.

H2: Motivation for learning science has a positive impact on students' academic achievement in science education.

Further, in this study, we tested two null hypotheses with the significance level at 0.05 margin of error. They are as follows:

H01: There is no significant difference in the academic achievement of male and female students in science education.

H02: There is no significant difference in the academic achievement of students in science education in terms of their national background.

METHODOLOGY

Design and Procedure

The study used a cross-sectional questionnaire survey design. The participants of this study include two groups: the first group consisted of senior secondary and high school teachers in four different cities of Iran and four different cities of Russia. The second group of participants includes students in the same schools of the teachers. The students actually belonged to the science classes (biology, chemistry, physics, environmental science, and sustainability) whose teachers participated in this study. The students were asked questions about their learning motivation and achievement in science classes. Questionnaire research in

Iran and Russia requires approval by ethic committees and thus the study was approved for following the regulations for data confidentiality. In addition, we informed the participant groups about the purpose and procedure of the research study before they completed the questionnaire, so that voluntary participation has been secured. At last, the participants gave in the completed questionnaires to the researchers directly.

Sampling Procedure and Sample

In the survey, 440 secondary school and 350 high school students drawn from 15 schools in two countries of Iran and Russia. Some of the participants gave multiple responses to single items, thus we accepted them as unanswered, and excluded them for eliminating the threats for further analysis. As a result, as counted for the usable questionnaires, totally 790 students participated in the study. This sample of students was randomly drawn from selected schools. Their age ranged from 12-20 years with a mean of 15.5 years and standard deviation (SD) of 3.6. The study included male (64.8%; SD=10.93) and female students (35.2%; SD=12.88). Besides, totally 350 teachers educating in science classes participated including male (56%) and female (44%) teachers. The mean age of the teachers was 35.93 (SD= 5.65) and their average years of experience was 12.16.

Instrumentation

In this study, for measuring teacher's self-efficacy belief, "Teacher Self-Efficacy Questionnaire" developed by Tschannen-Moran and Hoy (2001) was utilized. The questionnaire, includes 24 items which were assessing the teacher's belief about his/her effective control over Instructional Strategies (8 items), Classroom Management (8 items), and Student Engagement (8 items). In the original study, the three component scale used a 5-point Likert scale (ranging from 1 (Nothing) to 5 (A great deal)), to rank the teachers' level of self-efficacy. Tschannen-Moran and Hoy (2001) conducted first and second order factor analysis and confirmed the reliability and validity of the scale. The reliability coefficient (Cronbach Alpha) of the instrument was found to be 0.90. The Cronbach Alpha reliability value was yielded as 0.86 for instructional strategies, 0.86 for classroom management, and 0.81 for student engagement. Previously, the instrument was used by Mojavezi and Tamiz (2012) in their research investigating the relation of teacher self-efficacy with student motivation and achievement. Using Cronbach alpha, the reliability coefficient of the scale was 0.76. Thus, this instrument has been utilized in this study due to the reasonable acceptable index of reliability coefficient. The items were translated from English into Persian and Russian languages, and checked for their meaningfulness by the researchers. Initially, the questionnaire was taken to a pilot study in order to secure the researchers about the appropriate procedure and timing. Besides, piloy study helped the researchers to evade ambiguity and to observe other potential problems in the final study. An example of an item of "efficacy for instructional strategies" is "To what extend can you provide an alternative explanation or example when students are confused?" and an example of an item is "How much can you do to control disruptive behavior in the classroom?" from "efficacy for classroom management" component. An example item for "efficacy for student engagement" is "How much can you do to motivate students who show low interest in schoolwork?" Responses categories were evaluated with 5-point Likert scale following the original study of Tschannen-Moran and Hoy (2001). For the analyses the scale was reversed such that a high value represents a high level of self-efficacy.

Moreover, for obtaining data about the students' perceived learning motivation, a modified instrument namely "Student Learning Motivation for Science Questionnaire" (SLMSQ) was adopted. Items in the instrument were adapted from the study of Tuan, Chin and Shieh (2005). The original scale is composed of 35 items measuring six dimensions of "perceived self-efficacy, value for science learning, active learning strategies, achievement goal, performance goal, and learning environment stimulation". However, in this study due to the aim and scope the research, learning environment stimulation dimension was not included; thus, five dimensions consisting 29 items were utilized.

"Students' Achievement in Combined Science Education" (biology, chemistry, environmental science, physics, and sustainability classes) was evaluated by the average grades of the students obtained in the examinations in 2016-2018. The marks obtained range from 10% to 100% with a mean of 74%. In terms of gender, it was seen that the mean score of girls' was 76.89% (SD=.11) and boys' score was 81.36% (SD =.86). The grades were turned into interval scale as evaluated from 1 (1-29) to 5 (85-100) by the inclusion of combined science classes.

DATA ANALYSIS AND RESULTS

In this study, the collected data were analyzed through inferential statistics, in which correlation analysis, regression analysis and t-test analysis were performed. Specifically, the statistical analysis revealed findings for the inquiry of the first two research hypotheses. Additionally, in this study, we tested two null hypotheses with the significance level at 0.05 margin of error. The findings of the study are displayed in tables and interpretations of the findings are discussed below.

Initially, for evaluating the data in order to observe the relations among the study variables, a Pearson product-moment correlation coefficient was computed. Thus, it was aimed to identify the direction and the strength of linear relationship between the teacher self-efficacy, student learning motivation and academic achievement. Cohen 's (1988) implications were referred for interpretating the strength of the relationships among the variables. Based on the reliability analysis, all scales revealed acceptable internal consistency of Cronbach's alphas between 0.86-0.93

Table 1. Reliability values of the variables

Variables	Number of items	α
Total teacher self-efficacy scale	**24**	**0.91**
Instructional strategies	8	0.93
Classroom management	8	0.88
Student engagement	8	0.91
Total student learning motivation	**29**	**0.89**
Self-efficacy	7	0.93
Active learning strategies	8	0.88
Science learning value	5	0.91
Performance goal	4	0.86
Achievement goal	5	0.89
Total academic achievement	**5**	**0.86**

Table 2. Means, standard deviations, and correlations among study variables

Variables	M	SD	1	2	3	4	5	6
1. Total teacher selfeff.	4.08	.58	1	.325**	.311**	.336**	.465*	**.523***
2. Instructional str.	3.51	.53	.325*	1	.303**	.297**	.405**	.501**
3. Classroom mng.	3.81	.71	.311	.303**	1	.112**	.388**	.409**
4. Student engag.	3.95	.49	.336*	.297**	.112**	1	.225**	.344**
5. Total lear. motivation	3.85	.45	.465*	.328**	.156**	.204**	1	**.393****
6. Total acad. achivem.	3.89	.51	.523*	.503**	.406**	.341**	.393**	1

Pearson Correlation *Correlation is significant at the 0.05 level (2-tailed)./**. Correlation is significant at the 0.01 level (2-tailed).

Table 3. Model summary of regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
Acad. achievement	.677	.591	.622	.47332

Predictors: (Constant), Instructional strategies, Classroom management, Student engagement

Table 4. Regression analysis of student learning motivation

Model		Sum of Squares	df	Mean Square	F	Sig.
Acad. achievement	Regression	74.621	240	4.995	44.226	.001 (a)
	Residual	47.205	550	.232		
	Total	121.826	790			

a. Predictors: (Constant), Instructional strategies, Classroom management, Student engagement
b. Dependent Variable 1: Student academic achievement

(**Table 1**). **Table 2** presents descriptive statistics (means and standard deviations), and intercorrelations among teacher self-efficacy, learning motivation and academic achievement.

According to **Table 2**, there is a moderate significant, positive and linear relationship between teacher self-efficacy and students' academic achievement (r=.523, p<0.05). **Table 1** also reveals that there is a moderate, significant, and positive relation of each dimensions of teacher self-efficacy with both students' academic achievement. Instructional strategies dimension of teacher self-efficacy showed the highest correlation when analyzed with academic achievement [academic achievement (r=0.501, p<0.01)]. The correlations show that either form of teacher self-efficacy are likely to increase students' academic achievement of science classes.

Test of Hypotheses: The Impacts of Teacher Self-Efficacy and Learning Motivation on Academic Achievement

Multiple regression analysis was conducted in orer to test the main hypotheses of the study. The resuşts reported that there were significant positive impacts of perceived teacher self-efficacy and learning motivation of students on academic achievement. Additionally, each dimensions of teacher self-efficacy had significant positive impacts on academic achievement. **Table 3** presents the ANOVA results on the overall model and the findings show significance for teacher self-efficacy (F= 41.534, p<0.05) and learning motivation (F= 44.226, p<0.05) (**Table 4** and **Table 5**).

Table 5. Summary results of coefficients of regression analysis

Dependent Variable: Student academic achievement			
Independent Variables	**Beta**	**t Value**	**P Value**
Constant		1.726	0.020
Instructional strategies	0.543	3.715	0.000
Classroom management	0.515	2.191	0.000
Student engagement	0.365	4.246	0.000
R=0.691; R²=0.614; F Value=41.534; p<0.05			
Dependent Variable: Student academic achievement			
Independent Variable	**Beta**	**t Value**	**P Value**
Constant		1.678	0.020
Learning motivation	0.509	3.555	0.000
R=0.677; R²=0.591; F Value=44.226; p<0.05			

Table 6. T-test results of students' academic achievement according to gender and national background

		N	**Mean**	**Std. Deviation**	**Std.Error Mean**	**t**	**p**
Academic achievement	Female	343	3.6	16.11	.05622	-1.35	0.02*
	Male	447	4.07	16.86	.04725		
Academic achievement	Iran	475	3.77		.04116	2.952	.0.04*
	Russia	315	4.11		.06241		

*p< 0.05, **p< 0.01

The overall R² is .614 suggesting that instructional strategies, classroom management, student engagement dimension of teacher self-efficacy combine to explain approximately 61% of the variance in academic achievement of science among students. Besides, 59% (R²=.591) of the variance in academic achievement of students was explained by learning motivation for science. These figures may seem high and explains how the variance of teacher self-efficacy and learning motivation in academic achievement measured on students can be very important. Hypothesis 1 stated that teacher's self-efficacy has a positive impact on students' academic achievement in science education. The results showed that teacher self-efficacy statistically significantly impacts student's learning motivation in science ($\beta = 0.474$, t = 3.726, p <0.05) suggesting hypothesis 1 is supported. Hypothesis 2 stated that students' motivation for learning science has a positive impact on students' academic achievement in science education and this construct also showed statistical significance ($\beta = 0.509$, t = 3.555, p < 0.05) supporting Hypothesis 2. In addition, according to the beta coefficients and p-values, each of the dimensions of teacher self-efficacy contributed to academic achievement significantly (Instructional strategies: $\beta = 0.543$, t = 3.715, p < 0.05; Classroom management: $\beta = 0.515$, t = 2.191, p < 0.05; Student engagement: $\beta = 0.365$, t = 4.246, p < 0.05).

Furthermore, H01 proposed that there is no significant difference in the academic achievement of male and female students in science education and H02 proposed that there is no significant difference in the academic achievement of students in science education in terms of their national background. The results of the above hypotheses (H01 and H02) are presented in **Table 6**.

To test whether academic achievement significantly differentiates based on gender and national background, t-test analysis was conducted. As shown in **Table 6**, there is no significant gender difference in achievement in science classes between the two groups (t-value = -1.35, p = 0.02). However, as shown in **Table 6**, the level academic achievement is different for Iranian students and Russian students. Russian students have higher achievement level (t=2.952 ($\mu_{Iranian}$=3.77; $\mu_{Russian}$=4.11)) when compared to Iranian students. Based on the reported results, H01 is accepted and H02 is rejected.

DISCUSSION, SUGGESTION AND CONCLUSSION

In the 21st century, due to the societal needs and demands, there has been an increasing importance of science and technology advancements, which lead to the realization of science learning. This study has been constituted on the endorsement of the importance of science and technology for the national growth and economic development as well as the societal development of the societies within a continuous globalizing world. The literature also specified the relevance of science education and science learning in individual and societal outcomes by emphasizing that science learning at schools reshape the mental abilities of students towards academic performance and the improvement of the desired competencies, such as cognitive and scientific skills (Llbao et al., 2016; Kola, 2013; Bautista, 2012; Lavigne, Vallerand, & Miquelon, 2007). Fundementally, the strength of the societies and improvement in science and technology are suggested to be dependent on the young generation's attributes and commitment to scientific learning. Specifically, the crucial role of school education for science learning should be taken to account, including the interference of teachers, school management, students' achievement goals, etc. As

such, in this study, we highlighted the relevance of teachers' self-efficacy and students' lerning motivation for science on students' achievement in science branches at secondary and high school organizations. In the literature, it has been indicated that teachers' self-efficacy help to increase the quality of science education, to develop critical and creative thinking of the students, to encourage the students to understand and participate in science classes. Hence, academic performance of the students in science can be accepted as a result of both teachers' self-efficacy and encouragement and the students' learning motivation. A number of studies also argued the roles of teachers' self efficacy and students' interest and learning motivation in their accomplishment of science related tasks and academic pursuits (e.g., Llbao et al., 2016; Barmby, Kind, & Jones, 2008; Jegede, 2007; Osborne & Collins, 2001). Therefore, science learning is to engage students in a meaningful learning condition that constantly make them wander in a sustained implementations and practice (Osborne & Collins, 2001), and all these are influenced by the attitudes of classroom teachers and student's own learning motivation. Science education, in this sense, is suggested to be relevant with the societal impact of science; students' motivation and interests towards science learning; and the teachers' self-efficacy who are teaching science classes. In the studies of Holbrook, Rannikmae, Yager, and DeVreese (2003) and Llbao et al. (2016), the role of sociatal background and students' learning motivation on the academic achievement in science among students have been addressed. Further, several research indicated the influence of teacher self-efficacy on academic achievement in science. Ronfeldt, Loeb and Wyckoff (2011) addressed the negative impact of teachers' low self-efficacy on student achievement. A recent study (Huber, Fruth, Avila-John, & López-Ramírez, 2016) examined the relationship between teacher's self-efficacy and student performance through a reciprocal relationship perspective and confirmed that teachers' self-efficacy had positive impacts on positive student outcomes. As provided in the literature part of the study, the previous conceptual knowledge and empirical evidences have shed light on the suggestions of this study. However, as part of the exemption of this study, first, both teacher self-efficacy and learning motivation were examined as the predictors of academic achievement in science among students in secondary/high schools in Iran and Russia, second, comparative analysis were performed in order to observe the societal impact on academic achievement in science education. Besides, the outcome of academic achievement in science also evaluated in terms of gender difference for both societies.

The findings of this study showed that there is a statistically significant relationship between teacher self-efficacy and student academic achievement in science. The result of the first hypothesis, which proposed the impact of teacher self-efficacy on academic achievement of secondary and high school students in science was found to be significant. A moderate significant, positive relationship between teacher self-efficacy and students' academic achievement (r=.523, p<0.05) was found and further, it was revealed that each dimensions of teacher self-efficacy (instructional strategies, classroom management and student engagement) were significantly and positively related to students' academic achievement. Since the positive correlations between teacher self-efficacy and student achievement have been demonstrated by a number of studies in the extant literature, the current findings are consistent with the previous studies (Bietenbeck, 2011; Cardenas & Cerado, 2016; Gavora, 2010; Henson, 2001; Mojavezi & Tamiz, 2012; Porter & Brophy, 2008; Rink, 2013; Rivkin et al., 2005; Wayne & Youngs, 2003). Thereby, it is confirmed that either form of teacher self-efficacy increase students' academic achievement of science classes. On the other side, the findings of this study determined that learning motivation of students in science as measured with their perceptions of self-efficacy regarding science classes, active learning strategies, value given to science learning, performance goals and achievement goals had significant impact on academic achievement in school science. Along with the suggestions of Poledňová et al. (2014) and the implications of social-psychological perspective, the interactions of one's social relationships, self-evaluations and motivation reveals how his/her achievement orientation is shaped. Moreover, since motivation refers to reasons that underlie behavior that is characterized by the students' interests, willingness, and volition (Beal & Stevens, 2011), the impact of motivation in science learning is accrued to be the factor that adds to their achievements in school science. Thus, the finding of this study is also consistent with the background theories and other studies that addressed the influence of learning motivation of science classes on students' academic achievement in science (Tella, 2007; Bullock & Muschamp, 2006; Tuan et. al., 2005; Reynolds & Walberg, 1992; Napier & Riley, 1985; Uguroglu & Walberg, 1979).

Moreover, comparative analysis has been done for observing whether there is a difference in the academic achievement of the students in terms of the gender and national background factors. The findings showed that academic achievement in science levels of secondary and high school students did not differ with respect to gender. This finding is in disagreement with Tella's (2007) findings that Nigerian secondary school students of males and females rated differently in academic achievement. The variation in the present result on this study is connected with the issue of societal environment as also addressed by Llbao et al. (2016). Besides, the result of the hypothesis regarding national background showed that secondary/high school students differed significantly in their academic achievement based on the society they live in. While the present study was conducted in Iran and Russia; previous studies were conducted mostly in Asian or European countries, thus, this finding may contribute to the literature by providing knowledge about cultural factors. The results revealed that Russian students were high in academic achievement in science when compared to Iranian students. Indeed, societal factors may have roles in learning motivation and achievement in science, but further studies should be performed in order to obtain more

accurate results regarding societal effects. Furthermore, one thing that should be clear is the fact that achievement in science subject or academic generally depends on many motivating factors. The issue of gender or national background are only part of it likewise teacher support, school climate, parental involvement/support and or peer influence. All these should not be underrated because they are factors that can impact student achievement in science positively or negatively.

Consequently, when the teacher self-efficacy is high among teachers in science classrooms, the students display good attitude, better motivation and achievement in science. It is concluded that good impartation of science knowledge on the part of the teacher self-efficacy; along with student's interest and motivation in the subject and the display of positive attitude as earlier pointed out, are influential factorswhich when combine together are suggested to lead to better academic achievement in science education in secondary and high schools. We posit that the findings of this study will provide the basis for future research on this topic of growing scholarly and practical importance.

As for limitations of the study, there are some constraints of the study regarding the sample size and the focus area of the research. The research has been conducted in Iranian and Russian contexts with the participation of 790 students and 350 teachers drawn from 15 schools in two countries. It is suggested that future studies investigating the relevant topic should be performed within a larger sample groups and various schools including public and private educational institutions with all levels in order to better generalize the findings.

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