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Uncovering Students' Motivation for Learning Science: Gender Differences in Mumbai

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Abstract

Purpose: Scientific temperament is very important for societal growth, rational thinking and innovations. For achieving sustainable development and equality in society, it is important that women are equally motivated to pursue science and contribute to the nation's growth. Women representation in the field of science has been very minimal in India. This paper attempts to explore the differences in some motivational components among gender, in students pursuing science courses at various levels in Mumbai, India.

Design: This study is non-experimental, cross-sectional and quantitative in nature. Cluster sampling technique was followed. A survey method was used to obtain responses and a questionnaire was used as a survey instrument. 200 questionnaires were distributed of which 160 were returned yielding 80% response rate. Construct validity and reliability were established for the questionnaire and an independent-samples-t-test was used to analyse the data.

Findings: There is a significant difference in intrinsic motivation and grade motivation components among gender, though effect sizes were small.

Research Limitations: Geographical constraints can limit the generalizability of the result. Being a cross-sectional study it can lose the holistic context of the situation.

Value: The study is an important contribution to the scarce research work that is done in the field of understanding motivation towards science in the Indian context. The results of the study can also help the business community, educational institutions and teachers plan interventions to encourage more girls into taking up science.

Keywords: Construct validity, Extrinsic motivation, Gender, Intrinsic motivation, Motivation, Science Students

Introduction

The progress and growth of a nation depend on the emphasis placed on science and technology. The future generation of any country has to seriously take up science courses for ensuring a better understanding of the world and also to ensure that innovations and discoveries help in building the competitive advantage of a country over others. A strong background of science can help a nation grow socially and economically and thus many countries are giving impetus to science at the school levels (Chow & Yong, 2013).The governments of many countries are coming up with policies to encourage students to participate in the field of healthcare, engineering, pure science, medicine, and other science-based courses (Saleh, 2014). Science gives a feeling of well-being and reflects the success stories of millions of researchers working globally. These end products of research are manifestations of the emotions of frustrations, joy, delirium, creativity and

engrossment. Science has its own charm and enables an individual to look at the world differently and rationally. This charm should be a part and parcel of every student's education world (Chalmers, 1999). India with such an old civilization has been a huge contributor to the world as far as scientific and mathematical research is concerned. India has a steady growth rate and is expected to become the world's most populated nations. A country is recognized as a superpower when it acquires the status of a scientific superpower. This happens only when the younger generation is motivated to study science. According to a report on gender equality in the knowledge society, women representation in science and technology jobs has been the lowest for India although India ranks high on female enrolment in science and engineering courses ("Study," 2013). Indian society has its own social norms and certain underlying rules for women and their roles in society that causes hurdles for women pursuing science both as an educational aim or a career ("Gender,", 2008; Kumar, 2016; Masoodi, 2016). The enrolment of women in education in India is largely decided by the patriarchal system of society that stereotypes women and expects them to abide by the same negative thought process (that women are typically home keepers meant to rear children and stay at home taking care of families), that cuts across a huge cross section of the country (Kumar, 2009). Countries like India, UK, France and the USA have shown a steady slump in women representation in Physics (Kurup, Maithreyi, Kantharaju, & Godbole, 2010). Since science is very important for societal growth, it is important that women also are equally motivated to pursue science and contribute to the nation's growth. The study is an attempt to make an important contribution to the scarce research work that is done in the field of motivation to learn science among students in India. The results of this study also become important in view of the limitations that stereotyping imposes on women in India. Involvement of women in science is important for not only gender equality issues but, also for a sustainable growth of society. The younger generation has to be attracted towards science because they will be the ones who will anchor technology for business, taking into consideration the needs of the common man. The results can help the business community as well as the education sector in devising strategies and interventions and making science more interesting and exciting so that more students opt for this out of innate love rather than fear of the subject. The results can also help the government come up with policies to encourage sections of society with various schemes, concessions, and rewards for taking up science specialisation. It can also set teachers thinking on how to make science more interesting and practical so that students voluntarily take up this specialisation.

Literature Review

Motivation

Motivation is required for any activity, to begin, sustain and persevere at it till an end point is reached where the individual learns a new behaviour or a skill (Kusurkar, Croiset, Mann, Custers, & Ten Cate, 2012). Students should be motivated to learn so that teaching also becomes a joy because if the student is motivated, he knows ways and means to understand concepts, manage his education and career and also thirsts for more knowledge and if a student is not motivated, even the most qualified, capable and well-meaning teacher is proved useless (Walberg, 1988). The robustness of any school in any part of the world is assessed by the rigour of the science and mathematics program of the school and it is this aspect of the schooling that can enable countries like India to surge ahead of the rest of the world and participate in the global competition (Reddy, 2005; Mji & Makgato, 2006). Motivation is the key factor that gives a student that inner thrust to

go that extra mile to achieve something and plays an important role in energizing a students' action and focus towards a higher goal including learning (Ormrod, 2000; Pintrich & Maehr, 2004).

Previous research studies have indicated that motivation is an important predictor of students' achievement (Beal & Stevens, 2007; Skaalvik & Skaalvik, 2006; Zhu & Leung, 2011). Motivational orientation is the inner force that enthuses an individual to remain engaged to a task and these orientations consist of various aspects like, intrinsic motivation, extrinsic motivation, self -efficacy, self-determination, personal relevance, and assessment anxiety (Stewart, Bachman, & Johnson, 2010; Chow & Yong, 2013)

Motivation can come from within oneself (intrinsically driven) or from the external environment (extrinsically driven). Motivation studies started with an emphasis on extrinsic motivation which stresses on external positive reinforcers like grades, praises or appreciation that are expected to increase and cause repetition of a given behaviour in students (Stipek, 1996). External reinforcers work in different ways for different people and hence cannot be taken as a reliable method of motivation under all situations.

Intrinsic motivation is characterized by an innate interest, joy and pleasure that comes from within and is more long lasting as compared to extrinsic motivation (Guay, Chanal, Ratelle, Marsh, Larose, & Boivin, 2010). This motivation that comes from within enables an individual to enjoy and find pleasure in one's work and sustains their interest in the work for a longer period of time. When a student is intrinsically motivated he finds utmost joy, meaning and pride in his learning and subjects, a sense of achievement and challenge in learning and when he is extrinsically motivated he learns because he gets good grades, he sees his career being shaped and also feels he is being appreciated and applauded by others for his learning. Intrinsic motivation is of utmost importance because that is more sustainable and within one's control that helps a student find ways and means to keep going and retain information more easily. When a student is intrinsically motivated he takes on the responsibility of gaining and acquiring knowledge and reinforcing knowledge all his life (Ainley, 2004; Dev, 1997). An intrinsically motivated student finds ways and means to master content and skills required for learning science (Cavallo, Rozman, Blinkenstaff, & Walker, 2003). Intrinsically motivated students are good and enthusiastic learners who are ever ready to try newer methods of learning and are not scared of failure in their attempts. Students who are extrinsically motivated are dependent on various factors in the external environment like good grades, a bright promising career, parental approval or rewards by others. These rewards hold charm at a particular time but beyond that or in their absence, the individual doesn't feel the urge to learn (DeLong & Winter, 2002). For a student, though, both of these are essential, it has been suggested that extrinsic motivation can hamper intrinsic motivation of students (Bain, 2004).

As suggested in past studies using the social cognitive framework, motivation to learn science is self-regulated where the student takes complete control of their interests, behaviour and actions leading to favourable outcomes (Glynn, Brickman, Armstrong, Taasoobshirazi, 2011). Personal relevance indicates that if the task on hand is important, relevant or connected directly to the needs of the student either on a personal (any personal goals) or a professional front (career goals), they take more interest in accomplishing the task (Matthews, 2004; Osborne & Collins, 2001). Students will take interest in science only if it gives them a direction as far as their career is concerned, or they are allowed to perform activities and experiments themselves or the subject is taught to them in a meaningful and interesting way (Chow & Yong, 2013; Holbrook, Rannikmae, Yager, & De Vreese, 2003).

Self-efficacy refers to students' conviction that they can do well and achieve the required results in science (Lawson, Banks & Logvin, 2007). It indicates a student's belief about his capacity and capability to learn a new task and perform it successfully which in turn influences his thought process, plan of actions and behaviours (Bandura, 1997). Students usually have an unknown fear of science due to the rigours of the course, as well as practical experimentations and results to be reported and hence, self-efficacy becomes very important. Also, science courses progressively increase in the level of difficulty and hence it is important to have a high self-efficacy in order to persevere through the course, put in efforts and successfully come out of the course (Margolis & McCabe, 2006). Previous studies have shown a relationship between self-efficacy and achievement (Kan & Akbas, 2006; Zushou, Pintrich, & Coppola, 2003).

Self-determination is the choice and control students have over the way they learn science (Black & Deci, 2000; Reeve, Hamm, & Nix, 2003). It has been suggested in previous studies that if a student has some autonomy over choosing his course work, lab assignments, submission of class assignments, he perceives control over his task and is expected to be more motivated(Reeve et al., 2003).It was also suggested in previous studies that if instructors of the course were to encourage self-determination and confidence among students, it could result in more students pursuing science and giving up fear and anxiety (Lavigne, Vallerand, & Miquelon, 2007).

Gender Differences in Learning Science

Although female enrollment in STEM(Science, technology, Engineering and mathematics) related courses has risen over a period of time, there still does not seem to be a proportional rise in their representation in these fields (Beede, Julian, Langdon, McKittrick, Khan, & Doms, 2011; Burelli, Arena, Shettle, & Fort, 1996) . Gender differences in mathematics performance has been attributed to various factors like an inborn difference in spatial ability, brain development, hormonal impact as well as societal stereotyping of females (Terlecki, Newcombe & Little, 2007; Ardila, Rosselli, Matute, & Inozemtseva, 2011; Spencer, Steele, & Quinn, 1998). It has been suggested in previous studies that there is a difference in gender with regards science motivation. Male students are in general found to be more interested in physical sciences like physics, chemistry, mathematics while their female counterparts incline towards biological sciences(Alexander, Kuppam, Shaik Kadir, & See, 2010; Murphy & Whitelegg, 2006; Stadler, Duit, & Benke, 2000). In a study to understand gender differences in science achievement, it was found that boys exhibited greater confidence in science abilities than girls (Meece & Jones, 1996). In a study to investigate the influence of students' motivational beliefs (learning goal orientation, task value and self-efficacy) in science learning on students' self-regulation in the science classroom, it was found that that the influence of task value on self-regulation was statistically significant for boys only (Velayutham, Aldridge, & Fraser, 2012). In a study on a sample of 600 intermediate science students from Pakistan, it was seen that there is no difference between males and females as far as science motivation was concerned (Mubeen, Saeed, & Arif, 2013). In a study on self-regulated learning among 185 Malaysian science students, it was seen that girls exhibited a higher self-regulated learning than boys (Saad, Tek, & Bahrom, 2009). Intrinsic motivation is expected to cause better and more fruitful learning results as compared to extrinsic motivation (Ryan, Connell, & Plant, 1990).

Problem Statement

There have been past research studies that speak about gender inequality in education in India especially in the rural areas and the socioeconomically backward class though, the latter is not very conclusive in affecting learning in boys and girls (White, Ruther, & Kahn, 2016). Research to understand the gender differences in the motivation of students in learning science is limited in the Indian context and specifically in the urban areas. This study aims to understand the gender differences in some motivational components of learning science.

Methodology

Research Design

This study was carried out to examine the motivational components profiles in students who are in various stages of science education using a validated questionnaire developed by Glynn et al. 2011. This is a cross-sectional, quantitative, non-experimental study. A survey was conducted in the period January 2017 to February 2017. A questionnaire was used as the survey instrument.

Sampling

The study was conducted using cluster sampling technique. Educational Institutions were clustered based on their geographic vicinity. Five clusters were selected at random to represent the North, South, East, West and Central regions of Mumbai. Institutions were selected at random from the chosen clusters. The sampling frame included all the students pursuing science courses in these randomly chosen institutions from the chosen clusters and 200 students' names undergraduate random, using the random number table. 160 students responded to the questionnaire. The inclusion criterion for educational institutions was the medium of instruction, namely, English. The inclusion criterion for students was their knowledge, use and understanding of English and ability to respond to statements in the questionnaire which were in English.

Instrument

The various motivational components to learn science at college, graduation and post graduation levels were obtained using the Science Motivation Questionnaire II (SMQII) developed by Glynn et al. 2011. There are five items to assess each of the five components of science motivation: intrinsic motivation, self-determination, self-efficacy, grade motivation, career motivation. Students responded on a 5-point Likert scale (0 = Never, 4 = Always). Permission to use the SMQII was obtained from the author/s.

Data Analysis and Results

SPSS 16 was used for analysis of data

Sample Description

The questionnaire was responded to, by 160 students pursuing various levels of science courses. The mean age of the students was 18.46 years with a standard deviation of 2.65. The sample consisted of 102 male students and 58 female students. 51.2 % of students were pursuing their junior college (undergraduate), 33.1 % were pursuing their graduate studies, 13.1% were pursuing their post graduate studies and 2.5% were pursuing their doctoral studies.

Normality of data

The data was checked for normality before further analysis was done. It can be seen from Table1 that, the maximum absolute value of skewness is less than 2 and that of kurtosis is less than 7, hence, data assumed to be normally distributed (Dubey, Gunasekharan, & Samar Ali, 2015; Kim, 2013; Curran, West & Finch, 1996).

Table 1: Descriptive Statistics for the SMQII (n= 160)

Constructs	No of items	Mean (sd)	Skewness	Kurtosis
Intrinsic motivation	5	15.95 (3.28)	-.947	1.514
Self-efficacy	4	12.46 (2.40)	-.579	0.492
Self-determination	5	14.81 (3.30)	-.795	1.085
Grade motivation	5	15.03 (4.27)	-1.131	1.134
Career motivation	5	15.91 (3.93)	-.948	1.074

Validity of the Scale

To ensure that the instrument was valid, construct validity (consisting of convergent and discriminant validity) was checked for the same.

Table 2: Convergent Validity for SMQII (n= 160)

Construct	Items	Factor loading	Variance	Error	SCR	AVE
Intrinsic motivation	The science I learn is relevant to my life	0.687	0.471	0.528	0.844	0.524
α = 0.765	Learning science is interesting	0.693	0.480	0.519		
	Learning science makes my life more meaningful.	0.796	0.633	0.366		
	I am curious about discoveries in science.	0.636	0.404	0.595		
	I enjoy learning science.	0.792	0.627	0.372		
Grade motivation	I like to do better than other students on science tests	0.558	0.311	0.688	0.88	0.6
α = 0.833	Getting a good science grade is important to me.	0.866	0.749	0.250		
	It is important that I get an "A" in science.	0.871	0.758	0.241		
	I think about the grade I will get in science	0.716	0.512	0.487		
	Scoring high on science tests and labs matters to me	0.831	0.690	0.309		
Career motivation	Learning science will help me get a good job.	0.578	0.334	0.665	0.847	0.53
α = 0.767	Knowing science will give me a career advantage.	0.786	0.617	0.382		
	Understanding science will benefit me in my career.	0.744	0.553	0.446		
	My career will involve science	0.748	0.559	0.440		
	I will use science problem-solving skills in my career.	0.766	0.586	0.413		
Self-efficacy	I am confident I will do well on science tests.	0.772	0.595	0.404	0.8	0.497
α = 0.695	I am confident I will do well on science labs and projects	0.676	0.456	0.543		
	I believe I can master science knowledge and skills.	0.722	0.521	0.478		

Construct	Items	Factor loading	Variance	Error	SCR	AVE
	I believe I can earn a grade of "A" in science	0.655	0.429	0.570		
Self-determination α = 0.736	I put enough effort into learning science.	0.820	0.672	0.327	0.83	0.496
	I use strategies to learn science well.	0.526	0.276	0.723		
	I spend a lot of time learning science.	0.703	0.494	0.505		
	I prepare well for science tests and labs	0.746	0.556	0.443		
	I study hard to learn science.	0.717	0.514	0.485		

Note: 1 item of self-efficacy did not load above 0.5 and hence has been excluded

It can be seen from Table 2 that the standardized factor loadings for all the items are well above 0.5, the scale composite reliability is very much greater than 0.7 and the Average variance extracted is also greater than 0.5. Convergent validity is adequate for the scale (Fornell & Larcker, 1981). Although Average variance extracted is a little below for the components of self-determination (0.496) and self-efficacy(0.497), since the scale composite reliability is well above 0.7, convergent validity is established (Clayton, 2014; Malhotra & Dash, 2011).

Table 3: Discriminant Validity for SMQII (n=160)

Component	Grade motivation	Intrinsic motivation	Self determination	Self-efficacy	Career motivation
Grade motivation	***0.833* (0.774)***				
Intrinsic motivation	0.342**	***0.765* (0.723)***			
Self determination	0.599**	0.452**	***0.736* (0.704)***		
Self-efficacy	0.493**	0.498**	0.586**	***0.695* (0.704)***	
Career motivation	0.561**	0.662**	0.516**	0.527**	***.767* (0.728)***

*Diagonal entries are Cronbach alpha coefficients: others are Pearson's correlation coefficient
** correlations are significant at 0.01 level (2-tailed)
Fig in round brackets () indicate the square roots of the AVE

Discriminant validity (Table 3) is also established as per Gaski and Nevin (1985), as correlations between the factors are smaller than the Cronbach Alpha values in the corresponding row and column (Andaleeb & Conway, 2006; Genchev & Daugherty, 2005). Discriminant validity is also established as per Fornell and Larcker (1981), as correlations between the factors are smaller than the square root of AVE values in the corresponding row and column (see Table 3).
Considering that the Cronbach alpha values are all above 0.7 and the scale satisfies construct validity conditions, it was found to be both reliable and valid.

Research question

Is there a gender difference in the motivational components in learning science?

To answer the above question an independent-samples t-test was conducted.

Table 4: Independent-samples-t-test

	Males (n = 102)		Females (n = 58)			
Scales	***Mean***	***SD***	***Mean***	***SD***	***t-value***	***p***
Grade motivation	14.48	4.47	16.01	3.73	***-2.213***	***.028***
Intrinsic motivation	15.57	3.54	16.62	2.68	***-2.095***	***.038***
Self-determination	14.45	3.49	15.46	2.85	-1.883	.062
Self-efficacy	12.23	2.53	12.86	2.13	-1.590	.114
Career motivation	15.52	3.69	16.6	3.15	-1.880	.062

An independent-samples-t-test was conducted to compare the scores of grade motivation, intrinsic motivation, self- determination, self-efficacy and career motivation for males and females. It can be seen from Table 4 that there is a significant difference in scores for males (mean = 14.48, sd= 4.47) and females (mean = 16.01, sd = 3.73); t (158) = -2.213, $p<0.05$, in grade motivation component. To understand the relative magnitude of the differences we calculate the effect size, eta squared.

$$\text{Eta squared for grade motivation} = \frac{t^2}{t^2+(n_1+n_2-2)} = 0.03$$

(n1 and n2 represent the number of respondents in each category of males and females respectively)

It can also be seen from Table 4, there is a significant difference in scores for males (mean = 15.57, sd= 3.54) and females (mean = 16.62, sd = 2.68); t (158) = -2.095, $p<0.05$, in intrinsic motivation component. Eta squared for intrinsic motivation = 0.02

The guidelines (proposed by Cohen, 1988) for interpreting this value are, 0.01=small effect, 0.06 = moderate effect, 0.14=large effect. In the case of grade motivation (eta squared is 0.03) and intrinsic motivation (eta squared is 0.02), the effect sizes are small. Expressed as a percentage it can be seen that 3% of the variance in grade motivation can be explained by gender and 2% of the variance in intrinsic motivation can be explained by gender. There are no significant differences in scores for other components of science learning motivation as seen from Table 4.

Discussion

There is a significant difference in the components of grade motivation and intrinsic motivation between female and male students. Although the eta squared values are small and it shows a lack of practical significance, it may be worthwhile to discuss the difference.

The results of this study are different from the results obtained by a study conducted by Mubeen et al. 2013, on 600 students pursuing intermediate science courses in Pakistan, where they found that there was no difference in intrinsic motivation with regards gender. The results of this study are similar to the study conducted by Meece & Holt, 1993, on 257 students of the 5th and 6th grade, where girls showed greater intrinsic motivation as compared to boys. The results of this study are also similar to that obtained by Nadia (2010) on a sample of 200 students from various colleges in Pakistan. Past research has shown that girls are more disciplined as far as academics are concerned. They spend more time studying, are more engaged at school and work harder and this translates into motivation leading to better grades. Girls are more meticulous as far as notes-making is concerned and are particular about being regular in academics as and when it is taught. Girls have an inner trait of being more conscientious and hence are better at planning their studies

and achieving goals. Indian society has a severe stereotypical role for girls that includes home keeping and rearing children and this is drilled into them at a very young age. Girls probably have greater grade motivation than boys, because they feel an innate need to prove that they are as good as boys or even better. Past research has shown college female students do better than their male counterparts and are motivated by rewards and recognition from parents and teachers for the same (Davis, Winsler, & Middleton, 2006).

It was also observed in the current study that, girls have greater intrinsic motivation as compared to boys. Intrinsic motivation towards learning science is said to exist when the student sets academic goals for himself and controls his behaviour irrespective of existence or absence of external pressures (Brophy, 2010). In a study to understand the motivation towards learning English among engineering and technology students, it was found that girls have higher intrinsic motivation as compared to boys (Narayanan, Rajasekaran, & Iyyappan, 2007), lower intrinsic motivation to learn physical education as compared to boys(Shang, 1998). The results of the current study are different from the results of a study conducted on 137 students of a local university of Hongkong which suggested that intrinsic motivation towards study is the same for both the genders. There are mixed results in previous studies with respect to intrinsic and extrinsic motivation among males and females when considered on the basis of curiosity levels (Green & Foster, 1986).

This study showed no differences among gender as far as self-efficacy, self-determination and career motivation were concerned. There have been mixed results as far as gender differences are concerned in terms of self-efficacy. Past research studies have shown that male college students possess more self-efficacy as compare to their female counterparts (Cavallo, Potter, & Rozman, 2004). The results of the current study also differ from the results of the study conducted on high school students in Korea which suggest that females show a lower level of career motivation as compared to males. The results of the current study suggest that components of self-determination, career motivation and self- efficacy are similar as far as gender is concerned in a metropolitan city like Mumbai.

Implications for the Business Community

Science drives innovations that in turn drives business, so, the business community should be seriously interested that students take up science as a career so that the cycle of innovations continue to add to the growth of the economy and development of the nation. The business community should reach out to schools and organize science programs for students as well as their parents at grass root levels to remove the not so positive perceptions of roles that females develop at a young age. Programs like science quizzes, exhibitions or taking students through the lives of women scientists and achievers can be influential in girls taking up science as a career choice. Organizations can also offer special internships or projects for girls in order to allow girls interested in science to observe the activities done by people in that field and get a feel for what a career in science looks like.

Conclusions

The results suggest that females are more intrinsically motivated to learn science as compared to males. The results also suggest that postgraduate students show greater intrinsic motivation than junior college students. This means that if we want many students to take up to science as a future so that the country grows and develops we need to find means to improve intrinsic motivation.

This has positive implications for higher authorities and teachers in India. Intrinsic motivation stems from innate interest and enthusiasm and a desire to learn. It is important that teachers and educational institutions create an environment that enables students to feel that they have made the right choice in selecting science as their specialization. It is important to appreciate students who show up regularly to class and work hard and thereby reinforce the fact that learning science is a natural way of life and not an imposition they have to suffer. It is also important for educationists to instil confidence in the student about failures in science rather than penalties. It is important to show the practicalities of the outcomes of learning so that the student understands the importance of the course itself and enjoys the process of learning rather than worrying about the results. It may also be more interesting if teachers could present the lessons in the form of interesting quizzes or problems or laboratory team exercises so that the student experiences the situation and also is able to collaborate with colleagues to work out a solution or understand the concept in a better way. Once there is an improvement in intrinsic motivation, there would be enough drive in the student to sustain his desire and interest to learn science.

Limitations and Further Research Recommendations

The study is limited by geography as it has been conducted in a metropolitan city like Mumbai which is the financial capital of India. Generalizability of results can be difficult because of this. It is suggested that this study is replicated in different metropolitan cities of India and results be compared. It is further suggested that educational institutions of rural areas, from various parts of India, be taken up for replication of this study and a comparison be made with respect to urban and rural area students. Triangulation approach to the study can help researchers gain more insights during interviews on students' motivation to learn science. It may be worthwhile to conduct a longitudinal study to understand the motivation of students over a period of time. It would also be worthwhile trying to compare motivation of students from the non-science steam with the science stream. This study does not take into consideration various aspects like teacher motivation, school facilities, access to information and technology like the internet, kind of scientific books and magazines in the library, video demonstrations, educational CDs and the style of teaching that may play a major role in developing an inclination towards science among students. It is suggested that future studies also consider these factors and study the influence of these factors on motivation. Future studies should consider the relationship between science motivation and the actual grades obtained by students and study the mediating effects of variables like teacher motivation, teaching style and scientific culture of the school on this relationship.

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