STUDENTS' MOTIVATION TO LEARN SCIENCE AND ITS RELATIONSHIP TO THEIR ACHIEVEMENT IN SCIENCE: A STUDY IN THE CONTEXT OF MIZORAM

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There is a strong need for science-motivated high school students to enter the post-secondary science stream. Student enrolment in higher education science needs to be increased and higher levels of science motivation at the secondary and post-secondary levels can help to achieve this. To enrol students in various science courses, we must understand what motivates them. The purpose of the present study was to determine how secondary school students conceptualised their motivation to learn science using the Science Motivation Questionnaire (SMQ II) as a survey instrument. The students' achievement in science courses was measured through their term-end board results of Class X. Stratified random sampling with school types as strata were used to collect the sample comprising 1134 (532 boys and 602 girls) secondary school-going children of Aizawl district of Mizoram, India. All the students studied in schools affiliated to the Mizoram Board of School Education (MBSE). Descriptive, correlation and differential analysis was used to analyse the data. The findings of the study revealed that students were found to have more than moderate level of science motivation, and the mean science achievement score of the highly motivated group was found to be maximum indicating a favourable trait of science motivation within the students. Career motivation and grade motivation were found to be the strong motivational constructs by most of the students, whereas students were least motivated by the self-determination construct. Thus, in the present population, extrinsic motivational constructs are more decisive than intrinsic ones. It was also found that there is a significant positive relationship between students' science motivation and their achievement in science. Through differential analysis, it was revealed that a significant difference exists in the science motivation level of the high and low science achievers on all its five sub-constructs, with high achievers being more science motivated. Also, a significant difference exists in science motivational level in relation to gender, with boys being more science motivated; although, girls had a higher mean motivation level for grade motivation. However, no significant difference exists within the high and low achieving groups with regard to gender. Findings suggest that science motivation within secondary students can positively contribute to their achievement in science both at present and for their choice of a future career in science. The highlight of the findings was incorporating more of students' positive affective traits such as, science motivation inside science classrooms.

Keywords: Science motivation, Achievement in science, Mizoram

Introduction

Motivation is a psychological construct associated while complying to a certain set of needs. In educational psychology it is widely studied as a need of achievement (n-Ach), also referred to as achievement motivation. Brophy (2004) defines student motivation

as the degree to which students invest attention and effort. Motivation to learn refers to students' disposition to find academic activities relevant and worthwhile and derive the intended benefits. Glynn, Aultman and Owens (2005) defined motivation in general as an internal state that arouses, directs, and sustains goal-oriented behaviour. They further highlighted through their literature review that researchers in the past have been trying to employ various motivational constructs in teaching-learning contexts to motivate students to learn. However, it is hard to predict which constructs hold the best explanatory power. They categorised the reviewed construct mainly belonging to three categories: (i) the constructs referring to students' traits and states, such as activity and anxiety level, interest, and curiosity falling together in studies on comparison between intrinsic and extrinsic motivation to learn;
(ii) the constructs related to students' beliefs, such as self-determination, goal orientation, self-regulation, and self-efficacy; and
(iii) constructs that refer to students' responses to others' expectations such as instructors, advisors, and administrators. Domenech Betoret, Rosello and Gomez-Artiga (2017) suggested through their findings that expectancy-value beliefs of students, which included their achievement expectations, the value of the subject matter, process expectations with the teacher, expected cost to pass the subject, are capable of satisfactorily explaining and predicting student achievement and their degree of satisfaction with the teaching process followed with a specific subject matter. Pajares and Schunk (2001) found that students who are encouraged by parents favorably to explore and try different activities are found to be higher on their self-efficacy levels and are motivated to perform better academically. Favourable school environments and positive peer support contribute equally to their self-efficacy level. They reflect positive behaviours such as improved class attendance and class participation, asking questions, seeking advice, and participating in study groups.

Studies exclusively focusing on science motivation started with Glynn and Koballa's (2006) efforts to develop an instrument named students' motivation towards science. According to Glynn and Koballa, motivation to learn science, a social cognitive construct, is defined as an internal state that arouses, directs, and sustains science-learning behaviour. It is believed that high science motivation levels within students seem to be one of the vital indicators of high achievement in science. The six initially identified components of students' motivation were intrinsically motivated science learning, extrinsically motivated science learning, the relevance of learning science to personal goals, responsibility (self-determination) for learning science, confidence (self-efficacy) in learning science, and anxiety about science assessment. After this study, several other studies tried to measure science motivation levels in varied population samples. For example, Glynn, Taasoobshirazi, and Brickman (2009) tried to examine the motivation to learn science of non-science majors enrolled in a core-curriculum science course using the Science Motivation Questionnaire (SMQ). They found that in studying students' science motivation, researchers examine why students strive to learn science, how intensively they strive, and what beliefs, feelings, and emotions characterise them in this process. An exploratory factor analysis suggested that the questionnaire has construct validity. The students conceptualised their motivation to learn science in five dimensions: intrinsic motivation and personal relevance, self-efficacy and assessment anxiety, self-determination, career motivation, and grade motivation.

In yet another study, Glynn, et al. (2011) tried to measure the science motivation of science majors and non-science majors in American undergraduate students in order to assess the differences in the motivation to learn sciences by developing a new version of the Science Motivation Questionnaire, SMQ II using the perspectives of social cognitive theory of Bandura highlighting the importance of environmental factors in human functioning. SMQ II assesses five motivation components: intrinsic motivation, self-determination, self-efficacy, career motivation, and grade motivation. It was reported that the science majors were better on all the components of science motivation. Men had higher self-efficacy in science majors and non-science majors than women and women had higher self-determination than men. This suggested that science motivation differs with the background, i.e., their preference to choose science as a major or non-major subject at the undergraduate level with respect to subject specialisation and gender. Salta and Koulougliotis (2015) tried to adapt Science Motivation Questionnaire II (SMQ II) and made the Greek version of Chemistry Motivation Questionnaire II (Greek CMQ II) to investigate Greek secondary school students' motivation to learn chemistry for the first time. Some studies show that students' science motivational level varies with gender (Bryan, Glynn and Kittleson, 2011; Salta and Koulougliotis, 2015). Science motivational studies are a relatively new arena in science education. They are of far-fetching value in improving the motivational constructs applicable in science teaching-learning processes.

Rationale of the Study

The present study is undertaken in Mizoram, a tiny state in the northeastern part of India with a unique cultural and ethnic diversity. As far as Mizo society is concerned, it is a close-knit society of tribal and ethnic population of north-east. Mizo youth exhibit some unique traits of creativity, musical aptitude, cooperative living, hard-working and resource-sharing. In the last decade, Mizoram has held a record of high literacy rate in the country (Census India, 2011) and the society has a positive outlook for education and possesses a favourable cultural milieu for protecting the environment. However, despite several positive traits in youth, there is prevalent phobia towards science subjects at the school level. According to the Mizoram Board of Secondary Education (MBSE), fewer students choose the science stream at the senior secondary level than humanities. Therefore, the question arises, whether they are afraid of science as it will be more challenging at a higher level or are less motivated to take science as their career.

Why is it so that most science students do not wish to continue their careers in science? Severe implications can be felt at the upper end in terms of the low enrolment of students in higher education in the field of science. The student dropout problem after studying science at the senior secondary level needs to be addressed. There is a strong need for motivated science high school students to enter the post-secondary science stream. Student enrolment in higher education science needs to be increased and higher levels of science motivation at secondary and post-secondary level can help to achieve this. During high school, students' motivation to learn science is one of the highest predictors of science course success (Britner and Pajares, 2006). To enrol students in various science courses, what motivates them must be understood. It is the pre-university stage where the mindset of the students can be captured for motivating them to continue with higher education in science as this is the stage when differentiation and streaming of subject are introduced. Therefore, the present study attempts to understand the science motivation among the secondary school students of Mizoram, which is one of the vital indicators of their entry into the science stream at the higher secondary level.

Research Questions

Based on the rationale of the present study the following research questions were framed

1. What are the factors that motivate secondary school students of Mizoram towards learning science?
2. What is the science motivation level of secondary school students in Mizoram?
3. Are the secondary students of Mizoram with high achievement in science more motivated to learn science?
4. Does gender impact students' science motivation amongst the secondary school students of Mizoram?
5. How does gender impact secondary school students' science motivation within high and low science achieving groups of students in Mizoram?

Objectives of the Study

This study aimed to identify how secondary school students conceptualised their motivation to learn science. Also, it tried to investigate the nature of the relationship between students' science motivation and their achievement in science. Further, attempt was made to compare students' science motivation within the high and low-achieving students in science. Finally, the researchers also sought to find the influence of gender on students' science motivation. Following are the objectives of the present study:

1. To describe and measure the conceptual factors that motivated secondary school students of Mizoram in science.
2. To find out the relationship between students' science motivation and their achievement in science amongst secondary school students of Mizoram.
3. To compare the high and low achievers in science amongst secondary school students of Mizoram in relation to their science motivation.
4. To examine and measure the impact of gender on science motivation amongst the secondary school students of Mizoram.
5. To find out the gender differences among high and low achievers in science amongst secondary school students of Mizoram about their science motivation.

Research Hypotheses

Following are the prime research hypotheses guiding the present study:

1. There is a positive relationship between students' science motivation and their achievement in science.

2. High achievers in science have a higher level of science motivation, whereas low achievers in science have a lower level of science motivation.
3. There is a significant difference in science motivation of secondary school students with respect to their gender.
4. There is a significant difference in science motivation of high achievers of secondary school students with respect to gender.
5. There is a significant difference in science motivation of low achievers of secondary school students with respect to gender.

Population and Sample

The population of the present study comprised all secondary school students of the Aizawl District of Mizoram. The chosen sample comprised 1134 secondary students (532 boys and 602 girls) of Class X from 34 MBSE (Mizoram Board of School Education) affiliated schools in the Aizawl District of Mizoram, India. Therefore, all the MBSE affiliated secondary schools formed the study population. A stratified random sampling technique with school types as strata was used to pool the sample. There are six types of schools mentioned in the Annual Publication by the Directorate of School Education, Mizoram (2014-15): government, deficit, adhoc aided, lumpsum aided, RMSA, and private schools. In the present sample, student are 34.4, 10.23, 8.64, 7.76, 2.73, and 36.24 per cent from each school type, respectively, which approximately corresponds to the total percentage of students in different schools types of Aizawl District according to Annual Publication data (2014-15).

Methods and Procedures

The present study is descriptive in nature intending to measure the secondary students' motivation to learn science and differential analysis on the trait of motivation to learn science, emphasising achievement levels of students in science and their gender. The study used a correlational analysis to understand the relationship between students' science motivation and their achievement in science. Also, a similar point biserial analysis was done between genders and their level of motivation. The instrument used for the present study was Science Motivation Questionnaire II (SMQ II), constructed by Glynn, Brickman, Armstrong and Taasoobshirazi, 2011. The SMQ II is a revised version of SMQ (Glynn and Koballa, 2006). It was used to assess the science motivation level of secondary school students. The SMQ II has five subscales, each with five items measuring the dimensions of intrinsic motivation, self-determination, self-efficacy, career motivation, and grade motivation.

The questionnaire comprises 25 items where students respond to each item on a rating scale of temporal frequency: never (0), rarely (1), sometimes (2), often (3), or always (4). The raw scores should be interpreted carefully since the scale is ordinal. The possible score range of the 5-item scale is 0-20 making a total score range of 0-100. The items were randomly ordered as provided in the online version of SMQ II © 2011 Shawn M. Glynn, University of Georgia, USA. Since SMQ II has been standardised on college students, the score indicates "average" for undergraduate science majors and non-science majors at the University of Georgia; it does not provide any classification criterion based on obtained raw score. Only the magnitude of score can decide students' degree of science motivation from no science motivation to a very high science motivation. The efficiency of the scale is that it uses elementary, unambiguous, declarative, to the point focused questions on the motivation to learn science in courses rather than a multitude of contexts, such as hobbies and the Flesch-Kincaid formula indicates readability at the sixth-grade level (Glynn, et al., 2011). Also, the beauty of SMQ II is that it does not distinguish among different science subjects but focuses on a general motivation to learn science (Chumbley, et al., 2015). The reliabilities (internal consistencies) of the scales, assessed by Cronbach's alphas, are as follows in order from highest to lowest: career motivation (0.92), intrinsic motivation (0.89), self-determination (0.88), self-efficacy (0.83), and grade motivation (0.81). The Cronbach's alpha of all 25 items was reported as 0.92, an excellent and reliable value. The Science Motivation Questionnaire II is confirmed to have good content and criterion-related validity (Glynn, Taasoobshirazi and Brickman, 2009; Glynn, Brickman, Armstrong and Taasoobshirazi, 2011).

Findings

The first objective of this study was to describe and measure the conceptual factors that motivated Mizo secondary school students of Mizoram in science. Tables 1 and 2 describe these findings.

Table 1

Conceptual Factors Motivating Students to Learn Science (n=1134)

Components/ Statements				
Intrinsic Motivation	Mean(0-4)	Median(0-4)	Mode(0-4)	SD
Learning science is interesting	2.99	3	4	1.06
I am curious about discoveries in science	2.56	3	2	1.24
The science I learn is relevant to my life	2.68	2	2	0.96
Learning science makes my life more meaningful	2.84	3	4	1.12
I enjoy learning science	2.63	2	2	1.14
Career Motivation				
Learning science will help me get a good job	3.29	4	4	1.07
Understanding science will benefit me in my career	3.17	4	4	1.09
Knowing science will give me a career advantage	3.16	4	4	1.10
I will use science problem-solving skills in my career	2.56	3	2	1.21
My career will involve science	2.61	3	4	1.29
Self Determination				

I study hard to learn science	2.57	2	2	1.10
I prepare well for science tests and labs	2.31	2	2	1.12
I put enough effort into learning science	2.16	2	2	1.09
I spend a lot of time learning science	2.09	2	2	1.07
I use strategies to learn science well	2.06	2	2	1.09
Self Efficacy				
I believe I can earn a grade of "A" in science	2.54	2	2	1.19
I am confident I will do well on science tests	2.28	2	2	1.09
I believe I can master science knowledge and skills	2.08	2	2	1.32
I am sure I can understand science	3.01	3	4	1.04
I am confident I will do well on science labs and projects	2.26	2	2	1.12
Grade Motivation				
Scoring high on science tests and labs matters to me	2.79	3	4	1.24
It is important that I get an "A" in science	3.07	4	4	1.19
I think about the grade I will get in science	2.75	3	4	1.12
Getting a good science grade is important to me	3.31	4	4	1.09
I like to do better than other students on science tests	3.06	4	4	1.09
Summated score	66.83	-	-	28.24

With reference to Table 1, students have a moderate level of motivation to learn science with a summated average of 66.83 out of possible 100 scores. It was found that the most significant motivators for students were grade motivation; specifically, the importance of getting an 'A' in science (M=3.07) and career motivation, believing that learning science will help them get a good job (M=3.29). The least common motivator was self-determination, about being able to use strategies to learn science well (M=2.06) and self-efficacy, on believing that they can master science knowledge and skills (M=2.08).

Further, with reference to Table 2, the highest motivational constructs were found to grade motivation with an average mean for the five items of 3.00 followed by career motivation (M=2.96), intrinsic motivation (M=2.74), self-efficacy (M=2.43), and self-determination (M=2.24).

Table 2

Statistical Description of Five Motivational Constructs

Construct	Mean (0-4)	Median (0-4)	Mode (0-4)	SD
Grade Motivation	3.00	3.6	4.0	1.15
Career Motivation	2.96	3.6	3.6	1.15
Intrinsic Motivation	2.74	2.6	2.8	1.10
Self Efficacy	2.43	2.2	2.4	1.15
Self Determination	2.24	2.0	2.0	1.09

Table 3

Correlation between Science Motivation (IV) and Achievement in Science (DV)

Independent Variable (IV)	Dependent Variable (DV)	N	Df (N-2)	Pearson Product Moment correlation (r)	r^2	Significance level
Science motivation	Achievement in science	1134	1132	0.314	0.098	S**

Source: Field data. **Significant at 0.01 level.

The second objective of this study was to find out the relationship between Mizo secondary school students' science motivation levels and their achievement in science. Table 3 depicts the Pearson Product moment correlation value of 0.314 (df=1132), which is positive and highly significant at a 0.01 level of significance.

The third objective of this study sought to compare the high and low achievers in science in relation to their science motivation. To identify the high and low achievers in the sample, the obtained Class X MBSE board (the block year 2016-2017) scores for students' science achievement were arranged in descending order such that marks were arranged from highest to lowest. The upper 27 per cent of the sample, i.e., the top 306 samples were identified as the high achievers. Similarly, the lower 27 per cent of the sample, i.e., the bottom 306 samples were identified as the low achievers. The science motivation scores of the two groups were subjected to differential analysis. For the testing of the hypothesis, the student's t-test (independent sample) was performed (Table 4).

Table 4

Significance of Difference between High and Low Achievers in Science in Relation to their Science Motivation

Group	Number	Mean	S.D.	SEM	t value	df	Significance of Difference	Decision on Null Hypothesis
High Achievers	306	72.327	13.484	.7708	10.68	610	S**	Rejected
Low Achievers	306	60.307	14.350	.8204				

Source: Field data, **The test suggests that the difference between the two means is highly significant at 0.01 level

Interpretation of data: A reference to Table 4 reveals that there is a statistically significant difference between the mean science motivation scores of high achievers in science (M=72.327, SD=13.484) and mean science motivation scores of low achievers in science (M=60.307, SD=14.350); the obtained t value (10.68) was found extremely significant at 0.01 level with a degree of freedom 610, 't' critical value (2.576) being < obtained 't' value. It means that the science motivation of secondary school students varies between low and high achievers. Hence the null hypothesis was rejected. Furthermore, the science motivation of high achievers is greater than that of low achievers, which suggests that students who are highly motivated perform better in science.

An analysis was performed where the students' science motivation scores were segregated into five motivation levels. The SMQ (Science Motivation Questionnaire) II by Glynn, et al. (2011) does not specify the general science motivation levels as it is standardised on the American sample, but five motivational factors can be classified into different motivation levels. Students respond to each item on a rating scale of temporal frequency: never (0), rarely (1), sometimes (2), often (3), or always (4). The possible score range on every five 5-item scales is 0–20. For an individual student, on any of the five 5-item scales, they can be put into a degree of science motivation by dividing their scale score (0-20) by 5. For example, a student with an intrinsic motivation scale score of 12 (out of 20) is "sometimes too often" intrinsically motivated 12/5 = 2.4. A similar attempt to classify the total scores (range 0-100) into five levels of motivation was made. Five arbitrary categories of motivation scores were made such that 0 scores mean an absolute absence of science motivation score range from 1-25 meant only low science motivation, 26-50 meant an average or moderate level of science motivation, 51-75 meant an above moderate level and 76-100 meant a high level of science motivation; there were no students with 0 scores, and the least score was 12. there were only five students having science motivation scores between 1 and 25. One hundred forty-eight students scored from 26-50, 653 students scored from 51-75, which were maximum, followed by 328 students scoring from 76-100. The highest science motivation score was that of 100 (Table 5).

Table 5

Comparative Frequency Distribution of Students' Scores on Science Motivation

Classification	Score Range	No. of respondents	Percentage	Cumulative %
High Motivation	76-100	328	28.92%	100%
Above Moderate Motivation	51-75	653	57.58%	71.07%
Moderate Motivation	26-50	148	13.05%	13.49%
Low Motivation	1-25	5	0.44%	0.44%
No Motivation	0	0	0%	0%

Source: Field data

With reference to Table 5, it can be said that only 28.92 per cent of the total students possess high science motivation and 57.58 per cent of students possess above a moderate level of science motivation together, accounting for 86.5 per cent of the total students. This figure indicates that the sample population has an above-average level of science motivation, which is favorable for improving science achievement. There were no students with the absence of science motivation, and only five students possessed a low science motivation score. Nearly 13.05 per cent of students possessed a moderate level of science motivation.

A comparison of mean science scores of all the five categories of students segregated based on their science motivation levels (Fig.1) revealed that students possessing low science motivation (M = 54, SEM = 3.317) did not differ significantly (P>0.05) from any of the other groups. However, the other three groups significantly differed (P<0.001) in their mean science scores. The mean score of the moderate motivation group was the least (M = 48.83, SEM = 1.177), the above moderate level had the second highest (M= 55.92, SEM = 0.5601), and the high science motivation group had a maximum mean science score (M = 62.99, SEM = 0.8083).

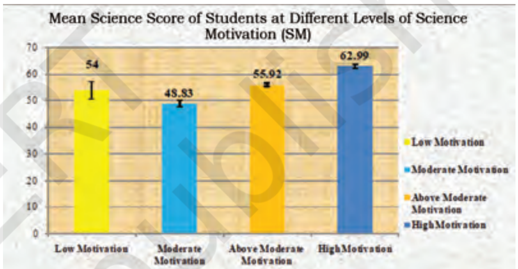

Fig.1. Mean science score of students at different levels of science motivation (SM)

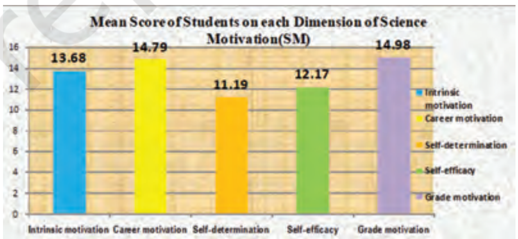

Fig. 2. Mean score of students on each dimension of science motivation (SM)

A further analysis was performed where the students' responses on science motivation were categorised into five dimensions of the SMQ II. As already mentioned, the scale comprises five items under its dimension 'intrinsic motivation', 'career motivation,' 'self-determination,' 'self-efficacy' and 'grade motivation.' Each dimension is measured through 5 items with a score range of 0-20. The minimum score obtained under each dimension can be 0, and the maximum score can be 20. The frequency distribution of the average score of students on each dimension of science motivation was analysed using percentages (Fig. 2). The findings revealed that students scored maximum under the 'grade motivation' dimension with the mean value of 14.98 followed by 'career motivation,' 'intrinsic motivation,' 'self-efficacy,' and minimum under 'self-determination' with the mean value of 11.18. The comparative mean scores obtained on all the five dimensions are summarised in Table 6.

Table 6

Mean Score of Students on each Dimension of Science Motivation

Dimensions of SM	Mean Score on each Dimension of Science Motivation
Grade Motivation (0-20)	14.98
Career Motivation (0-20)	14.79
Intrinsic Motivation (0-20)	13.68
Self-Efficacy (0-20)	12.17
Self-Determination (0-20)	11.19

To have a clear-cut understanding of the differences of high and low achievers in science in terms of their science motivation, a student t-test (independent) was performed to compare the high and low science achievers for their science motivation levels on each of its five dimensions as mentioned before.

Table 7 depicts the results of the hypothesis testing.

Interpretation of data: A reference to Table 7 shows that for all the five dimensions of SMQ II, there is a statistically significant difference between the mean science motivation scores of high and low achievers in science, which are Intrinsic motivation [$t(610)=6.657$, $p<.0.0001$)], Career motivation [$t(610)=8.114$, $p<.0.0001$)], Self-determination [$t(610)=5.879$, $p<.0.0001$)], Self-efficacy [$t(610)=8.043$, $p<.0.0001$)] and Grade motivation [$t(610)=11.575$, $p<.0.0001$)]. In all the dimensions, the high achievers in science differed significantly with higher mean science motivation scores than those of low achievers.

The fourth objective of the study was to examine the gender variation in science motivation amongst secondary school students. Here the primary variable of concern is the student's science motivation at the secondary level. Gender can be an essential factor impacting students' motivation to learn science. In the present study, the sample comprises more girls than boys, i.e., 602 girls and 532 boys, i.e., 53.086 per cent and 46.91 per cent, respectively, which almost corresponds to the original population of data of secondary school students of Aizawl District (State Yearbook 2014-15), which is 51.44 per cent and 48.55per cent, respectively. Table 8 depicts the t-test analysis.

Table 7
Significance of Difference between High and Low Achievers in Science in Relation to Their Means on Different Dimensions of Science Motivation

Dimensions	Groups	Number	Mean (M)	S.D.	SEM	t value	df	Significance of Difference	Decision on Null Hypothesis
Intrinsic Motivation	High achievers in science	306	14.56	3.497	0.1999	6.657	610	S**(0.01)	Rejected
	Low achievers in science	306	12.67	3.535	0.2021				
Career Motivation	High achievers in science	306	15.91	3.754	0.2146	8.114	610	S**(0.01)	Rejected
	Low achievers in science	306	13.31	4.138	0.2365				
Self-Determination	High achievers in science	306	11.98	3.670	0.2098	5.879	610	S**(0.01)	Rejected
	Low Achievers in science	306	10.29	3.449	0.1972				
Self-Efficacy	High achievers in science	306	13.23	3.719	0.2126	8.043	610	S**(0.01)	Rejected
	Low achievers in science	306	10.69	4.073	0.2329				
Grade Motivation	High achievers in science	306	16.64	3.260	0.1864	11.575	610	S**(0.01)	Rejected
	Low achievers in science	306	13.25	3.950	0.2258				

Source: Field data, ** The test suggests that the difference between the two means is extremely significant at 0.01 level.

Table 8

Significance of Difference between Boys and Girls in Relation to Their Science Motivation

Group	Number (N)	Mean	S.D.	SEM	t value	Df	Significance of difference	Decision on Null Hypothesis
Boys	532	67.938	14.854	.644	2.36	1132	S*	Rejected
Girls	602	65.895	14.282	.582				

Source: Field data. *The test suggests that the difference between the two means is significant at 0.02 level.

Interpretation of data: A reference to Table 8 reveals that the obtained t value (2.36) was found significant at 0.02 level with a degree of freedom 1132, 't' critical value (2.326) being < obtained 't' value. It means that the science motivation of secondary school students varies with respect to their gender, with boys being more science motivated. Hence the null hypothesis is rejected.

Table 9 further depicts the mean and standard deviation scores of students for different dimensions of the Science Motivation Questionnaire (SMQ II) with regard to gender.

Table 9

Mean and Standard Deviation Values of Boys and Girls on Different Dimensions of Science Motivation Questionnaire

Factors of science motivation	Boys (n=532)	Girls (n=602)	Total (n=1134)
Intrinsic motivation	M=14.103	M=13.314	M=13.684
	sd=3.552	sd=3.532	sd=3.562
Career motivation	M=14.881	M=14.723	M=14.797
	sd=3.953	sd=3.976	sd=3.964
Self-determination	M=11.240	M=11.149	M=11.192
	sd=3.678	sd=3.511	sd=3.589
Self-efficacy	M=12.714	M=11.694	M=12.173
	sd=4.048	sd=3.834	sd=3.967
Grade motivation	M=14.951	M=15.015	M=14.985
	sd=3.910	sd=3.795	sd=3.848

A reference to Table 9 suggests that the mean score of boys and girls on all the five dimensions of science motivation differed slightly, with boys' average being slightly higher except for the dimension grade motivation where girls had a higher mean score. Interestingly, the standard deviation for both boys and girls was almost neck to neck except for dimension self-efficacy, where boys had a higher mean score and standard deviation than their counterparts.

Researchers also attempted to perform a point bi-serial correlation between the variable gender and student's score on science motivation, which is a special type of Pearson product-moment Correlation considering the nature of a variable. With reference to Table 10, it can be seen that science motivation and gender are negatively correlated, i.e., a higher level of science motivation is exhibited by a lower number of group variable 'gender,' which is 1 for boys and correspondingly, girls with group variable 2 exhibited a lower level of science motivation. However, the girls did not underperform compared to boys at the same time as the correlation is low negative, although significant at 0.05 level.

The fifth objective of the present study was to find out the gender differences among high and low achievers in science in relation to their science motivation. Table 11 depicts the result of the t-test.

Table 10

Correlation between Science Motivation (IV) and Gender (DV)

Independent Variable (IV)	Dependent Variable	N	Df (N-2)	Point bi-serial Correlation	Significance level
Science motivation	Gender	1134	1132	-0.07	S*

Source: Field data. *Significant at 0.05 level

Table 11

Significance of Difference Between Boys and Girls within High and Low Achieving Groups of Science in Relation to Their Science Motivation (SM)

Group	Number	Mean	SD	SEM	T value	df	Significance of Difference	Decision on Null Hypothesis
SM of High Achieving Boys	156	72.70	14.58	1.168	0.491	304	NS	Accepted
SM of High Achieving Girls	150	71.94	12.27	1.002				

SM of Low Achieving Boys	120	61.26	14.25	1.301	0.931	304	NS	Accepted
SM of Low Achieving Girls	186	59.69	14.42	1.057				

Source: Field data

Interpretation of data: A reference to Table 11 reveals that after the comparison between mean on science motivation of boys and girls within the high achieving group, the obtained t value (0.491) was found not significant at 0.05 level with a degree of freedom 304, 't' critical value (1.960) being < obtained 't' value. It means that there is no variation in students' science motivation within the high achieving group with respect to their gender. Hence the null hypothesis is accepted. A similar comparison within the low achieving group was also performed. Again with reference to Table 11, the obtained t value (0.931) was found not significant at 0.05 level with a degree of freedom 304, 't' critical value (1.960) being < obtained 't' value. It means that there is no variation in science motivation of students within the low achieving group with respect to their gender. Hence the null hypothesis is accepted.

Discussion

The purpose of this study was to determine how the secondary students conceptualised their motivation to learn science, particularly those belonging to a close-knit population of ethnic diversity in the northeastern state of Mizoram, India. When analysing the conceptual factors that motivate the students to learn science, the highest motivational construct existed for grade motivation, followed by career motivation, intrinsic motivation, self-efficacy, and least for self-determination construct. The study also showed a significant positive relationship between students' science motivation level and achievement in science (r =.314**, r^2=.098, p=.000). This finding is sinking with a similar study on Malaysian secondary school students (Chan and Norlizah, 2017). The results indicated that students' motivation towards science learning significantly correlates with students' science achievement (r =.354**, r^2=.125, p=.000). The present study revealed that high and low achievers in science significantly differed on their science motivation level, with high motivators scoring high. This finding is analogous to the finding of Tuan, Chin and Shieh (2005), who found in their study of junior high school students from central Taiwan that high motivators and low motivators showed a significant difference (p <0.01) in students' motivation toward science learning (SMTSL) score measured with six scales of self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment.

However, in the present study, a significant difference existed between boys and girls regarding their science motivational level. Comparing their mean scores favours the boys; exceptionally, girls were found to obtain a higher mean score for grade motivation than their counterparts compared to their mean scores for each of the five sub-constructs. It suggests that girls are more motivated to obtain higher grades in science, which is also the highest motivational construct that impacts students' high achievement in science. Although in a similar study by Salta and Koulougliotis (2015) based on the Greek version of Chemistry Motivation Questionnaire II (Greek CMQ II), girls differed from a boy on other dimensions, and gender-based comparisons showed that girls had higher self-determination than boys; also the girls of lower secondary groups had a higher career and intrinsic motivation than the boys of the same age group. In general, the present sample could conclude that extrinsic motivational factors of obtaining good grades and a promising career in science propel students more to perform well than intrinsic motivational factors. The least motivating factor of self-determination and self-efficacy to perform well in science is indicative that science learning is being treated as more of a mechanical endeavour than a practical exercise. As a result, students fail to build upon trust to do well in science. Thus science learning needs a more favourable environment where fears and phobias need to be erased, lacking which intrinsic motivational factors do not work. The findings also indicate no significant difference in students' science motivational levels within high and low science achievement groups with regard to their gender. This suggests that gender is not a deciding factor for students' science achievement differences in extreme groups, although differences exist. In their study, Chan and Norlizah (2017) found that Malaysian secondary school students' motivation towards science learning is impacted by gender. The female students were found to be significantly more motivated than the boys. Also in the Malaysian sample results showed that the level of students' motivation towards science learning was moderate, and the science achievement level was between averages to low.

The present study's findings revealed that the level of science motivation of secondary students in Mizoram is towards a higher range, and it was found that they scored more than average in all the dimensions. They scored a maximum for the dimension of grade motivation followed by career motivation, intrinsic motivation, self-efficacy, and self-determination. The findings agree with earlier studies (Bryan, Glynn and Kittleson 2011; Salta and Koulougliotis, 2015; Chumbley, Haynes and Stofer, 2015). It indicates students are maximally motivated to perform better in sciences to get good grades and find a good career option, and to some extent, they have more than a moderate level of intrinsic motivation. However, self-efficacy and self-determination are of average level, which needs further improvement. It conveys that students are not self-motivated and confident for doing academically better in science, which may be due to a lack of favourable environmental factors.

Recommendations

The present study recommends bringing changes in traditional science classroom experiences for students providing equal opportunities and encouragement for girls and boys. This study tried to show the gender differences in motivational constructs, majorly revealing the dominance of boys in being highly motivated to learn science; however, reasons for less science motivation among girls need to be found out. In the present sample, girls were found to be more than boys, but despite gender parity in the Mizo schools, it needs to be investigated why girls are less motivated to learn science. Further, it needs to be investigated what kind of preferences for learning science are sought by the students at the secondary level of schooling in general. Also, additional research is needed to enrol more students in the science stream and investigate the factors that favour more boys to join the stream than their counterparts. Some specific questions such as, what are the factors preventing girls from choosing science stream in the future and how the science content should be organized to attract an equal audience of both the gender and why is it so that students are moderately motivated to do science in their future endeavours needs to be answered through further research. Secondary school students need to be motivated well for learning science. Students with high science motivation levels should be constantly encouraged to enter higher education in sciences as they befit there very well. The positive affective traits of students such as motivation and interest towards science subjects are needed to be readily incorporated both inside and outside classroom teaching-learning situations. Its beneficial effect on learner gets translated to improved performance of students in science, and vice versa is one of the vital recommendations of the present study.

Conclusion

The present study suggests that science motivation within secondary students can positively contribute to their achievement in science both at present and for their choice of a future career in science. The present findings in the particular context of Mizo secondary school students reveal similarities with many populations of different contexts, emphasising the need to promote students' positive affect in connection with science subjects. Science motivation is an affective construct in science education, which refers to students' psychological state that arouses them to perform better in a science subject. This construct positively influences a student's science performance, so its advantage readily needs to be incorporated in science classrooms. In addition, student environmental factors such as, school, teachers, peers, parents, etc., can also influence it. In the present study, secondary school students possess above moderate level of science motivation, suggesting that students want to learn science and science hold a crucial position in the school curriculum. The affective traits of learners have a significant role in both science and students' overall academic achievement to such an extent that the science teaching and learning process cannot afford to ignore it.

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