The predictive effects of motivation toward learning science on TIMSS grade 8 students' science achievement: A comparative study between Malaysia and Singapore

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TIMSS routinely presents very powerful evidence showing that students with more positive motivation toward learning science have substantially higher achievement. The results from TIMSS 2011 are consistent with previous assessments. This study explored the predictive effects of motivation toward learning science on science achievement among Malaysian and Singaporean eighth graders who participated in the TIMSS 2011. In this study, students' interest in and liking of learning science, students' understanding about the importance and the usefulness of the science subject, and students' self-confidence or self-concept in their ability to learn science were measured. Secondary data of the study were obtained from 5,733 Malaysian students and 5,927 Singaporean students who participated in the TIMSS 2011. The results of the present study indicated that eighth-graders' liking and valuing of learning science were positively associated with Malaysian and Singaporean Grade 8 students' science achievement.

Keywords: Motivation toward learning science, science achievement, TIMSS

INTRODUCTION

Singapore and Korea are two countries that have consistently been outperforming their counterparts in mathematics and science on most cycles of the Trends in International Mathematics and Science Study (TIMSS) since its inception in 1995. The

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findings of the recent cycles of TIMSS reveal that Korea and Singapore are the top-performing countries in science in TIMSS 2011 at the fourth grade, followed by Finland, Japan, Russian Federation, and Chinese Taipei. At the eighth grade, Singapore had the highest average science achievement followed by the next highest-performing-countries, namely Korea, Chinese Taipei, and Japan. Malaysia, however, was 31 on the list in science at the eighth grade.

Much research about students' learning has studied the complex phenomenon of motivation (Nolen, 2003; Pintrich, 2003; Singh, Granville, & Dika, 2002) . For example, students' motivation to learn can be affected by whether or not they find the subject enjoyable and place value on the subject. In addition, students' motivation can be affected by their self-confidence in learning the subject (Linnenbrink & Pintrich, 2003). Hence, TIMSS 2011 included scales about three motivational constructs: intrinsic value (interest), utility value, and ability beliefs (Martin, Mullis, Foy, & Stanco, 2012). However, factors that might have contributed to the outstanding science performance in TIMSS are multi-faceted, and such factors have been widely researched recently, including cognitive, affective (i.e., interest, attitude, and motivation), as well as psychological and sociological aspects (see Ong & Gonzalez, 2012; Ong, Gonzalez, & Shanmugam, 2013). Hence, the purpose of the present study is to examine the predictive effects of an affective factor, i.e., students' motivation towards learning science on science achievement among eighth grade students from Malaysia and Singapore who participated in the TIMSS 2011 assessment.

State of the literature

- How science is taught influences students' interests and prospective career choices in the subject.
- Cognitive science, constructivism, and social constructivism to review cognitive and social dimensions of learning have been analyzed in the learning about learning curriculum.
- According to the attribution theory for motivation, students who believe that success is related to effort will be more likely to use effort than those who believe that success is due to inherent ability.

Contribution of this paper to the literature

- Compares Malaysian and Singaporean students' motivation for learning science based on TIMSS assessment.
- Compares Malaysian and Singaporean students' psycho-socio aspects of science, as well as understanding the importance and usefulness of the subject.
- Helps educators and policy makers to identify and nurture the strong learning prerequisites of early adolescents in the Malaysian and Singaporean education systems.

LITERATURE REVIEW

Self-Beliefs in Motivational Constructs and Constructivist Theoretical Framework

Much effort has been made to review the contemporary issues and challenges faced in motivating students to like science and to outline relevant factors contributing to the cognitive, psychomotor, and affective domains of science learning. Various aspects of behaviourism, cognitivism, and constructivism have been compared in the areas of 'learning process, framework, principles, strategies and theorists' (Berns & Erickson, 2001; EdTech Project, 2007). Three contemporary theories of learning, i.e., 'cognitive science, constructivism and social constructivism' to review 'cognitive and social dimensions of learning' have also been analyzed in the 'learning about learning' curriculum (University of Washington, 2001).

Constructivist and motivation theories recognize that motivation is influenced by how interesting and relevant the learners perceive the activities and information. According to educational psychologists, students' motivation is influenced by a number of beliefs, values, interests, and attitudes that can be positive or negative in their effects. The construct about 'self' was grounded on the 'self-determination'

theory (stating that students may do activities for interest or enjoyment, i.e., intrinsic motivation), and/or the 'self-belief' theory (including self-efficacy which states that when self-confidence is high, students will be more motivated to persist in a task until it is completed). The construct 'belief on own coping ability' (intrinsic motivation) is based on the Expectancy-Value theory explaining that beliefs about one's ability to succeed are expectancy beliefs, beliefs about the extent to which the task is useful, enjoyable, or relates to one's self-image as value beliefs (Glynn, Taasoobshirazi, & Brickman, 2007; Palmer, 2007; Phillips, 2007; Weiner, 1979). It is believed that students are motivated to learn when they value either the outcome or process of learning and they expect that they will be successful. As explained from psychological theories, students believe that the task is of value (value beliefs) and they believe he/she has the ability and confidence to succeed in the learning task (expectancy and self-efficacy beliefs) (Lefton, 1991; Phillips, 2007). In other words, highly positively motivated students would find the task inherently enjoyable (intrinsic motivation), have an established long-term interest in particular topics (personal interest) based on interest theory, have a desire to fully understand the content (a mastery goal) and believe that success will be related to effort (an attribution). According to Weiner (1979), the attribution theory for motivation states that students who believe that success is related to effort will be more likely to use effort than those who believe that success is due to inherent ability. When individuals have a positive sense of effort, ability, and efficacy, they are more likely to choose to do the challenging tasks and excel in academic performance.

Relationship between Self-Efficacy Beliefs and Achievement in Science

Self-efficacy is a very specific form of self-concept theory that refers to people's beliefs about their mastery or capabilities to perform a task successfully at designated levels with convictions about their own effectiveness that can determine the types of behaviour they will engage in or the amount of risk they will undertake. It is a belief about whether or not they can successfully engage in and execute a specific behaviour or their confidence in their ability to behave in such a way to produce a desirable outcome (Bandura, 1977, 1997; Lefton, 1991). Self-efficacy determines and flows from the feelings of self-beliefs and self-worth. In other words, the people with self-efficacy consider themselves to be capable and worthy. A strong sense of self-efficacy allows people to feel free to select the influence, construct their own desirable lives, and even effect changes in themselves and persevere in tough times. Self-efficacy or self-beliefs make a difference to how people feel, think, and act, such as in science-related learning or activities. If people feel themselves to be able to control a situation, this increases their perceived self-efficacy or self-beliefs to manage it. In fact, people with a high level of self-efficacy are more likely to attribute success to variables within themselves rather than to chance factors and are more likely to pursue a task (Bandura & Wood, 1989 in Lefton, 1991), subsequently striving towards accomplishing the task with commendable achievement.

In a study to examine the effect of a computer-enhanced problem-based learning (PBL) environment on middle school students' learning, Liu, Hsieh, Cho, and Schallert (2006) found that self-efficacy was shown to be a statistically significant predictor of science achievement scores. On the other hand, literature has revealed that early experience with science is expected to influence students' self-belief or self-efficacy towards their involvement in science. Students will 'like or be interested in' and 'value' science learning, like to be 'engaged' more in science related lessons and be even be more 'confident' to pursue science-related studies and careers. Conner et al.'s (2013) revealed that greater emphasis on early years in scientific and reading literacy promote student-centred learning and thinking skills.

BACKGROUND

Background Information of Malaysia and Singapore in TIMSS 2011

TIMSS is an international comparative study that has been implemented by The International Association for the Evaluation of Educational Achievement (IEA) since 1995. It was designed to assess the quality of the teaching and learning of science and mathematics among Grades 4 and 8 students across the participating countries (Martin, Mullis, Foy, & Stanco, 2012). This study examined the predictive effects of motivation towards learning science on science achievement among Grade 8 students in Malaysia and Singapore who participated in the TIMSS 2011. Singapore joined the TIMSS since 1995 at both the fourth and eighth grade levels. However, Malaysia joined the programme in 1999 only at the eighth grade level. A summary of the science performance at the eighth grade of the two countries from TIMSS 1995 to TIMSS 2011 is provided in Table 1.

Rationale

There are 11 SEAMEO countries in the Southeast-Asian (SEA) region. Four out of the 11 SEAMEO member countries, Indonesia, Malaysia, Singapore, and Thailand, participated in TIMSS 2011. However, only Singapore as the top-performing country

Table 1. TIMSS Science Scores (Grade 8) from 1995 to 2011 for Malaysia and Singapore

Year	No. of Participating Countries	Science Scores among Grade 8 Students	
		Malaysia	**Singapore**
TIMSS 1995	45	-	580
TIMSS 1999	38	492	568
TIMSS 2003	46	510	578
TIMSS 2007	59	471	567
TIMSS 2011	63	426	590

in SEAMEO was selected for comparison with Malaysia based on two main concerns. First, the purpose of this study was to identify areas in which the Malaysian education system can be improved after analyzing Grade 8 students' motivation toward learning science in Malaysia and Singapore. Second, Malaysia and Singapore share some similarities related to the socio-cultural background of the students and differences in geographical structures.

Research question

How well does Grade 8 Malaysian and Singaporean students' motivation towards learning science predict their science achievement in TIMSS 2011?

METHOD

Data

Secondary data were downloaded from the TIMSS 2011 database (http://timssandpirls.bc.edu/timss2011/international-database.html). A total of 11,660 Grade 8 students from Malaysia (N = 5,733) and Singapore (N = 5,927) participated in the TIMSS 2011 science assessment.

Measures

Science Achievement. The TIMSS 2011 science achievement scale was based on 302 items involving content (in Biology, Chemistry, Physics, Earth Science) and cognitive (i.e., Knowing, Applying, Reasoning) domains in science. TIMSS uses an imputation methodology, involving plausible values, to report student performance. Plausible

values (Misly & Sheehan, 1987, 1989; Rubin, 1987) are random elements from set of scores are used as a measure of science achievement. The IEA's International Database (IDB) Analyzer for TIMSS, a plug-in for SPSS, was used to combine the five plausible values as well as to produce their average values and corrected standard errors.

Students Liking for Learning Science. Essentially, intrinsic motivation refers to doing an activity because it is interesting or enjoyable. The 'Students Like Learning Science' Scale was developed to measure students' interest in and liking for learning science. The TIMSS 2011 'Students Like Learning Science' Scale was based on five items (i.e., "I enjoy learning science", "I wish I did not have to study science", "Science is boring", "I learn many interesting things in science", "I like science"). All items were rated on a 4-point Likert-type scale, ranging from '1' (for *Disagree a lot*) to '4' (for *Agree a lot*). The Cronbach's alpha reliability coefficients for the scale were 0.84 and 0.89 for Malaysia and Singapore, respectively.

Students Value Science. In contrast to intrinsic motivation, extrinsic motivation refers to doing something because it leads to a desirable outcome (e.g., teacher praise, good grades, being accepted to a good university, having a successful career in life, etc.). The TIMSS 2011 'Students Value Science' Scale addresses students' attitudes about the importance of the subject and usefulness of the subject, sometimes called attainment value and utility value (Wigfield & Eccles, 2000). The TIMSS 2011 'Students Value Science' Scale was based on six items (i.e., "I think learning science will help me in my daily life", "I need science to learn other school subjects", "I need to do well in science to get into the university of my choice", "I need to do well in science to get the job I want", "I would like a job that involves using science", "It is important to do well in science"). All items were rated on a 4-point Likert type scale, ranging from '1' (for *Disagree a lot*) to '4' (for *Agree a lot*). The Cronbach's alpha reliability coefficients for the scale were 0.87 for Malaysia and Singapore, respectively.

Students Confident in Science. Motivation to learn includes having the feeling that you can succeed. A strong self-concept encourages students to engage with the instruction and show persistence, effort, and attentiveness. Students' self-confidence or self-concept in their ability to learn science was assessed via the 'Student Confident in Science Scale'. The TIMSS 2011 'Students' Confidence in Science' Scale was based on nine items (i.e., "I usually do well in science", "Science is more difficult for me than for many of my classmates", "Science is not one of my strengths", "I learn things quickly in science", "Science makes me confused and nervous", "I am good at working out difficult science problems", "My teacher thinks I can do well in science with difficult materials", "My teacher tells me I am good at science", "Science is harder for me than any other subject"). A 4-point Likert type scale, ranging from '1' (Disagree a lot) to '4' (Agree a lot) was used. The scale's Cronbach's alpha reliability coefficients were 0.78 and 0.91 for Malaysia and Singapore, respectively. In addition to these measures, student demographic characteristic such as gender (1 = 'female', 0 = 'male') was included in the study as a control variable.

RESULTS

Descriptive statistics for the predictor variables (students like learning science, students value science, and students' confidence in science) are presented in Table 2.

Tables 3, 4, and 5 show the percentage of Malaysian and Singaporean Grade 8 students who liked learning science, valued science, were confident in science, with their average science achievement.

Table 2. Descriptive Statistics (Weighted) for Students Like Learning Science, Students Value Science, and Students Confident in Science

	Malaysia		Singapore	
Variables	**M**	**SD**	**M**	**SD**
Students Like Learning Science				
I enjoy learning science.	3.24	.799	3.25	.779
*I wish I did not have to study science.	1.69	.886	1.96	.932
*Science is boring.	1.84	.918	1.84	.909
I learn many interesting things in science.	3.38	.799	3.41	.722
I like science.	3.18	.856	3.17	.827
Students Value Science				
I think learning science will help me in my daily life.	3.31	.810	3.39	.705
I need science to learn other school subjects.	3.01	.855	3.00	.849
I need to do well in science to get into the university of my choice.	3.35	.874	3.31	.792
I need to do well in science to get the job I want	3.29	.878	3.12	.889
I would like a job that involves using science.	2.91	.967	2.74	.996
It is important to do well in science.	3.52	.761	3.51	.674
Students' Confidence in Science				
I usually do well in science.	2.59	.810	2.89	.832
*Science is more difficult for me than for many of my classmates.	2.48	.871	2.18	.870
*Science is not one of my strengths.	2.50	.925	2.37	.970
I learn quickly in science.	2.80	.855	2.79	.837
*Science makes me feel confused and nervous.	2.27	.921	2.23	.900
I am good at working out difficult science problems.	2.31	.832	2.48	.857
My teacher thinks I can do well in science programs/classes/lessons with difficult materials.	2.29	.882	2.65	.842
My teacher tells me I am good at science.	2.26	.897	2.43	.882
*Science is harder for me than any other subject.	2.44	.941	2.12	.940

*(Note: * negatively-worded items ; 1 = Disagree A Lot, 4 = Agree A Lot)*

Students Like Learning Science

Table 3 presents the Grade 8 students' results for the 'Students Like Learning Science' Scale for TIMSS 2011.

The general/integrated science panel summarizes responses for countries where students are enrolled in science as a single subject (Martin, Mullis, Foy, & Stanco, 2012). Students who liked learning science had a score of at least 10.8, which corresponds to their "agreeing a lot" with three of the five statements and "agreeing a little" with the other two. Students who did not like learning science had a score no higher than 8.4, which corresponds to their "disagreeing a little" with three of the five statements and "agreeing a little" with the other two. All other students somewhat liked learning science.

Students Value Science

Table 4 presents the results for the TIMSS 2011 'Students Value Science' Scale for Grade 8 students.

Students who valued science had a score on the scale of at least 10.5, which corresponds to their "agreeing a lot" with three of the six statements and "agreeing a little" with the other three, on average. Students who did not value science had a score on the scale no higher than 8.6, which corresponds to their "disagreeing a little" with three of the six statements and "agreeing a little" with the other three, on average. All other students somewhat valued science.

Table 3. Students Like Learning Science

Country	N	Like Learning Science		Somewhat Like Learning Science		Do Not Like Learning Science		Average Scale Score
		%	**Average Achievement**	**%**	**Average Achievement**	**%**	**Average Achievement**	
Malaysia	5702	42 (1.4)	457 (5.8)	44 (0.9)	418 (6.3)	13 (1.0)	364 (9.4)	10.4 (0.06)
Singapore	5919	38 (0.8)	617 (5.2)	46 (0.7)	584 (4.2)	16 (0.5)	542 (5.4)	10.2 (0.03)
International		35 (0.2)	515 (0.8)	44 (0.2)	472 (0.8)	21 (0.2)	450 (1.1)	10.3 (0.03)

(NOTE: Standard errors in parentheses)

Table 4. Students Value Science

Country	N	Value		Somewhat Value		Do Not Value		Average Scale Score
		%	**Average Achievement**	**%**	**Average Achievement**	**%**	**Average Achievement**	
Malaysia	5689	49 (1.6)	453 (5.7)	34 (0.9)	419 (6.4)	17 (1.1)	370 (9.2)	10.3 (0.07)
Singapore	5914	41 (0.8)	616 (4.6)	43 (0.7)	583 (4.3)	17 (0.6)	546 (5.9)	10.2 (0.03)
International		41 (0.2)	502 (0.8)	33 (0.2)	477 (0.8)	26 (0.2)	457 (1.1)	10.2 (0.04)

(NOTE: Standard errors in parentheses)

Students' Confidence in Science

Table 5 presents Grade 8 students' results for the TIMSS 2011 'Students' Confidence in Science' Scale.

Table 5. Students' Confidence in Science

Country	N	Confident		Somewhat Confident		Not Confident		Average Scale Score
		%	**Average Achievement**	**%**	**Average Achievement**	**%**	**Average Achievement**	
Malaysia	5693	4 (0.4)	511 (9.0)	45 (1.1)	437 (6.2)	51 (1.3)	411 (6.5)	9.1 (0.04)
Singapore	5917	14 (0.5)	630 (5.9)	48 (0.7)	600 (4.8)	37 (0.8)	562 (4.2)	9.6 (0.03)
International		20 (0.2)	536 (1.0)	49 (0.2)	482 (0.8)	31 (0.2)	450 (0.9)	9.4 (0.03)

(NOTE: Standard errors in parentheses)

Table 6. Correlations between Motivation towards Science with Science Achievement

	Malaysia							
	SLS		**SVS**		**SCS**		**Science**	
	r	SE	*r*	SE	*r*	SE	*r*	SE
SLS	1.00	0.00	0.63*	0.01	0.59*	0.01	0.32*	0.02
SVS			1.00	0.00	0.46*	0.02	0.34*	0.02
SCS					1.00	0.00	.22*	0.02
Science							1.00	0.00
	Singapore							
	SLS		SVS		SCS		Science	
	r	SE	*r*	SE	*r*	SE	*r*	SE
SLS	1.00	0.00	0.59*	0.01	0.71*	0.01	0.29*	0.02
SVS			1.00	0.00	0.49*	0.01	0.26*	0.02
SCS					1.00	0.00	0.26*	0.02
Science							1.00	0.00

*Note: *p < 0.05; SLS – Students Liking Science; SVS – Students Value Science; SCS – Students' Confidence in Science; Science – Science Achievement*

Students who were confident in science had a score of at least 11.5, which corresponds to their "agreeing a lot" with five of the nine statements and "agreeing a little" with the other four. Students who were not confident had a score no higher than 9.0, which corresponds to their "disagreeing a little" with five of the nine statements and "agreeing a little" with the other four, on average. All other students were somewhat confident in science.

To address the purpose of the study, correlation and separate simultaneous multiple regression analyses were conducted for each education system to determine whether or not students' motivation towards learning science was predictive of science achievement (see Table 6).

DISCUSSION AND CONCLUSION

On average, 42% of the Malaysian students like learning science, and only 13% do not like learning science as compared to 38% of the Singaporean students who like learning science and 16% do not like learning science. Accompanying the decrease in liking learning science is a widening achievement gap between students who like learning science (457, 617) and those who do not (364, 542) for Malaysian and Singaporean students, respectively. It is noticeable that Singapore, one of the highest performing countries in TIMSS shows a smaller percentage of students reporting positive motivation toward learning science. The tendency of the smaller percentage of students in Singapore and some East Asian countries (such as Chinese Taipei, Japan, and Korea) to report positive motivation is consistent with previous TIMSS assessments. The relatively low percentages of students who like learning science may partially be the result of the high level of difficulty of the science being studied, and also these countries have a cultural tradition of serious attitudes toward learning. Perhaps Grade 8 teachers should make greater efforts to make science relevant to students' daily lives and provide interesting materials, especially in light of the decrease by the eighth grade in students' liking science learning.

At the eighth grade, internationally, about one-third (35%) of the students, on average, like learning science, and about one-fifth (21%) do not like learning science. Accompanying the decrease in liking learning science is a widening achievement gap between students who like learning science (515, on average) and those who do not (450). Hence, it can be concluded that students who liked learning science had higher average science achievement than those who only somewhat liked or did not like learning science (Martin, Mullis, Foy, & Stanco, 2012).

On average, 49% of the Malaysian students value science, and only 17% do not value science compared to 41% of the Singaporean students who value science and 17% who do not value science. Accompanying the decrease in valuing science is a widening achievement gap between Malaysian and Singaporean students who value science (453, 616) and those who do not (370, 546). Internationally, on average, Grade 8 students from countries where students study general or integrated science placed a high value on science. On average, 41% were in the "Value" category and another 33% were in the "Somewhat Value" category. However, about one-fourth (26%) were in the "Do Not Value" category. Across Grade 8, students who said they valued science typically had higher achievement than students who only valued it somewhat, and those students, in turn, had higher achievement than students who did not value science (Martin et al., 2012).

On average, only 4% of the Grade 8 students in Malaysia expressed confidence in their science ability, with 45% somewhat confident, and 51% not confident. On the other hand, 14% of Singaporean students, on average, expressed confidence in their science ability, with 48% somewhat confident and 37% not confident. Accompanying the decrease in confidence in science is a widening achievement gap between students who are confident in science (511, 630) and those who are not (411, 562)

Table 7. Grade 8 Students' Motivation towards Science in Predicting their Science Achievement

	Malaysia		Singapore	
	β	*SE*	*β*	*SE*
Gender	10.91*	4.98	6.82	3.82
Students like science	9.40*	1.70	7.17*	1.28
Students value science	12.49*	1.62	7.31*	1.17
Students confident in science	1.45	1.88	5.21*	1.02
Adjusted R^2	.14		.10	

*p < 0.05

for Malaysian and Singaporean students, respectively. On average internationally, only 20% of the Grade 8 students from countries where students study general or integrated science expressed confidence in their science ability, with 49% somewhat confident and 31% not confident (Martin et al., 2012).

The results in Table 6 indicate that Grade 8 students' liking, valuing, and confidence of learning science were positively and significantly associated with their science achievement ($r = 0.22$ to 0.34 in Malaysia; $r = 0.26$ to 0.29 in Singapore). Besides that, Malaysian and Singaporean students' liking, valuing, and confidence of learning science were also moderately, positively, and significantly correlated among each other ($r = 0.46$ to 0.63 in Malaysia and $r = 0.49$ to 0.71 in Singapore).

Grade 8 students in Malaysia and Singapore who liked learning science scored statistically and significantly higher on the TIMSS science assessment than their peers who did not like learning science (see Table 7). Similarly, Grade 8 students in Malaysia and Singapore who greatly valued learning science also scored significantly higher on the TIMSS science assessment than their peers who did not value learning science. However, only Singaporean Grade 8 students who were more confident in learning science scored significantly higher on the TIMSS science assessment than their peers who were less confident in learning science. On the other hand, Malaysian female students scored significantly higher than their counterparts on the TIMSS science assessment. TIMSS routinely presents very powerful evidence showing that within countries, students with more positive attitudes toward science have substantially higher achievement, and the results from TIMSS 2011 are consistent with previous assessments (Martin et al., 2012). There is extensive research showing that students with more positive attitudes toward mathematics and science attain higher average achievement in mathematics and science (Martin et al., 2012; Mullis, Martin, Foy, & Arora, 2012).

The largest *β* value of 12.49 (students value science) suggests that this variable makes the strongest unique significant contribution to explaining the dependent variable for the Malaysian sample, when the variance explained by all the other variables in the model is controlled for. The significant *β* value of 5.21 (students' confidence in science) for the Singaporean sample was the lowest significant value indicating that it made the least contribution. However, the lowest non-significant value of 1.45 (students' confidence in science) was obtained for the Malaysian sample.

This study found that Grade 8 students in Malaysia and Singapore who liked learning science scored significantly higher on the TIMSS science assessment than did their peers who did not like learning science. Similarly, students who greatly valued learning science also scored significantly higher on the TIMSS science assessment than did their peers who did not value learning science in Malaysia and Singapore. However, it should be understood that the relationship between positive motivation and high achievement is bidirectional, with motivation and achievement mutually influencing each other, e.g., students who are good at science also are more likely to enjoy learning science. Due to the fact that this study was a non-experimental survey research using secondary data drawn from the TIMSS 2011 database, it is highly recommended that an experimental research design should be adopted to further

investigate the predictive effects of motivation toward learning science on students' science achievement in future researches.

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