A CORRELATIONAL-COMPARATIVE STUDY OF GRADES 9, 10, 11 AND 12 STUDENTS' MOTIVATION FOR LEARNING BIOLOGY AND THEIR BIOLOGY ACHIEVEMENT AT PAN-ASIA INTERNATIONAL SCHOOL, THAILAND

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Abstract: This study investigated student motivation for learning biology, with student biology achievement at Pan-Asia International School (PAIS) in Thailand. The study separated Grades 9 and 10 students, and Grades 11 and 12 students according to their academic program. The study examined the motivation of 64 Grades 9 and 10 students ("Pre-IB" Program), and 43 Grades 11 and 12 students (International Baccalaureate Diploma Program). The researcher used the Motivated Strategies for Learning Science Questionnaire (MSLSQ) to identify the student motivation level for learning biology of these 107 students in the high school department at PAIS. Student motivation level for learning biology was determined from five components of motivation for learning: intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs and self-efficacy for learning and performance. Student achievement in biology was examined using two achievement placement tests created from past International Baccalaureate exam questions. The data collected was analyzed using means, standard deviations, Pearson product moment correlation coefficients and an independent samples t-test. The findings showed that the level of students' motivation for learning biology in both Grades 9 and 10 and Grades 11 and 12 was high. A significant relationship was determined between students' motivation level for learning biology and student biology achievement for both Grades 9 and 10 and Grades 11 and 12. Grade 12 students at PAIS were determined as having a lower level of motivation for learning biology, in comparison with the other grade levels studied. Recommendations for schools, teachers and future researchers were identified.

Keywords: Motivation, Biology, Achievement, Science, High School, International Baccalaureate Diploma Program.

Introduction

Pan-Asia International School (PAIS) is an International school in Bangkok, Thailand. PAIS utilized a modified form of the Massachusetts State curriculum until

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2013, when it transitioned to a Common Core based curriculum. In 2010, PAIS introduced the International Baccalaureate Diploma Program, to provide greater opportunities for students to attend universities internationally. PAIS currently offers the Common Core curriculum of the United States in primary and middle school (Grades 1-8), and then offers the International Baccalaureate Diploma Program (IBDP) in Grades 11 and 12.

This situation created a curriculum misalignment for PAIS students entering Grade 11 as the Common Core curriculum is not aligned with the requirements of IBD. Simply put, the content and skills the students learned in Grades 9 and 10 at PAIS did not prepare them sufficiently to take the IB Diploma. To resolve this situation PAIS introduced a "Pre-IB" program to improve learning in Grades 9 and 10. To more adequately prepare students for the IB Diploma Program, the objectives for IBDP students were taught to Grades 9 and 10 students, but the content is reduced and taught in a simplified manner. PAIS is currently (as of April 2017) an IB Middle Years Program candidate school, attempting to implement a long-term solution in the form of the International Baccalaureate Middle Years Program.

This study is intended to evaluate student motivation and achievement in both programs (Pre-IB and IBDP), to determine if there is a difference in student motivation between these two streams, and the relationship on student biology achievement. As this study is conducted by a biology teacher, the researcher will study students studying biology at PAIS. Science teachers at PAIS do not currently have enough information about Pre-IB student motivation to determine any changes required to the Pre-IB program to improve student achievement. It is therefore hopeful that this study will identify a relationship between students' motivation level for learning science and the students' achievement in science. This will allow teachers and administrators a more informed understanding of the effect transition from Pre-IB to IBDP and any resultant effect upon student motivation.

Research Objectives

The following are the research objectives for this study.

1. To determine the levels of the students' motivation for learning biology for Grades 9 and 10 students, at Pan-Asia International School.
2. To determine the levels of the students' motivation for learning biology for Grades 11 and 12 students, at Pan-Asia International School.
3. To determine if there is a significant relationship between students' motivation for learning biology and student biology achievement amongst Grades 9 and 10 students, at Pan-Asia International School.
4. To determine if there is a significant relationship between students' motivation for learning biology and student biology achievement amongst Grades 11 and 12 students, at Pan-Asia International School.
5. To determine if there is a significant difference in student motivation for learning biology between Grades 9 and 10 students, and Grades 11 and 12 students at Pan-Asia International School.

Conceptual Framework

This study was intended to determine the students' level of motivation for learning biology amongst Grades 9, 10, 11 and 12 students at Pan-Asia International School. The levels of student motivation for learning biology were identified using the MSLSQ, or Motivated Strategies for Learning Science Questionnaire. The MSLSQ was adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich, Smith, Garcia, & McKeachie (1991). Student's motivation levels were assessed using the constructs of the students' intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, and self-efficacy for learning and performance to create a composite score of student motivation. To determine the level of student achievement for biology, the students took an assessment created from a previous year's International Baccalaureate biology examination.

The researcher then looked for a significant relationship between student motivation for learning biology and student biology achievement for Grades 9, 10, 11 and 12 students at Pan-Asia International School. The motivation level for learning biology was compared between Grades 9 and 10 (pre-IB students), and Grades 11 and 12 (IBDP students) to ascertain if there was a significant difference between these two groups. See Figure 1 for the conceptual framework of this study.

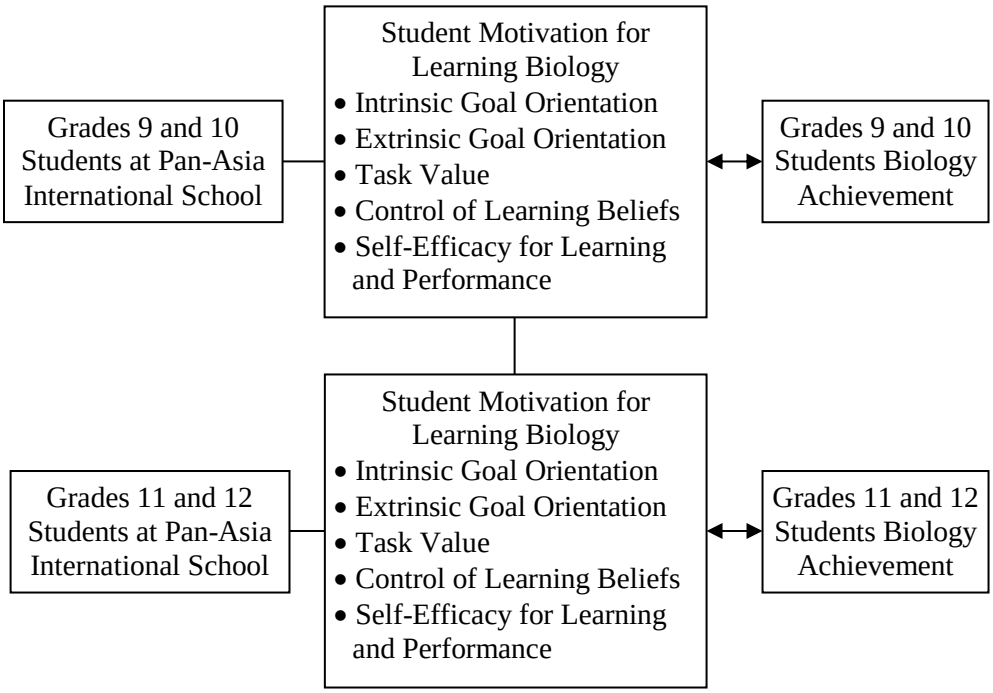

Figure 1: Conceptual Framework of This Study

Literature Review

Social Cognitive Theory

Social cognitive theory (SCT) developed from the work of noted psychologist Albert Bandura. Bandura's original work targeted the foundations of human behavior, particularly children, and how they model observed behaviors in their environment. Bandura's work led to the creation of social learning theory, examining how people learn through observing other people's behavior and the results of their actions. Bandura (1977) determined that most human behavior is created by modelling the behavior of others. Cognition resulted from observation of others' behavior, and acted as a guide for the future actions of the observer. In 1986, Bandura renamed social learning theory to social cognitive theory to create a better description of how learning comes from social experiences and cognition that resulted (Bandura, 1986).

SCT is a model used to explain the developmental changes a person goes through during their life (Bandura, 1989). A feature of SCT is the idea of reciprocal determinism, that interactions between the environment, the behavior of the person, and their internal cognition are related in a bi-directional method. These factors can affect each other in a reciprocal fashion (Bandura 1986; Bandura 1989).

Instrumentation and the MSLSQ

The instrument for this will be the Motivated Strategies for Learning. Science Questionnaire (MSLSQ). The MSLSQ is adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich et al. (1991). The MSLQ was developed to measure college age student's motivational orientations, and their learning strategies they employed (Artino, 2005; Pintrich et al., 1991). The MSLQ was developed using the social cognitive view of motivation and student learning strategies (Artino, 2005; Pintrich, 2003).

Intrinsic Goal Orientation

Intrinsic goal orientation is a student's orientation towards completing a task for internal, self-motivating reasons such as the challenge or curiosity (Pintrich et al., 1991). Intrinsic motivation requires some inherent satisfaction to be present in performing a task or activity itself, not related to any external reward (Deci & Ryan, 1985).

Extrinsic Goal Orientation

Extrinsic goal orientation refers to the reasons for completing a task, and complements intrinsic goal orientation. Extrinsic goal orientation is a student orientation towards completing a task for an external reason, such as grades, competition or career purposes (Pintrich et al., 1991). Extrinsic motivation is motivation identified as coming from potential external rewards, rather than from the reward of performing a task itself (Deci & Ryan, 1985; Ryan & Deci, 2000).

Task Value

Task value is a measure of a student's opinion about the task they are attempting to complete. Task value is the student's evaluation of their assigned work, and its

importance and utility to this individual (Pintrich et al., 1991). Task value represents the personal relevance to complete a task that an individual finds. (Agnesia, 2010). A task with high perceived personal relevance to the learner results in a higher level of motivation. For example, creating career motivation is one example where personal relevance is important.

Control of Learning Beliefs

Control of learning belief is the relationship the student feels between their academic performance and the outcome (Pintrich et al., 1991). Control of learning beliefs refers to the individual's belief in the causes of their success and failure. It is related how much control the individual has to create the desired behavior and achieve desired outcomes (Bandura, 1997; Pintrich, 2003). Students who believe they are in control of their learning and can create the outcomes they desire are more motivated and more likely to achieve than those who do not (Pintrich & Schunk, 2002).

Self-Efficacy for Learning and Performance

Self-efficacy is a related to an individual's ability to master and perform an assigned task (Pintrich et al., 1991). Self-efficacy is an individual's self-belief in their ability to execute activities and achieve (Bandura, 1991, 1997). Self-efficacy has been defined to be a sense of confidence of the individual's ability to perform certain tasks (Lorsbach & Jinks, 1999).

International Baccalaureate

International Baccalaureate (IB) is an organisation, curriculum and series of qualifications recognised internationally and taught in international schools. The framework for the International Baccalaureate system was laid down in 1948 with a paper by Marie-Thérèse Maurette with the title "Educational Techniques for peace. Do they exist?" (Maurette, 1948). In the 1960s, a group of teachers from the International School of Geneva created the International Schools Examinations Syndicate (ISES) based upon these recommendations, which would eventually become the current International Baccalaureate (Fox, 2001). At PAIS, IB is taught as the International Baccalaureate Diploma Program (IBDP) to Grades 11 and 12. According to the International Baccalaureate Organisation (2008), the IBDP is explicitly constructivist in nature, and deliberately articulates the very nature of science, as part of its curriculum (International Baccalaureate Organisation, 2008).

Method

The research design was a quantitative, a correlational-comparative study between motivation for learning biology and biology achievement. The first and second objectives required simple descriptive statistics, intended to determine the motivation level for learning biology amongst the Grades 9 and 10, and Grades 11 and 12 students. The third and fourth objectives required the use of inferential statistics, intended to test the correlation between motivation for learning biology and biology achievement. The third objective also required the use of inferential statistics, as it will compare the motivation for learning biology levels of the Grades 9 and 10, and Grades 11 and 12 students.

Population and Sample

There are 107 high school students studying biology in Grades 9, 10, 11 and 12 at Pan-Asia International School. For this study, the sample was all of the 107 high school students currently studying biology by the researcher at Grades 9, 10, 11 and 12, in the 2016-2017 academic year at Pan-Asia International School (see Table 1)

Table 1: Students Sampled per Grade Level

Grade Level	Sample
9	36
10	28
11	20
12	23
Total	107

Research Instruments

There were two research instruments used in this study. The first was the Motivated Strategies for Learning Science Questionnaire (MSLSQ), which examined student motivation levels for learning biology. The second was a biology placement examination, which assessed student biology achievement.

MSLSQ

The Motivated Strategies for Learning Science Questionnaire (MSLSQ), is an adaptation of the Motivated Strategies for Learning Questionnaire (MSLQ), developed by Pintrich et al. (1991). The MSLSQ uses a 7-point Likert-type scale, where students state their agreement or disagreement with offered statements on six subscales. There are 26 items on this instrument, and possible responses range from one (*not at all true of me*) to seven (*very true of me*), giving a minimum possible response of 26 and a maximum possible response of 182.

The adapted MSLSQ utilised five of the six subscales, each examining a component of motivation. The five utilised subscales were intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs and self-efficacy for learning and performance. The specifications of the MSLSQ with the alpha value for reliability are presented below as Table 2.

Table 2: Reliability Statistics of the MSLSQ

Subscale	Item Numbers	Number of Items for Each Component	Cronbach's Alpha Value by Pintrich Et Al. (1991)	Cronbach's Alpha Value in This Study
Intrinsic Goal Orientation	1, 13, 18, 20	4	.74	.53
Extrinsic Goal Orientation	6, 9, 11, 25	4	.62	.69
Task Value	3, 8, 14, 19, 22, 23	6	.90	.82

Table 2: Reliability Statistics of the MSLSQ

Subscale	Item Numbers	Number of Items for Each Component	Cronbach's Alpha Value by Pintrich Et Al. (1991)	Cronbach's Alpha Value in This Study
Control of Learning Beliefs	2, 7, 15, 21	4	.68	.65
Self-efficacy for Learning and Performance	4, 5, 10, 12, 16, 17, 24, 26	8	.93	.86
Total	26	26	.77	.71

As per research objective one, the researcher identified the students' motivation level for learning biology. The MSLQ matches the mean value to an interpretation, ranging from a very high level of motivation (scores 5.81-7.00) to a very low level of motivation (scores 1.20-2.00). The interpretation for motivation level from the MSLSQ results can be found in Table 3.

Table 3: Interpretation of the MSLSQ

Mean Response Score	Interpretation
5.81-7.00	Very high motivation level
4.61-5.80	High motivation level
3.41-4.60	Moderate motivation level
2.21-3.40	Low motivation level
1.00-2.20	Very low motivation level

Biology Placement Examination

The second instrument in this study was a biology placement examination, a test of student understanding of content. Two placement examinations were used, one with common questions for Grades 9 and 10 (Pre-IB students) and one with common questions for Grades 11 and 12 (IBDP students). These biology placement examinations each contain 20 multiple choice questions, giving the students a biology achievement score of 1-20.

The placement questions were taken from previous International Baccalaureate Diploma Program biology exam papers. As the International Baccalaureate Diploma Program uses an external assessment aimed at International Schools all over the world, this should ensure a high level of validity and reliability.

Findings

Research Objective One

The first research objective was to determine the level of the students' motivation for learning biology for Grades 9 and 10 (Pre-IB) students, at Pan-Asia International

School. This was performed by calculating the means and standard deviations of the students' motivation scores. This is shown as Table 4 below.

Table 4: Means and Standard Deviations and Interpretation of MSLSQ Components for Grades 9 and 10 Students

Item Numbers	Component	Mean	S.D.	Interpretation (Motivation Level)
1, 13, 18, 20	Intrinsic Goal Orientation	5.268	1.420	High
6, 9, 11, 25	Extrinsic Goal Orientation	5.094	1.788	High
3, 8, 13, 19, 22, 23	Task Value	5.110	1.550	High
2, 7, 15, 21	Control of Learning Beliefs	5.683	1.409	High
4, 5, 10, 12, 16, 17, 24, 26	Self-Efficacy for Learning and Performance	4.650	1.427	High
	Overall Motivation	5.054	1.441	High

According to Table 4, the overall level of motivation for Grades 9 and 10 (Pre-IB students) was 5.054. According to the interpretation table shows a high level of motivation for learning biology. The range of values recorded was from 4.357 (moderate) to 5.964 (very high). Overall it can be stated that the level of motivation for learning biology for Grades 9 and 10 students ranged from 4.357 - 5.964, with a mean value of 5.054.

Research Objective Two

The second objective was to determine the level of the students' motivation for learning biology for Grades 11 and 12 (IBDP) students, at Pan-Asia International School. This was performed by calculating the means and standard deviations of the students' motivation scores, the results are shown as Table 5 below.

Table 5: Means and Standard Deviations of MSLSQ Components for Grades 11 and 12 Students

Item Numbers	Component	Mean	S.D.	Interpretation (Motivation Level)
1, 13, 18, 20	Intrinsic Goal Orientation	4.865	1.524	High
6, 9, 11, 25	Extrinsic Goal Orientation	4.365	1.872	Moderate
3, 8, 13, 19, 22, 23	Task Value	5.095	1.615	High
2, 7, 15, 21	Control of Learning Beliefs	5.345	1.450	High

Table 5: Means and Standard Deviations of MSLSQ Components for Grades 11 and 12 Students

Item Numbers	Component	Mean	S.D.	Interpretation (Motivation Level)
4, 5, 10, 12, 16, 17, 24, 26	Self-Efficacy for Learning and Performance	4.196	1.511	Moderate
	Overall Motivation	4.628	1.560	High

According to Table 5, the overall level of motivation for Grades 11 and 12 (IBDP students) was 4.628. According to the interpretation table, this shows a high level of motivation for learning biology. The range of values recorded was from 3.275 (low) to 5.700 (high). In summary it can be stated that the level of motivation for learning biology for Grades 11 and 12 students ranged from 3.275 - 5.700, with a mean value of 4.628.

Research Objective Three

Research objective three was to determine if there was a significant relationship between students' motivation for learning biology and student biology achievement amongst Grades 9 and 10 students, at Pan-Asia International School. This was determined using a Pearson product moment correlation coefficient calculated by entering data into statistical analysis software. Data for this objective was collected using a combination of the MSLSQ and the students' Pre-IB biology achievement exam scores and presented in Table 6.

Table 6: Pearson Product Moment Correlation Coefficient between Grades 9 and 10 Students' Motivation Level for Learning Biology and Grades 9 and 10 Students' Biology Achievement

Motivation Level for Learning Biology		Interpretation
Biology Achievement	Pearson Correlation .277**	There is a significant relationship
	Sig. (2-tailed) .039	

Note. ** Correlation is significant at the .05 level (2-tailed).

According to Table 6, the *r* value of .277 indicates that there was a weak positive relationship between students' motivation for learning biology and the student's biology achievement amongst Grades 9 and 10 students, at Pan-Asia International School. The significance of .039 indicates that this relationship was significant at the .05 level.

Research Objective Four

Research objective four was to determine if there was a significant relationship between students' motivation for learning biology and student biology achievement amongst Grades 11 and 12 students, at Pan-Asia International School. This was determined using a Pearson product moment correlation coefficient calculated by

entering data into statistical analysis software. The results are shown as Table 7 below:

Table 7: Pearson Product Moment Correlation Coefficient between Grades 11 and 12 Students' Motivation Level for Learning Biology and Grades 11 and 12 Students' Biology Achievement

Motivation Level for Learning Biology		Interpretation
Biology Achievement	Pearson Correlation .366**	There is a significant relationship
	Sig. (2-Tailed) .027	

Note. ** Correlation is significant at the .05 level (2-tailed).

The *r* value of .366 indicates that there was a moderate positive relationship between students' motivation for learning biology and student biology achievement amongst Grades 11 and 12 students, at Pan-Asia International School. The significance value of .027 indicates that this relationship was significant at the .05 level.

Research Objective Five

Research objective five was to determine if there was a significant difference in student motivation for learning biology between Grades 9 and 10 students, and Grades 11 and 12 students at Pan-Asia International School. An independent-samples *t*-test was conducted to compare student motivation for learning biology between Grades 9 and 10 (Pre-IB students) and Grades 11 and 12 (IBDP students). The results are presented in Table 8 below.

Table 8: T-Test Result Comparing Motivation Level for Learning Biology between Grades 9 and 10 (Pre-IB Students) and Grades 11 and 12 (IBDP Students)

Grade Level	Mean	S.D.	*t*	*df*	Sig. (2-tailed)
9 and 10	5.054	1.441	2.259	89	0.026
11 and 12	4.628	1.560			

According to Table 8, the *p* value of this *t*-test was .026, which was significant at the .05 level. There was a determined to be a significant difference in student motivation level for learning biology between Pre-IB students (M=5.054, SD=1.441) and IBDP students (M=4.628, SD=1.560).

Additional Finding

The original intention of this study was to compare two study groups at PAIS, namely the Pre-IB and IBDP students. However, it was considered informative by the researcher to identify which of the grade levels studied was positive or negatively impact the mean value for the grouped scores. Focusing on the Grade 12 students' motivation levels for learning biology (see Table 9), the Grade 12 students exhibited the lowest overall level of motivation for learning biology.

Table 9: Means, Standard Deviations and Interpretation of the Motivation Level in Learning Biology, for Each Grade Level at PAIS.

Grade level	Mean	S.D.	Interpretation (motivation level)
Grade 9	5.059	1.527	High
Grade 10	5.045	1.580	High
Grade 11	5.146	1.361	High
Grade 12	4.346	1.729	Moderate

Discussion

The following conclusions were drawn from the findings of this study. For both Grades 9 and 10 students (Pre-IB students) and Grades 11 and 12 students (IBDP students), there was found to be a significant relationship between the students' motivation level for learning biology and their biology achievement. There was determined to be a significant difference in the students' motivation level for learning biology between Grades 9 and 10 (Pre-IB students) and Grades 11 and 12 (IBDP students) at Pan-Asia International School. This difference was demonstrated by a lower level of extrinsic goal orientation and a lower level self-efficacy for learning and performance when learning biology, amongst the Grades 11 and 12 students.

As detailed in the additional finding, the greatest difference in motivation between the two groupings (Pre-IB and IBDP) comes from the Grade 12 students. The Grade 11 students had retained a high level of motivation for learning biology, while Grade 12 students declined to a *moderate* level of motivation for learning biology. Research objective five indicated there to be a significant difference in motivation level for learning biology, between Grades 9 and 10 (Pre-IB students) and Grades 11 and 12 (IBDP students)

The results of this study indicate a significant relationship between student motivation level for biology and student biology achievement. This study indicated a decrease in student motivation for learning biology as students' progress through grade levels at PAIS. However, the decline did not occur at the boundary between the Pre-IB and IBDP programs. The original expectation of this study was of a possible misalignment between the Pre-IB and IBDP students at PAIS. However, the findings of this study suggest there is relatively little difference in motivation between the Grade 9, 10 and 11 students at PAIS, and thus the transition between the Pre-IB and IBDP programs need not be regarded as damaging students' motivation for learning biology.

Recommendations

Recommendations for School Administrators

School administrators should be aware of the importance of student motivation, amongst the factors that affect student achievement. School administrators should make sure that motivation is considered in school policies, and teachers are considering motivation when designing their subject course. While teachers can plan to address motivation individually, any solution performs best when treated holistically. Administrators should attempt to standardize solutions amongst teachers, and training provided where possible. Teacher In-Service Education of Teachers

(INSET) training should logically address factors that affect student achievement, and some time should be specifically spent on ways to address poor student motivation. Teachers should be provided with opportunities to work together, and experienced teachers encouraged to provide peer feedback on their preferred ways to increase students' motivation levels.

Recommendations for Teachers

It is important for all teachers to be aware of the factors that affect student achievement, and to consider whether they are being considered in their classroom. Teachers should consider the factors that affect student achievement individually, and holistically to aid student progress. Teachers should aid the students' task value and where possible control of learning beliefs when designing tasks. Teachers increase task value by creating study programs that are relevant to student needs, and control of learning beliefs can be improved by allowing students choices about how they complete an activity, or which activities they complete. Self-efficacy can be improved through allowing students the opportunity to demonstrate their success, and designing a course of study where students experience a climate where they expect to succeed.

Recommendations for Future Researchers

A follow-up study is recommended with an opportunity to identify the reasons behind decreased motivation for Grade 12 students in biology. The researcher would recommend a qualitative study, where a number of respondents are selected for interview. This would allow for a researcher to examine a number of the study respondents as to why they do or do not feel motivated when studying biology. A mixed qualitative and quantitative follow-up study would allow a more comprehensive examination of the issues. A recommendation for future research would be to conduct the study using a larger population and sample. It would be an ideal future practice to extend this study using students in different IBDP international schools and additional science subjects such as chemistry or physics.

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