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Fifth and ninth grade students' engagement in science classes in Palestine

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In the study reported on here I aimed to measure the extent to which fifth and ninth grade science students were cognitively, behaviourally, emotionally and socially engaged in science classes. These constructs of engagement were examined based on a set of variables: the grade, students' gender, teachers' gender, teachers' specialisation, teachers' experience and teachers' academic degree. To measure these constructs, I used the Wang Engagement Scale as well as a descriptive approach, especially in its relational components. The population, which comprised 15,057 students from the northern West Bank, was divided into groups; from each I chose a representative sample drawn using a random sampling technique based on the size of each of the three directorates of education (Jenin, Qabatia and Tubas). A questionnaire was then designed and delivered to 1,132 respondents from the fifth and ninth grades. The results suggest that fifth graders are by far more engaged than ninth graders, especially female students, and that female teachers, teachers with a degree in science, teachers with 1 to 5 years of experience and teachers with a 2-year associate degree were particularly motivating for student engagement.

Keywords: science education; student engagement; teachers' variables

Introduction

The topic "student engagement" falls within the debate on the methods that should be devised to improve education and student achievement. The concept is embedded within a broader philosophy of education underlying the methods of active learning, where learners, contrary to the conventional classroom environment, are supposed to be fully involved in all activities taking place in the classroom. In particular, the active role of students has been emphasised whereby learning is done through work, research, experimentation, and learners' self-reliance in obtaining knowledge, acquiring skills, nurturing good values, working within groups and solving problems (Abualrob, 2019).

Educational systems looking to improve the performance of their young learners have come to realise the imperative of student-centred approaches in motivating and advancing meaningful learning processes. The issue has garnered much attention from teachers who are aware of the benefits of such approaches, which are now recognised as fundamental to getting all students engaged toward achieving the objectives of the curriculum. Out of the unpretentious conviction that education should deliver what it is supposed to deliver – learners who are active enough to acquire and apply 21st century skills, innovative teachers are allowing their students to use whatever is available to them to link what they learn to their real-life experiences. This is possible through developing in students a sense of responsibility, which is in turn possible only through strategies that build in the learners' positive attitudes toward school and learning. The outcome is improved performance and reduced drop-out rates (Truta, Parv & Topala, 2018).

Student engagement has been associated with preferable outcomes in terms of learning achievement and later-life career-building (Russel & Slater, 2011). Despite that, percentages for student engagement in our schools are still disquieting. The Follow-up and Evaluation Report by the Palestinian Ministry of Education and Higher Education (2017) found that only 12.8% of school male students and 13.9% of female students were actively engaged in classroom activities across the West Bank and the Gaza Strip. The report also indicates that approximately three quarters of class time is spent on teaching (four periods per week), with the teacher delivering the lesson and the students sitting and listening, with little engagement on their part (Ministry of Education and Higher Education, 2017).

However, the level of engagement for each subject taught was not assessed. As an effort to fill one of the gaps in that report – or to complement it, with this study I measured the extent to which the fifth and ninth grade students were cognitively, behaviourally, emotionally and socially engaged in science classes. Existing Palestinian literature has yet to link these constructs to variables such as the students' gender, the teachers' gender, the teachers' education, the teachers' years of experience, and the teachers' specialisation. The results are likely to inform policymakers of the imperative of engagement and the need for policies that make engagement integral to the teaching and learning process in Palestinian schools.

Research Questions

The study was designed to address the following questions:

1) To what degree are science students in the fifth and ninth grades cognitively, behaviourally, and socially engaged in the science classes?
2) Are there significant engagement differences between fifth and ninth graders?
3) Are there significant engagement differences attributed to the students' gender, or teachers' gender, specialisation, academic degree and years of experience?

Background

Interest in student engagement has increased over the past two decades. Several studies from around the world have been carried out in order to define engagement, understand its role in student achievement, identify its drivers, and measure it (Fletcher, 2005). In defining student engagement, researchers focused on students' desire to participate in learning activities, use time effectively, perform the required tasks attentively and act in accordance with the teacher's instructions in the classroom (Chapman, 2003).

The early efforts have drawn specifically on constructivism, which, in its simplest form, views knowledge as a construct built actively by the learner (Piaget, 2013). This is a call for learners to create meaningful constructs for themselves, suggesting that learners should be immersed in classroom activities that help them build knowledge rather than acquire it (Bruning, Schraw & Ronning, 1999; Cooper, 1993). Present-day education theories emphasise the pivotal role of student engagement in building knowledge and understanding content (Baranova, Khalyapina, Kobicheva & Tokareva, 2019). Engagement is found to greatly influence learners' performance, help them find solutions to problems, and equip them with the skills needed to face life's challenges (Glanville & Wildhagen, 2007; Wang & Holcombe, 2010).

Findings of several studies (e.g., Fredricks, Blumenfeld & Paris, 2004) suggest that engagement is positively correlated with academic achievement. As simple as it seems, engagement allows students to come up with principles and concepts for themselves (Brown, Collins & Duguid, 1989). At some point, engagement would help students build confidence, develop positive attitudes toward the school (Abualrob, 2019) and perform better on standardised tests (Marks, 2000).

In an account on the factors that enhance student engagement, De Villiers and Werner (2016) cite student behaviour (enhanced by technological connectivity) and institutional conditions (such as teacher-student relationship, school support, allocation of resources and creation of enabling environments) as the most engagement-enabling predictors. In particular, the level of students' engagement in learning activities is closely related to the teacher's behaviour. In examining the role of the learning environment in student engagement, teachers have been found to be the most influential force (see, for example, Chipangura & Aldridge, 2017; Sun & Hsieh, 2018) and learners themselves reported that teachers were central to the enhancement of students' engagement and achievement (Wood, 2019).

Engagement strategies are about learners' positive participation, student-student communication and meaningful interaction with the curriculum. The framework of the 21st century skills provides a foundation that ensures student engagement in the learning process and helps students build confidence and be innovative (Abualrob, 2019). Yet, for effective implementation of the framework, schools need to provide a stimulating environment that deals flexibly with the curriculum and focuses on quality, not quantity (how the curriculum is delivered rather than how much of it is delivered).

In theorising the field, literature focuses on four engagement constructs that are believed to cover all dimensions of student actions within a classroom environment. The behavioural construct is concerned with involvement in classroom activities (Hughes, Luo, Kwok & Loyd, 2008). According to Ogbuanya and Efuwape (2018), behavioural engagement involves not only the conduct of students at school, but also their involvement and participation in learning activities.

The emotional construct pertains to the attitudes toward people within the classroom (Buhs, Ladd & Herald, 2006). The cognitive construct is linked to the efforts that learners exert to understand the activities presented to them (Duchesne & Ratelle, 2010). What's more, this construct can be said to be linked directly to behavioural engagement (Kuru Cetin, 2018). Finally, there is the social construct which involves interaction among students (Fredricks, Wang, Schall Linn, Hofkens, Sung, Parr & Allerton, 2016; Wang & Degol, 2014).

For building universal tools, scholars have devised frameworks that can predict engagement and measure its constructs. Fredricks, McColskey, Meli, Mordica, Montrosse and Mooney (2011) enumerate 21 measures of student engagement (4 observation instruments, 14 student self-report instruments, and 3 teacher report instruments). Testing student engagement involves observation of consistent behaviour that demonstrates learners' positive attitudes toward learning activities and efforts to carry out tasks eagerly. When engaged, learners are found to listen carefully to the instructor, exhibit optimism and maintain enthusiasm and curiosity (Skinner & Belmont, 1993). When not engaged, however, learners show estrangement, they lose interest in addressing challenges and they feel bored, isolated and frustrated. Observation tools include, but are not limited to, the Engagement versus Disaffection with Learning (EvsD) Scale, which measures student engagement based on behavioural and emotional factors (Lee, Song & Hong, 2019).

To address this problem of inconsistency, Fredricks and McColskey (2012) propose using interviews and students' self-report to measure engagement. While interviews with elementary school students are not particularly helpful (owing to communication difficulties), self-reports are easy

to administer. Taking the form of a questionnaire (Sinatra, Heddy & Lombardi, 2015), a student self-report was completed by the target students under my direct guidance and that of the teacher, which helped avoid ambiguity and maintain reliability.

Methodology

For the purposes of this study, I used the descriptive approach, especially its relational components, to measure the degree of cognitive, behavioural, emotional and social engagement of fifth and ninth-grade students in science classes. Drawing on the multidimensional model proposed by Wang, Fredricks, Ye, Hofkens and Linn (2016), I measured engagement constructs alongside a set of variables, namely the students' gender, the teachers' gender, the teachers' academic degree, the teachers' years of experience and the teachers' specialisation.

Study Population

The study population consisted of all students in the fifth and ninth grades in the schools of Jenin, Qabatiya and Tubas Directories (in the northern West Bank, Palestine); 15,057 students (according to the Educational Services Department at the Ministry of Education, 2020). Table 1 shows the study population and their distribution across the target Directories.

Table 1 Study population

	Fifth grade		Ninth grade		
Governorate	Male	Female	Male	Female	Total
Jenin	1,732	1,843	1,730	1,767	7,072
Qabatia	1,378	1,359	1,280	1,184	5,201
Tubas	767	694	641	682	2,784
Total	3,877	3,896	3,651	3,633	15,057

Study Sample

I used random cluster sampling in which the population was divided into groups. Following the model developed by Wang et al. (2016), a questionnaire was then designed, and items were informed by already-existing instruments. Based on the sampling, the questionnaire was delivered to 1,500 respondents (thus covering about 10% of the population). The response rate was very high (97%); however, the correct, analysable responses were only 1,132 (around 75% of the total). Table 2 shows the demographic characteristics of the study sample.

Table 2 Demographic characteristics of the study sample (N = 1,132)

Demographic variables		Frequency	Percentage
Gender (Students)	Male	392	34.62
	Female	740	65.38
	Total	1,132	
Gender (Teachers)	Male	389	34.36
	Female	743	65.64
	Total	1,132	
Grade	Fifth	518	45.76
	Ninth	614	54.24
	Total	1,132	
Teachers' specialisation	Science methods	461	40.72
	Chemistry	174	15.37
	Biology	179	15.81
	Physics	112	9.89
	Other	206	18.19
	Total	1,132	
Teachers' academic degree	Diploma	55	4.86
	Bachelor	825	72.88
	Master's	252	22.26
	Doctor of Philosophy (PhD)	0	
	Total	1,132	
Teachers' experience	Up to 5 years	275	24.29
	6 to 10 years	227	20.05
	11 years and above	630	55.65
	Total	1,132	

Study Tool

To gather data, I used a paper-and-pencil questionnaire which the fifth and ninth grade science students completed during regular class time. During this time the teacher and I were present to assist, while the teacher read the

statements to the students. The questions were aggregated into a scale developed by Wang et al. (2016) to measure four constructs of engagement: cognitive, behavioural, emotional and social. However, I modified the scale to specifically measure engagement for only science classes (thus excluding mathematics, which the scale measures together with science). The questionnaire includes 33 statements: 1 to 8 for the cognitive construct (with statements 5 to 7 in the negative form, for example, I don't); 9 to 16 for the behavioural construct (with statements 14 to 16 in the negative form); 17 to 26 for the emotional construct (with statements 21 to 26 in the negative form); and 27 to 33 for the social construct (with statements 31 to 33 in the negative form) (cf. Appendix A).

To measure the sum of responses, I used a five-level Likert scale (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). Because data collection was conducted in Palestine, the questionnaire was translated by a professional into Arabic so that the students could understand it.

Validity of the Tool

For face validity of the tool, the questionnaire was delivered to six academic referees who are known to be well-versed in the topic of student engagement, to ensure objectivity, intelligibility for respondents, conformity with the culture, and relevance. Based on their remarks, some of the statements were modified before the questionnaire was administered. Once the questionnaire had been modified, it was delivered to the sample students, who started completing the questionnaire only after the teacher and I had read all the items to them.

Internal Consistency

To ensure internal consistency and how the statements are closely related within the questionnaire, I carried out a pilot study with 50 members of the relevant population. The simulation members reported their full understanding of all the items. Using Cronbach's alpha, the analysis resulted in reliable consistency coefficients for the cognitive, behavioural, emotional and social constructs (with 0.759, 0.811, 0.842 and 0.828, respectively, with the average at 0.8105).

Data Analysis Techniques

For the analysis stage, I used descriptive statistics (namely, repetitions percentages, the arithmetic mean and the standard deviation) as well as inferential statistics to reach conclusions that cannot be obtained from descriptive statistics alone. Specifically, I used one-way anova and *t*-test (to identify statistically significant differences between the means of the groups); one sample *t*-test (to determine whether the mean of the sample was statistically different from the hypothesised population mean); and LSD-test (to identify the groups whose means were statistically different from the means of other groups). The results are presented, analysed and interpreted hereafter.

Results and Discussion

In this section, the results are presented and considered in terms of their relevance to the five questions raised earlier. However, I needed to test the results to answer the following general question: Is there correlation between the cognitive, behavioural, emotional and social constructs of engagement?

Table 3 Correlation between engagement constructs

Construct	CE	BE	EE	SE
Cognitive engagement (CE)	1			
Behavioural engagement (BE)	.573*	1		
	.000			
Emotional engagement (EE)	.422*	.428*	1	
	.000	.000		
Social engagement (SE)	.171*	.214*	.127*	1
	.000	.000	.000	
Total	.711*	.733*	.874*	.377*
	.000	.000	.000	.000

Note. *Correlation is significant at the 0.01 level (2-tailed).

As is clearly shown in Table 3, all constructs of engagement (cognitive, behavioural, emotional, and social) were empirically linked to each other, as correlation coefficients (all above 0.01 level) clearly indicate, suggesting a significant statistical relationship between the four constructs. Having reached this conclusion of correlation, I move to the main questions of the study, trying to find answers based on the results and the statistical analysis.

Level of Engagement by Fifth and Ninth Graders

Question 1: To what degree are students in the fifth and ninth grades cognitively, behaviourally, and socially engaged in the science classes?

To address the first question, a one-sample *t*-test was conducted to determine whether the observations were obtained with a specific mean for the four constructs in questions. The objective was to test whether the arithmic means of

the constructs were significantly different from a cut-off point of 3.67, a value that is often used with such statistics. The results of the one-sample *t*-test for the constructs of engagement (Abualrob, 2019) are presented in Table 4.

Table 4 One-sample *t*-test for engagement constructs

Construct	*N*	*M*	*SD*	*t*	Significant ([Sig.] 2-tailed)
Cognitive engagement	1,121	3.9659	.67720	14.628	.000
Behavioural engagement	1,122	3.9309	.72090	12.124	.000
Emotional engagement	1,105	3.9302	1.31924	6.557	.000
Social engagement	1,126	3.1764	.57981	-28.569	.000
Total	1,079	3.7772	.63484	5.549	.000

As the figures in Table 4 reveal, CE, BE and EE have shown highly significant positive values at $t = 14.628$, $p = 0.000$; $t = 12.124$, $p = 0.000$; and $t = 6.557$, $p = 0.000$, in a row. For the social construct, however, the *t*-test produced a negative value ($t = -28.569$, $p = 0.000$), which was well below the hypothesised mean (i.e., the cut-off point). This negative mean, however, still predicts some evidence for the significance of the social construct. In aggregate terms, the results suggest that students in the fifth and ninth grades were indeed engaged in the science classes, with a mean of 3.7772.

These results (pertaining to the cognitive, behavioural, and EE) are in conflict with the results reached by the Follow-up and Evaluation Report by the Palestinian Ministry of Education and Higher Education (2017), which concluded with negative results. The disparity might be attributed to two main reasons. Firstly, the Report was published 3 years earlier, and many things could have changed during this period, especially with launching the new curricula for all school stages. Secondly, and probably the more important reason, could be that the approach in this study was far different from that used by the Ministry's report (in which the findings were based on the students' versus the teachers' roles in the classroom). In this study, by contrast, I used a reliable and indicative tool that was designed specifically for testing engagement.

Engagement Differences between the Fifth and Ninth Graders

Question 2: Are there significant engagement differences between the fifth and ninth graders?

To find answers to the second question I carried out a *t*-test and calculated the arithmetic means and standard deviations for the students' responses on the engagement scale, with the two variables being the fifth grade and the ninth grade (cf. Table 5).

Table 5 *T*-test results for engagement of 5th and 9th grades students in science classes

Construct	Grade	*N*	*M*	*SD*	*t*	Sig. (2-tailed)
Cognitive engagement	5	509	4.2024	.60581	11.244	.000
	9	612	3.7692	.67095		
Behavioural engagement	5	512	4.1392	.61500	9.188	.000
	9	610	3.7561	.75645		
Emotional engagement	5	493	4.3876	.74446	10.880	.000
	9	612	3.5618	1.54713		
Social engagement	5	513	3.2629	.58660	4.622	.000
	9	613	3.1039	.56443		
Total	5	474	4.0459	.41413	13.266	.000
	9	605	3.5667	.69569		

Obviously, there were statistically significant differences between the two groups (fifth and ninth grade students) across the four constructs, with higher values associated with the fifth grade students. These results are in agreement with findings by several international studies. Wilcox, McQuay, Blackstaffe, Perry and Hawe, (2016), for example, found that primary school pupils were generally more engaged than high school students. In trying to interpret why fifth graders always exhibited higher engagement levels compared to ninth graders, one might think of different factors. Firstly, students as young as 10 and 11 years old have fewer distraction (compared to adolescent ninth graders who might be distracted by many things outside the classroom environment). Secondly, the content of the science curriculum for the fifth grade is much more related to the real-life needs of the students. Thirdly, the curriculum of basic elementary school is generally presented in ways that capture the attention of learners, with each lesson featuring pictures and short, easy activities (Abualrob, 2018).

Engagement and Students' Gender

Question 3: Are there significant engagement differences attributed to the students' gender?

Arithmetic means and standard deviations for students' responses were calculated based on the values of the engagement scale, with the *t*-test values showing the difference between the means for male and female students (cf. Table 6).

Table 6 *T*-test results for engagement of male and female students in 5th and 9th grades

Construct	Gender	*N*	*M*	*SD*	*t*	Sig. (2-tailed)
Cognitive engagement	Male	391	3.8338	.63550	-4.828	.000
	Female	730	4.0366	.68857		
Behavioural engagement	Male	389	3.7985	.69424	-4.520	.000
	Female	733	4.0012	.72536		
Emotional engagement	Male	381	3.8916	1.71642	-.706	.480
	Female	724	3.9506	1.05257		
Social engagement	Male	389	3.1205	.60084	-2.355	.019
	Female	737	3.2059	.56660		
Total	Male	374	3.6943	.70453	-3.139	.002
	Female	705	3.8212	.59038		

The values obtained for this section reveal significant variation between male and female students in cognitive, behavioural and SE (and therefore in the overall value of engagement), with females exhibiting more positive values. At the emotional level, however, there were no significant differences. Again, this result supports the findings reached by Wilcox et al. (2016), and at the same time gives credence to the findings by the Follow-up and Evaluation Report by the Palestinian Ministry of Education and Higher Education (2017) – both found that females were more engaged than males.

Student Engagement and Teachers' Gender

Question 3: Are there significant engagement differences attributed to the teachers' gender?

In Table 7 I present the arithmetic means, standard deviations and *t*-test values for the third variable – the teachers' gender.

Table 7 *T*-test results for engagement of students based on teachers' gender

Construct	Gender	*N*	*M*	*SD*	*t*	Sig. (2-tailed)
Cognitive engagement	Male	388	3.8302	.64221	-4.930	.000
	Female	733	4.0377	.68463		
Behavioural engagement	Male	386	3.7979	.69941	-4.514	.000
	Female	736	4.0007	.72266		
Emotional engagement	Male	377	3.8955	1.72459	-.630	.000
	Female	728	3.9482	1.05058		
Social engagement	Male	386	3.1199	.60206	-2.364	.000
	Female	740	3.2058	.56605		
Total	Male	370	3.6938	.70946	-3.132	.000
	Female	709	3.8208	.58803		

It is clear from Table 7 that statistically significant differences existed across all constructs of engagement in favour of female teachers. Literature shows evidence of a positive correlation between female teachers and the performance of students in mathematics and sciences. For example, a study by Lim and Meer (2017) reached the conclusion that when taught by a female teacher, students' performance in mathematics was roughly 10% of a standard deviation higher than when taught by a male teacher. The latter finding is supported by my test, in which female teachers were found to be higher predictors of student engagement in science classes.

Student Engagement and Teachers' Qualifications

The published literature shows a positive correlation between teachers' qualifications and the level of student engagement (see e.g. Kola & Sunday, 2015). To answer the question pertaining to such a relationship in the Palestinian context, a one-way analysis of variance (one-way anova) was used to compare the arithmetic means for engagement values based on the teachers' specialisation, academic degree and experience (cf. Table 8).

Table 8 One-way ANOVA results of student engagement based on teachers' variables

	Specialisation		Academic degree		Experience	
Construct	*F*	Sig	*F*	Sig	*F*	Sig
Cognitive engagement	15.367	.000	10.161	.000	5.657	.004
Behavioural engagement	21.142	.000	.542	.582	2.068	.127
Emotional engagement	19.938	.000	3.656	.026	10.242	.000
Social engagement	4.939	.001	1.886	.152	3.104	.045
Total	28.453	.000	6.618	.001	8.095	.000

The one-way ANOVA analysis resulted in indicative values for some variables when they were measured relative to the engagement constructs. Firstly, the variable, teacher specialisation, was found to be positively significant across the four engagement constructs. Secondly, the variable, academic degree, was found to be a predictor of engagement in general (but with only the cognitive and emotional aspects showing positively significant values). Thirdly, the figures for the variable, teachers' experience, were found to be positively significant for cognitive, emotional, and SE (and thus for the overall variable). The latter variable, however, was found to have no bearing on BE. In Table 9 I present the results of the LSD-test to identify teachers' qualifications with statistically different arithmetic means.

Table 9 LSD-test results of student engagement based on teachers' qualifications

Variable			Mean difference (I–J)	*SE*	Sig.
Teachers' specialisation	Science teaching methods	Chemistry	.46242*	.05526	.000
		Biology	.42789*	.05410	.000
		Physics	.36400*	.06405	.000
		Others	.29222*	.05256	.000
	Chemistry	Others	-.17020*	.06436	.008
	Biology	Others	-.13567*	.06337	.032
Teachers' academic degree	Two-year associate degree	Bachelor	.26817*	.09045	.003
		Master	.34805*	.09640	.000
Teachers' experience	11 years and above	1–5 years	-.15976*	.04651	.001
		6–10 years	-.14967*	.05001	.003

Note. *The mean difference is significant at the 0.05 level.

At the level of the teachers' specialisation, differences in student engagement existed between teachers with a degree in science teaching methods (with significance at .000) on the one hand, and those with degrees in chemistry, biology, physics and other fields, on the other. Significant differences were also observed for chemistry (as compared to other specialisations), and for biology (as compared to other specialisations), but to a lesser degree.

Meanwhile, differences in student engagement were also apparent based on teachers' academic degrees. The LSD-test revealed indicative differences between student engagement levels based on whether they were taught by a teacher with a 2-year associate degree or a teacher with a bachelor degree (0.003), and by a teacher with a 2-year associate degree or a teacher with a master's degree (0.000), both in favour of the 2-year associate degree.

Finally, the level of student engagement was conditioned by the teachers' experience. Firstly, students taught by teachers with 1 to 5 years of experience in teaching were more engaged than those taught by teachers with more than 11 years of experience (with the difference at 0.001). Secondly, students taught by teachers with 6 to 11 years of experience were more engaged than those taught by teachers with more than 11 years of experience (with a statistical significance of 0.003). However, teachers in their early career life could be more productive, more energetic. Being under constant, tight supervision from their superiors, they are more worried about how others evaluate them; hence their diligence and greater degree of dedication. Also, the small age gap between teachers and learners might explain the students' closer identification with the teacher.

Conclusion

In this study I examined the factors that condition the cognitive, behavioural, emotional and SE of fifth and ninth grade students in science classes. The results suggest that the grade (fifth or ninth), the teachers' gender, the teachers' specialisation, the teachers' experience and the teachers' academic degree are all predictors of the level of engagement, but to varying degrees (with *F* values at 28.453, 6.095 and 6.618, respectively). In terms of external factors, female teachers, teachers with 1 to 5 years of experience, teachers specialising in science, and teachers with a 2-year associate degree were found to be more catalysing of students' engagement.

While these external drivers can still be powerful motivators for students' engagement,

genuine engagement naturally occurs when learners understand that what is being taught to them can help them fulfil their goals. In terms of students' self-motivation, the students' gender was found to be a significant predictor, with females exhibiting more engagement than males. It could be the case that the curriculum has been designed to relate more to the needs of female students. The difference might also be attributed to gender roles where males are more likely to have other concerns outside the classroom environments.

The results also suggest that fifth graders are by far more engaged than ninth graders. This is perhaps because the activities in the fifth grade science books are particularly linked to the interests and true needs of the learners (with the word "true" meaning that the tasks performed assisted in the psychological, cognitive, social, behavioural and emotional growth of the learners). When learners are self-motivated and adequately engaged, they exhibit satisfactory engagement and more positive attitudes toward their achievement, which helps them build confidence, understand their responsibilities and be independent learners when they grow up.

Recommendations and Limitations

The results do not, however, suggest a call for unburdening the teachers, schools and decision-makers of their responsibilities. Educational strategic plans should make student engagement a priority. When considering the strategies of delivering science education to students, plans should be in place to ensure that students are fully engaged, which in turn requires assigning roles and responsibilities for students, teachers, school principals and educational supervisors. These plans could serve as protocols that delineate a relationship intended to enhance student engagement through shifting from teacher-centred to student-centred learning.

Yet this also needs weaving interconnections between teachers and learners to realise the shared goals. These connections work as an integrated system aimed at enhancing student engagement. Policy-makers can effectively incorporate such principles within educational strategies: building curricula that keep pace with today's scientific and technological developments, providing teachers with relevant training that enables them to create and support student engagement, helping teachers to better support the cognitive, behavioural, emotional and social growth of the learners, assigning learners with tasks that keep them involved, and adopting scales that measure student engagement.

That said, the results of this study can be extended by additional research that could cover other constructs (in addition to the four covered by this study), and target other age groups – as comparing only two grades might not fully capture all dimensions of engagement and would only allow generalisation for these two grades.

Notes

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Appendix A

Item descriptive statistics for student- and teacher-report math and science engagement scales.

	Student report engagement				Teacher report engagement			
	Math (n = 3883)		Science (N = 3883)		Math (N = 282)		Science (N = 300)	
	M	SD	M	SD	M	SD	M	SD
Cognitive Engagement								
1. I go through the work for science/math class and make sure that it's right.	3.78	.99	3.72	1.00	3.45	1.28	3.37	1.29
2. I think about different ways to solve a problem.	3.67	1.09	3.47	1.11	3.21	1.27	3.22	1.19
3. I try to connect what I am learning to things I have learned before.	3.88	1.08	3.80	1.10				
4. I try to understand my mistakes when I get something wrong.	4.21	.96	4.09	1.02	3.80	1.24	3.51	1.23
5. I would rather be told the answer than have to do the work (rev)	3.59	1.30	3.46	1.29	3.22	1.32	3.23	1.30
6. I don't think that hard when I am doing work for class (rev)	3.70	1.19	3.71	1.15				
7. When work is hard, I only study the easy parts (rev)	3.98	1.11	3.99	1.09				
8. (S) do just enough to get by (rev)/(T) do more than required in class.	3.15	1.25	3.17	1.24	2.58	1.26	2.67	1.35
Behavioral Engagement								
9. I stay focused	3.72	1.09	3.69	1.08	3.51	1.27	3.31	1.34
10. I put effort into learning science/math	4.12	.96	4.12	.94	3.73	1.17	3.65	1.17
11. I keep trying even if something is hard.	3.99	1.00	3.95	1.00	3.40	1.27	3.39	1.33
12. I complete my homework on time	4.10	1.13	4.18	1.09	3.81	1.37	3.60	1.420
13. I talk about science/math outside of class	2.77	1.26	2.89	1.29				
14. (S) don't participate in class (rev)/(T) participate in class.	4.12	1.10	4.16	1.08				
15. I do other things when I am supposed to be paying attention (rev)	3.84	1.11	3.85	1.09	3.51	1.31	3.35	1.26
16. If I don't understand, I give up right away (rev)	4.18	.98	4.21	.97				
Emotional Engagement								
17. I look forward to science/math class.	3.13	1.39	3.33	1.34	3.39	1.10	3.28	1.10
18. I enjoy learning new things about science/math.	3.38	1.31	3.79	1.23	3.53	1.10	3.72	1.11
19. I want to understand what is learned in science/math class.	4.30	1.01	4.35	.97	4.01	1.14	3.87	1.09
20. I feel good when I am in science/math class.	3.37	1.27	3.48	1.19				
21. I often feel frustrated in science/math class (rev)	3.30	1.31	3.48	1.24	3.40	1.14	3.79	1.01
22. I think that science/math class is boring (rev)	3.33	1.40	3.53	1.31				
23. I don't want to be in science/math class (rev)	3.69	1.38	3.82	1.32				
24. I don't care about learning science/math (rev)	4.33	1.09	4.34	1.07				
25. I often feel down when I am in science/math class (rev)	3.98	1.19	4.10	1.11				
26. I get worried when I learn new things about science/math (rev)	3.87	1.22	3.91	1.18				
Social Engagement								
27. I build on others' ideas.	3.14	1.14	3.20	1.14	3.25	1.20	3.26	1.25
28. I try to understand other people's ideas in science/math class.	3.58	1.11	3.62	1.09	3.59	1.10	3.41	1.22
29. I try to work with others who can help me in science/math	3.73	1.18	3.76	1.17	3.67	1.10	3.55	1.12
30. I try to help others who are struggling in science/math	3.50	1.23	3.44	1.23	3.37	1.29	3.33	1.26
31. I don't care about other people's ideas (rev)	4.25	.99	4.29	.96				
32. When working with others, I don't share ideas (rev)	4.09	1.04	4.10	1.04	3.94	1.00	3.91	1.11
33. I don't like working with classmates (rev)	4.09	1.17	4.17	1.11				

Note. (rev) indicates reverse coded items; (S) refers to student item only; (T) refers to teacher item only.