Effects of Learning Strategies and Growth Mindset on Students' Achievement in Southern Belize: An Experimental Study

Elmar L. Requena[1]
Mathias R. Vairez Jr.[1]
Olga Manzanero[1]
Cordelia Requena[1]

Abstract

This study investigated the effects of learning strategies and growth mindset on first-form students' academic performance using a randomized pretest-posttest waitlist control group design. The treatment group consisted of 34 students and the control group had 32 students on a waitlist. The effect of intervention workshops promoting the development of learning strategies and growth mindset on students' integrated science test scores was measured. Results indicated a positive impact of learning strategies and a growth mindset on first-form students' academic performance. Results from Independent Samples t-tests confirmed that students in the experimental group experienced an increase in growth mindset and learning strategies which contributed to increased academic performance. Schools can incorporate the findings from this study into decision-making that includes: promoting a growth mindset and learning strategies, and increasing awareness among stakeholders about the positive effect of learning strategies and growth mindset on students' academic performance.

Keywords: Growth mindset, Learning strategies, high school students, academic performance

[1] University of Belize

Corresponding Author: Elmar L. Requena, Faculty of Education & Arts, University of Belize, Hummingbird Avenue, Belmopan, Cayo, Belize. email: 2004112163m@ub.edu.bz

Introduction

Transitioning from primary to secondary school for students is often an exciting, yet challenging experience. Students' experience in a new school environment can increased stress levels, decreased self-esteem, and academic performance if unprepared for the transition (Blackwell et al., 2007; Holcomb-McCoy, 2007). Therefore, students should prepare to cope with these challenges when transitioning to high school to ensure good academic performance. Ormrod (2016) explained that "many high school and college students are uninformed or misinformed about how they can best learn or study" (p. 382), resulting in their poor academic performance. Thus, first form students must develop the ability to cope with and manage change in their new school environment (Holcomb-McCoy, 2007).

The ability to cope in a new school environment requires students to develop skills and competencies that are important to improve academic performance. Ormrod (2016) reinforced that a skill not commonly used by students is the process of metacognition; the ability for students to understand one's thinking and learning process to improve one's own learning and memory that are essential in academic performance. Farrington et al. (2012) outlined the different methods encompassed in learning strategies, including metacognition, self-regulated learning, time management, and goal setting, also known as learner-directed strategies that contribute to academic performance.

Farrington et al. (2012) acknowledged that students' school performance is influenced by different factors intrinsic to students and their environment. Students should develop content knowledge and academic skills; however, academic behaviors, skills, and strategies are essential to academic performance. These are known as noncognitive factors, soft skills, or social-emotional learning (Farrington et al., 2012). The commonly used academic tests do not measure these skills; however, these noncognitive factors have shown a direct positive relationship with student performance and future educational outcomes. Ormrod (2016) concluded that successful students understand and adapt to their learning environment, some are self-developed; however, many emulate others.

Learning strategies use cognitive processes to accomplish learning (Panorama Education, 2020). Therefore, students are encouraged to have intentional understanding and the ability to have conscious intellectual activities to achieve a specific learning task (Ormrod, 2016). Ormrod (2016) identified two sets of effective learning and study strategies for students: meaningful learning, organization of knowledge, and elaboration, known as long-term memory. The second set of strategies is note taking, identifying important information, summarizing, monitoring comprehension, and mnemonics necessary in academic learning. Farrington et al. (2012) confirmed that learning strategies are malleable and can be learned.

Academic mindset studies have been prevalent among researchers because short-term interventions focused on changing students' mindsets identified lasting effects on school performance (Farrington et al., 2012). Farrington et al. (2012) asserted that an academic mindset is positively related to persistence in academics and claimed that the effect of mindset on academic performance is perseverance, which improves students' academic behaviors. Furthermore, research on mindset has shown that a psycho-social approach can have a positive impact on initiatives to reduce disparities in student performance among different ethnic groups (Farrington et al., 2012). Since current research (Blackwell et al., 2007; Farrington et al., 2012; Holcomb-McCoy, 2007; and Ormrod, 2016) established that noncognitive factors positively impact students' academic achievement, it is essential for experimental studies to validate the extent noncognitive factors influence students' academic achievement. Intervention studies are essential to provide the foundation for developing in-school programs targeting enhanced students' academic success. If students can understand that their academic performance is not fixed and through their efforts in practicing learning strategies they can change their learning path, they can become successful in school and life (Farrington et al., 2012; Ormrod, 2016).

Therefore, the purpose of this quantitative, experimental research with a randomized pretest-posttest waitlist control group design was to determine the effect of a growth mindset and learning strategies on first form students' academic performance using a four-week intervention in a sample of first form students at a high school in Southern Belize. It was assumed that if a growth mindset and learning strategies influence academic performance and these noncognitive skills are malleable, then school leaders' interventions to develop these

noncognitive factors would result in increased student academic performance. The following three research questions were explored:

1. Is there a statistically significant difference in students' academic performance between the treatment and control groups before and after the intervention?
2. Is there a statistically significant difference in students' learning strategies between the treatment and the control groups before and after the intervention?
3. Is there a statistically significant difference in students' growth mindset between the treatment and the control groups before and after the intervention?

Review of Relevant Literature

Growth Mindset

Farrington et al. (2012) described growth mindset as students' confidence, attitudes, and perceptions concerning learning and cognitive ability to support their academic performance. Research conducted in controlled and classroom settings confirmed a positive relationship between a growth mindset and academic performance; results of these studies identified a significant correlation between students having a growth mindset and improved academic performance (Farrington et al., 2012; Ormrod, 2016). Students with a positive academic mindset had the drive to complete schoolwork allowing for academic perseverance resulting in improved academic behaviors, which resulted in improved academic performance (Farrington et al., 2012). Yeager and Walton (2011) reported that a literature review of 13 related studies indicated the success of interventions and concluded that mindset could be changed intentionally. They confirmed that classroom factors that influence student mindset include the level of academic challenge and teacher expectation of success.

Farrington et al. (2012) reported that several short-term interventions focused on changing students' mindset have a lasting effect on school performance. The authors stated that an academic mindset is positively related to persistence at academic tasks; one of the evident mechanisms of the effect of a growth mindset on academic performance is perseverance which leads to improved academic behaviors. This psycho-social approach influences reform efforts that focus on closing ethnic gaps in students' performance (Farrington et al., 2012).

Learning Strategies

Learning strategies are a set of mental processes that include metacognition, self-regulated learning, time management, and goal setting, also identified as learner-directed strategies that contribute to academic performance (Farrington et al., 2012). The use of learning strategies allows for understanding one's cognition, self-regulated learning and goal setting. Learning strategies include remembering facts, evaluating one's understanding, and detecting and correcting confusion or error in one's reasoning. Farrington et al. (2012) elaborated that learning strategies allow for monitoring, manipulating, and organizing materials to allow for deeper understanding and improved academic performance. Therefore, prioritizing desired outcomes allows students to manage the learning process.

Students transitioning to high school face many challenges entering a new school environment. Farrington et al. (2012) elaborated that recent research on improving students' academic performance has focused on the positive correlation between students' noncognitive factors development and student academic achievement. Prior research has rested on the premise that students' cognitive development results in academic achievement (Ormrod, 2016). According to Farrington et al. (2012), learning strategies help with cognitive processes to maximize learning, and these include the use of mnemonic devices to help recall facts, strategies to monitor one's comprehension while reading or doing math, and strategies to self-correct when one detects confusion or error in one's thinking, goal setting and time management. A criticism of noncognitive factors is identifying which factors can be intentionally developed and which attributes are not likely to be changed by the school. Additionally, most research on noncognitive factors is correlational, only showing a relationship between two factors. Farrington et al. (2012) stated that one of the central claims of research on noncognitive factors is that disparities in school performance by ethnicity or gender could be reduced by focusing on certain

noncognitive factors. Most of the documented interventions were with primary school-aged students, and there is inadequate work studying the success at the high school level (Farrington et al., 2012).

Conceptual Framework

The noncognitive factors framework (Figure 1) with a socio-cultural context adopted from Farrington et al. (2012) outlines the relationship among the five major noncognitive factors categories in a school and classroom context. The framework's reciprocal relationships allow for a complex relationship among factors. As illustrated in Figure 1, the five noncognitive factors associated with academic performance are academic behaviors, perseverance, growth mindset, learning strategies, and social skills. The conceptual framework illustrates one-way arrows to show the most substantial proposed relationship to academic performance.

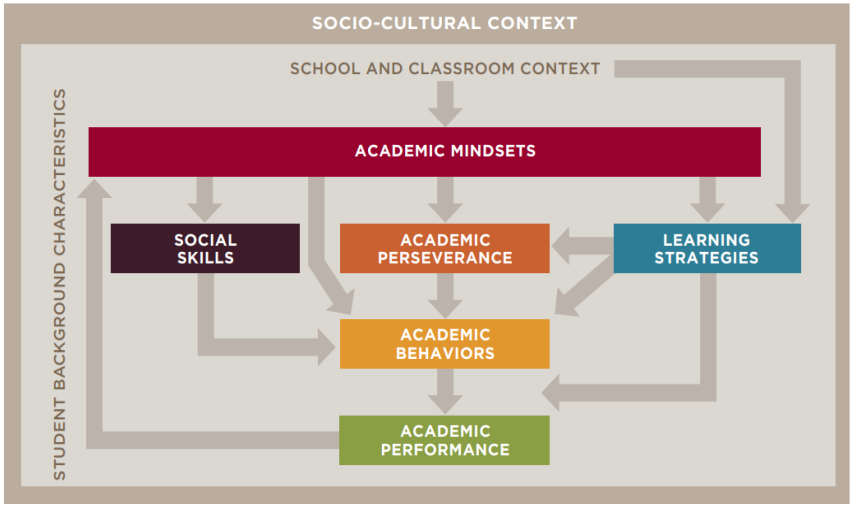

Figure 1. ***Noncognitive Factors Conceptual Framework*** (Farrington et al., 2012)

Figure 2 illustrates the relationship between academic mindset, learning strategies and academic performance. The development of learning strategies can contribute to positive academic behaviors or academic perseverance that leads to improved academic performance. Likewise, poor learning strategies contribute to poor academic behaviors that contribute to poor academic performance. Academic performance contributes to an academic mindset that contributes to improving learning strategies. Academic mindset contributes to academic perseverance that contribute to good academic behaviors that contribute to improved academic performance (Farrington et al., 2012).

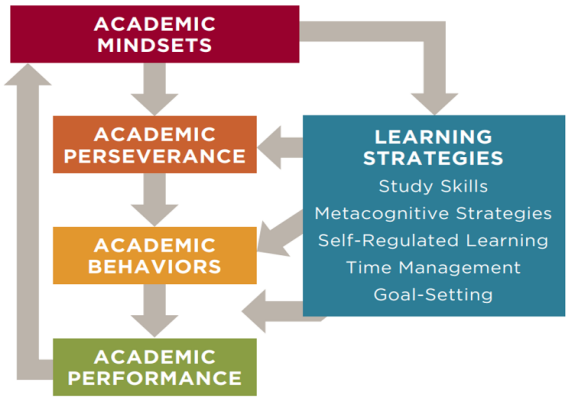

Figure 2. ***Summary of Research on Learning Strategies*** (Farrington et al., 2012)

Methodology

As illustrated in Figure 3, a quantitative experimental research using a randomized pretest-posttest waitlist control group design was used to investigate the effects of growth mindset and learning strategies on students' academic achievement. The target population was 204 first form students at a high school in Southern Belize. A sample of 66 students from two classes with 34 students in the treatment group and 32 students in the control group participated in this study. Students were assigned to a class using systematic random assignment at the start of the school year. Participation in the study was voluntary, and parents' consent and students' assent were obtained before the study started. Random factors resulted in the sample containing more females (*n* 36) than males (*n* 30). Seven ethnic origins were represented in the study sample, 12 participants were Q'eqchi Maya, 7 were Mopan Maya, 8 were Mestizo, 9 were Garifuna, 11 were East Indian and 10 Multi-ethnic.

Group	Assignment	Pre-tests	Treatment	Post-tests	Treatment
Treatment	R	O_1 O_2 O_3	X	O_1 O_2 O_3	C
Control	R	O_1 O_2 O_3	C	O_1 O_2 O_3	X

R = Random Assignment, O_1 = Academic Performance, O_2 = Learning Strategies, O_3 = Growth mindset, X = Intervention, C = No Intervention

Figure 3. ***Randomized Pretest-Posttest Wait List Control Group Design***

Instrumentation

To collect the data for this study, the instrument was adapted from the Panorama Social-Emotional Learning Survey collection from the category students: skills and competencies. The two surveys used were the growth mindset and learning strategies surveys. The widely used Panorama surveys were developed by a team of researchers at the Harvard Graduate School of Education under the direction of Dr. Hunter Gehlbach (Panorama Education, 2020). The reliability of the instrument was evaluated using Cronbach's alpha which measured internal consistency of surveys. Panorama Education (2020), reported that all survey topics met or exceeded the sufficiency threshold of .70. The surveys were also tested for structural validity and convergent and discriminant validity, which measures how well the surveys measure what they intended to measure (Panorama Education, 2020). The overall instrument had three sections: states of matter test, growth mindset survey, and learning strategies survey. The integrated science test was a unit test on states of matter consisting of seven true and false items, 15 multiple-choice items and two constructed response items. The growth mindset and learning strategies surveys were Likert-type items with 6 and 5 items, respectively.

Variables

This study explored three main variables – growth mindset, learning strategies and academic performance. According to Lamas (2015), academic performance is a measure of students' acquired skills and competencies in a subject. Academic performance is expressed through grades on tests and alternative assessments on the subject content. In this study, academic performance was measured using the grade students earned on the states of matter, integrated science unit test, and was used to assess the outcome of the intervention. A growth mindset is a belief that a student's ability and competence grow with the effort made (Farrington et al., 2012). Growth mindset was measured using an interval scale with five levels, from 1 = being not possible to change to 5 = completely possible to change. Learning Strategies, Farrington et al. (2012) elaborated, are the monitoring, manipulation, and organizing of materials to allow for deeper understanding and improve academic performance. Learning strategies was measured using an interval scale with five categories with 1 = not at all likely to 5 = extremely confident.

Data Collection

Data were collected from 64 randomly assigned first form students from a high school in Southern Belize. An information session was conducted with parents and students to provide an overview of the research and to answer questions or concerns about the research. Parents' written consent and students' written assent were acquired before the commencement of data collection. Data collection started by administering pretests, including an integrated science unit test, a growth mindset, and learning strategies Likert-type scale survey adapted from Panorama Social-Emotional Learning Survey (Panorama Education, 2020). Thereafter, the treatment group received a four-week growth mindset and learning strategies intervention workshops twice weekly for 45 minutes each. Concurrently with the intervention, the treatment and control groups completed the integrated science unit content on states of matter. After four weeks of intervention, the posttests were administered to both the treatment and control groups. The control group received the four-week intervention immediately after the posttests were completed.

Data Analysis

The data was analyzed using IBM SPSS 23 statistical software. Independent samples t-tests were used to compare the means of the treatment and control group for each of the dependent variables, students' academic performance, learning strategies and growth mindset. Results from the pretest were compared with the posttest results to identify intervention effects using independent samples t-tests and correlation. According to Fraenkel et al. (2012), a t-test is a "parametric statistical test used to see whether a difference between the means of two samples is significant" (p. 233). Independent samples t-tests were used, knowing that the data passes several assumptions. The first assumption was that the dependent variable academic performance was measured using a continuous (ratio) scale and growth mindset and learning strategies were measured using an interval scale. The independent variable consisted of two categorical independent groups, the experimental and the control. Each group was independent of the other, with participants in different groups. The effect of growth mindset and learning strategies on students' achievement was determined using an effect size estimate via the Partial Eta Squared statistic. Cohen's effect size as reported by Richardson (2011), was used to evaluate the effect size. A Partial Eta Squared (η_p^2) effect size of .0099 was classified as small, .0588 was classed as medium, and .1379 was classified as large (Richardson, 2011).

Results

The goal of the first research question was to determine if there was a statistically significant difference in students' academic performance between the experimental and control group before and after the intervention. Before the experiment, students in the experimental group (M = 25.38, SD = 6.209) performed higher in science than students in the control group (M = 21.75, SD = 8.374). The results from the independent samples t-test (t_{64} = 2.010; p = .049), confirmed that the difference in students' science performance before the experiment was statistically significant ($p < .05$). Therefore, we rejected the null hypothesis ($H_{01.1}$: $\mu_{1AP\ control\ before} - \mu_{2AP\ experimental\ before} = 0$) and concluded that there was a statistically significant difference in students' science performance before the experiment between the experimental and control group. The experimental group performed significantly higher in science than the control group before the experiment.

After the experiment, students in the experimental group (M = 35.74, SD = 7.806) performed slightly higher in science than students in the control group (M = 34.34, SD = 8.011). The results from the independent samples t-test (t_{64} = 0.715; p = .477) confirmed that the difference in students' science performance after the experiment was not statistically significant ($p > .05$). Therefore, we failed to reject the null hypothesis ($H_{01.2}$: $\mu_{1AP\ control\ after} - \mu_{2AP\ experimental\ after} = 0$) and concluded that there was no statistically significant difference in students' science performance after the experiment between the experimental and control group. However, the experimental group did perform slightly higher in science than the control group after the experiment.

The goal of the second research question was to determine if there was a statistically significant difference in students' learning strategies between the experimental and control groups before and after the intervention. Before the experiment, students in the experimental group (M = 3.7765, SD = 0.628) performed higher in learning strategies than students in the control group (M = 3.5437, SD = 0.789). The results from the

independent sample *t*-test (t_{64} = 1.330; p = .188) confirmed that the difference in students' learning strategies performance before the experiment was not statistically significant (p > .05). Therefore, we failed to reject the null hypothesis ($H_{02.1}$: $\mu_{1LS\ control\ before} - \mu_{2LS\ experimental\ before} = 0$) and concluded that there was no statistically significant difference in students' learning strategies performance before the experiment between the experimental and control group.

However, after the experiment, students in the experimental group (M = 3.494, SD = 0.904) performed lower in learning strategies than students in the control group (M = 3.631, SD = 0.870). The results from the independent samples *t*-test (t_{64} = -.627; p = .533) confirmed that the difference in students' learning strategies performance after the experiment was not statistically significant (p > .05). Therefore, we failed to reject the null hypothesis ($H_{02.2}$: $\mu_{1LS\ control\ after} - \mu_{2LS\ experimental\ after} = 0$) and concluded that there was no statistically significant difference in students' learning strategies performance after the experiment between the experimental and control group.

The goal of the third research question was to determine if there was a statistically significant difference in students' growth mindset between the experimental and control groups before and after the intervention. Before the experiment, students in the experimental group (M = 2.8382, SD = 0.647) performed higher in growth mindset, than students in the control group (M = 2.7135, SD = 0.585). The results from the independent samples *t*-test (t_{64} = 0.819; p = .416) confirmed that the difference in students' growth mindset before the experiment was not statistically significant (p > .05). Therefore, we failed to reject the null hypothesis ($H_{03.1}$: $\mu_{1GM\ control\ before} - \mu_{2GM\ experimental\ before}$ 0 =) and concluded that there was no statistically significant difference in students' growth mindset before the experiment between the experimental and control group.

After the experiment, students in the experimental group (M = 2.9461, SD = 0.654) performed higher in growth mindset than students in the control group (M = 2.6875, SD = 0.612). The results from the independent samples *t*-test (t_{64} = 1.657; p = .102) confirmed that the difference in students' growth mindset after the experiment was not statistically significant (p > .05). Therefore, we failed to reject the null hypothesis ($H_{03.2}$: $\mu_{1GM\ control\ after} - \mu_{2GM\ experimental\ after} = 0$) and concluded that there was no statistically significant difference in students' growth mindset after the experiment between the experimental and control group. However, the experimental group did perform higher in growth mindset than the control group after the experiment.

Additional Analysis

To further explore the effect of the intervention on students' science achievement, learning strategies and growth mindset, Pearson's correlation coefficients were computed to determine if there were significant relationships between the experimental and control group's post science achievement, growth mindset, and learning strategies scores. The Pearson's correlation coefficient between students from the experimental group post science and level of growth mindset scores was .446, which is positive, is interpreted as a medium effect size (Cohen, 1988), and is statistically different from 0 (r = .446, n = 34, p = .008). Thus, there was a medium, positive correlation between students from the experimental group's post science and growth mindset scores. The Pearson's correlation coefficient between students from the experimental group post learning strategies and science scores was .317, which is positive, is interpreted as a medium effect size (Cohen, 1988), and is statistically different from 0 (r = .317, n = 34, p = .068). Thus, there was a medium, positive correlation between students from the experimental group post learning strategies and science scores. Further, the Pearson correlation coefficient between students from the experimental group post level of growth mindset and level of learning strategies scores was .458, which is positive, is interpreted as medium effect size (Cohen, 1988), and is statistically different from 0 (r = .458, n = 34, p = .006). Thus, there was a medium, positive correlation between students from the experimental group's post level of growth mindset and level of learning strategies scores.

The Pearson's correlation coefficient between students from the control group post level of growth mindset and science scores was -.271, which is negative, is interpreted as small effect size (Cohen, 1988), and is not statistically different from 0 (r = -2.71, n = 32, p = .133). Thus, there was a small, insignificant negative correlation between students from the control group's level of growth mindset and science scores. The

Pearson's correlation coefficient between students from the control group post learning strategies and science scores was .227, which is positive, is interpreted as a small effect size (Cohen, 1988), and is not statistically different from 0 (r = .227, n = 32, p = .211). Thus, there is a small, insignificant positive correlation between students from the control group post learning strategies and science scores. The Pearson correlation between students from the control group post level of learning strategies scores and growth mindset was .534, which is positive, is interpreted as medium effect size (Cohen, 1988), and is statistically different from 0 (r = .534, n = 32, p = .002). Thus, there was a medium, positive correlation between students from the control group's post level of learning strategies and growth mindset and scores.

Limitations

The major limitation of this study was the length of the intervention – data collection period. Data collection was completed over an 8-week period, September 2022 to October 2022, and this was a short period of time for data collection to implement a comprehensive intervention. Additionally, the demographics of the population can be better represented in the study by having equal numbers of male and female participants and ensuring that all ethnic groups have proportionate representation in the sample. Generalization is limited as this experimental research was conducted at one high school in Southern Belize.

Conclusions

There was a statistically significant difference in students' science performance before the experiment between the experimental and control group. However, there was no statistically significant difference in students' science performance after the intervention between the experimental and control group. Although there was no statistical significance, there was practical significance of these results as indicated by an improvement in the experimental group's mean science score after the intervention when compared with the control group. On average, students from the experimental group performed slightly higher in science, than students from the control group. This is an indication that the growth mindset and learning strategies intervention had a positive effect on improving students' academic performance. The medium positive correlation indicated that as learning strategies increased, academic performance also increased.

There was no statistically significant difference in students' learning strategies performance before the experiment. Likewise, there was no statistically significant difference in students' learning strategies after the experiment. However, there was practical significance as students in the experimental group performed slightly lower in learning strategies than students in the control group. This is a confirmation that there was a decrease in learning strategies scores in the experimental groups' learning strategies after the intervention. This can be an indication that with increased awareness on the use of learning strategies students were able to self-reflect on their use of learning strategies to support learning. Importantly, results from Pearson's correlation between students from the experimental group post growth mindset and learning strategies scores confirmed a medium, positive effect size (Cohen, 1988) demonstrating that as growth mindset increased, learning strategies also increased or vice versa.

There was no statistically significant difference in students' growth mindset before the experiment. However, students in the experimental group performed higher in growth mindset, than students in the control group after the intervention. The improvement in growth mindset positively influenced students' academic performance. In order to encourage students to develop a growth mindset and learning strategies teachers need to have professional development to guide the development of noncognitive skills and awareness in the classroom.

Understanding the relationship between growth mindset and learning strategies on first form students' academic performance confirmed that a curriculum that promotes the development of noncognitive factors is a viable option to support students' academic performance. Growth mindset and learning strategies had a medium positive correlation, an indication that these noncognitive factors have a positive effect on first form students' academic performance. Growth mindset is the belief that with effort students' intelligence and skills can be developed and learning strategies is the physical and mental organization of knowledge to allow for

deeper understanding. The development of a growth mindset can be accomplished through hard work, good strategies, instruction and support from others (Jacovidis et. al., 2020; Ormrod, 2016).

Additionally, students can be encouraged to use effective learning strategies such as studying, goal setting and time management. The use of these learning strategies can contribute to students' academic performance, if students do not use these skills they may struggle to meet the academic requirements of the school. Ultimately, students will find out that with adequate effort and use of learning strategies they can learn and understand content that improves their academic performance. If students are able to develop a growth mindset, then they can take ownership of their learning and are inclined to use effective learning strategies.

Recommendations

The results of this study build on existing evidence that indicate that a growth mindset and use of learning strategies result in an increase in academic performance. These results confirm that noncognitive skills are essential for successful academic performance. Therefore, it is recommended for Belize to have an education policy that supports the development of noncognitive skills within the high schools' and primary schools' curriculums. An essential subject within this curriculum is life skills that should promote the development of noncognitive skills and allow linkages to other subjects. To support the successful implementation of this curriculum, educators need professional development. Therefore, the Ministry of Education should have a policy that ensures teachers receive adequate continuous professional development to support the successful implementation of curriculum inclusive of noncognitive factors.

Existing curriculums should be revised to ensure that the grading and testing support a growth mindset and assessments measure students' mastery of subject content focusing on both cognitive and noncognitive skills. High schools should invest in programs that promote a growth mindset for all first form students, then incrementally offer the programs to other levels. The program should be designed to develop noncognitive skills in students. The results of this study, supports the recommendation of Jacovidis et al. (2020) to include classroom practices to promote the development of a growth mindset. These practices include having an encouraging classroom environment, practicing growth mindset thinking, the use of growth mindset language, the high expectation for all students, intentional teaching about the brain, and use of growth mindset activities and assessments. Also, it is recommended that educators can encourage students to use effective learning strategies such as studying, goal setting and time management to improve their academic performance. If students do not use these skills, they may struggle to meet the academic requirements of the school and later, the demands of life.

This research tested part of Farrington et al's. (2012) conceptual framework of how five noncognitive factors affect academic performance and the results validate part of the framework. Other components of this conceptual framework need to be tested. Thus, an experimental research to further explore the effects of a growth mindset and learning strategies on high school students' academic performance can be conducted in multiple schools to contribute to the existing body of knowledge that informs school leadership. The data collection can be extended for a longer period, at least for 15 weeks or one semester. Farrington et al. (2012) identified the transition from primary school to high school as a critical time for students to develop noncognitive skills; therefore, first form students should be prioritized. Additional research should be designed with a larger sample size and representation of the population demographics that include gender and ethnicity to allow for generalizability of the results. Also, research in traditional classroom settings to assess growth mindset and learning strategies used in the classroom can also be conducted. Future research can also focus on teachers' need to develop knowledge and skills to promote noncognitive skills development in the classroom.

Competing Interests

The authors declare that they have no conflict of interest.

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