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ACADEMIC SELF CONCEPT AS A PREDICTOR OF CHEMISTRY ACHIEVEMENT AMONG JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT

This study investigated the relationship between junior high school students' self-concept in Chemistry and their academic performance in the subject. A quantitative descriptive correlational design was used. Participants were 300 students from Davao City National High School who had complete data on a standardized Chemistry self-concept questionnaire by Emmanuel Uwadone and official Chemistry grades. Self-concept scores were obtained from a validated Likert type instrument, and grades were taken from school records for a completed grading period. Descriptive statistics, assumption checks, correlational analyses, and simple linear regression were conducted. Results showed that Chemistry grades were generally high and moderately dispersed, whereas self-concept scores were more variable and positively skewed. Pearson product moment correlation indicated a significant moderate positive relationship between self-concept and Chemistry grades, $r = 0.400$, $p < .001$. Spearman rank correlation produced a comparable coefficient, $\rho = 0.417$, $p < .001$, which confirmed that the association was robust to non-normality and potential outliers. Regression analysis further showed that self-concept significantly predicted Chemistry grades and accounted for approximately 16 percent of the variance in academic performance. The findings suggested that students who held more positive beliefs about their capability in Chemistry tended to obtain higher grades, although self-concept represented only one of several influences on achievement. The pattern of high grades but uneven self-concept highlighted the need to address possible underestimation of competence among some students. The study underscored the importance of classroom practices that support both academic performance and adaptive self-beliefs in Chemistry at the junior high level.

KEYWORDS: *Academic Self-Concept; Chemistry Achievement; Junior High School; Philippine Secondary Education*

INTRODUCTION

Chemistry in junior high school is often treated as a gateway subject that shapes learners' later participation in science, technology, engineering, and mathematics programs. Persistent gaps in chemistry achievement have been explained not only by cognitive factors such as prior knowledge and reasoning skills but also by noncognitive variables, including motivation, attitudes, and beliefs about academic capability. Researchers have shown that students who possess more adaptive beliefs about their competence in science tend to participate more actively in class, persist longer on difficult tasks, and achieve higher grades than peers with less positive beliefs (Hattie, 2009; Pintrich & De Groot, 1990). These findings suggest that affective characteristics play an important role in determining how learners respond to chemistry instruction.

Within this line of work, academic self-concept has been identified as a central construct. Academic self-concept refers to a learner's self-perceptions of competence in academic settings and has been described as multidimensional and hierarchical (Shavelson et al., 1976). In this framework, students form general self-beliefs that are further differentiated into subject specific self-concepts, such as self-concept in mathematics, language, or science. These beliefs develop through feedback from significant others, interpretations of one's own performance, and social comparison with classmates. Because self-concept reflects how learners interpret their academic experiences, it is regarded as more proximal to day-to-day classroom performance than broader personality traits or global self-esteem (Marsh & Craven, 2006).

A substantial body of empirical research has documented a robust association between academic self-concept and academic achievement. Correlational and longitudinal studies have typically reported moderate positive correlations, indicating that students with higher academic self-concept tend to obtain higher grades and test scores (Guay et al., 2003; Marsh & Craven, 2006). Meta analytic work has further suggested a reciprocal effects pattern in which prior self-concept predicts later achievement and prior achievement predicts subsequent self-concept, implying that self-beliefs and performance reinforce one another over time (Marsh & Craven, 2006). These findings have important implications for schooling because they indicate that interventions which improve either self-concept or achievement can potentially produce benefits in the other.

In science education, domain specific investigations have extended these conclusions to subjects such as physics, biology, and chemistry. Studies have shown that students who report higher science or chemistry self-concept tend to achieve better outcomes on classroom examinations and standardized tests, even after controlling for prior achievement and background variables (Jansen et al., 2015; Lent et al., 2011). Classroom based interventions that emphasize cooperative learning, inquiry activities, and supportive teacher feedback have been found to raise both science achievement and students' self-concept in

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science subjects (Acar & Tarhan, 2008). These results suggest that self-concept in a particular subject, such as chemistry, is a meaningful target for instructional practice.
Adolescence has also been identified as a period during which academic self-beliefs undergo considerable change. Longitudinal research has shown that academic self-concept often declines from late elementary school into junior high school, coinciding with increased academic demands and more competitive social comparison (Jacobs et al., 2002). This decline has been particularly marked in mathematics and science for some groups of students. For learners who already struggle with chemistry or perceive it as difficult, negative shifts in self-concept during junior high school risk amplifying disengagement, increasing anxiety, and lowering subsequent achievement.

In the Philippine context, studies in basic education have reported similar patterns. Research in public secondary schools has indicated that students with higher academic self-concept, as well as related constructs such as self-efficacy and self-regulated learning, tend to obtain higher grades and more favorable teacher evaluations (Bernardo, 2010; King, 2016). However, many of these investigations have treated achievement as a general index across subjects or have focused on mathematics and language, leaving less evidence for subject specific self-concept in chemistry at the junior high school level. Moreover, large urban public schools, which typically enroll diverse learners and operate under resource constraints, have been underrepresented in the literature.

Given these gaps, there has been a need for empirical evidence that describes the level of chemistry self-concept among junior high school students in a Philippine public school and examines how this self-concept relates to their actual chemistry grades. The present study therefore aimed to explore the relationship between students' self-concept in chemistry and their academic performance in the subject. Specifically, it sought to describe the level of self-concept and the level of academic performance in chemistry of junior high school students at Davao City National High School, to determine whether a significant relationship exists between these two variables, and to examine whether self-concept significantly predicts students' chemistry grades.

METHODOLOGY

This study employed a quantitative approach using a descriptive correlational research design. The design was appropriate because the study sought to describe the levels of junior high school students' self-concept in Chemistry and their academic performance in the subject, and to examine the degree of association between these variables without manipulating any conditions. Variables were measured as they naturally occurred, and statistical procedures were used to estimate the strength and direction of their relationship.

2.1 Research Setting. The study was conducted at Davao City National High School, a large urban public secondary school in Davao City, Philippines. The school implemented the K to 12 Basic Education Curriculum and offered Chemistry as part of the science program at the junior high school level. Data collection took place during the regular school year after the release of official grades for a completed grading period in Chemistry, ensuring that all participants had recorded achievement data in the subject.

2.2 Participants and Sampling Procedure. The population of interest comprised all junior high school students enrolled in Chemistry classes at Davao City National High School during the time of data collection. Intact class sections were used as the sampling units in order to minimize disruption to instruction. With permission from the school administration and class advisers, all students in the selected sections were invited to participate.

A total of 496 students received information about the study and parental consent forms. Only students who returned signed parental consent forms and who provided written assent were allowed to participate. After data screening, cases with incomplete questionnaire responses or missing Chemistry grades were removed. The final analytic sample consisted of 300 students with complete data on both self-concept and academic performance in Chemistry. This sample size was adequate for correlational analysis and for detecting moderate effect sizes with acceptable statistical power.

2.3 Self Concept in Chemistry Questionnaire. Students' self-concept in Chemistry was assessed using a standardized self-concept questionnaire by Emmanuel Uwadone that measured their perceived competence and confidence in learning Chemistry. The instrument consisted of a set of Likert type items to which students responded using a fixed response scale that ranged from strong disagreement to strong agreement. Items tapped perceptions of understanding of Chemistry concepts, confidence in solving Chemistry problems, and expectations of success in the subject.

Scores for negatively worded items were reverse coded, and all item scores were summed to obtain a total self-concept score for each respondent. Higher total scores indicated more positive self-concept in Chemistry. Before the main data collection, the instrument underwent content validation by a panel of experts in science education and educational measurement who reviewed the items for clarity, relevance, and alignment with the construct. In the present sample, internal consistency reliability was evaluated using Cronbach's alpha, which yielded a coefficient in the acceptable range for research purposes.

2.4 Academic Performance in Chemistry. Academic performance in Chemistry was operationalized through students' official grades in the subject. For each participant, the researcher obtained the numerical grade for the most recently completed grading period in Chemistry from the class record and the school registrar, with appropriate permission. Grades followed the school's standard 60 to 100 rating scale, where higher values reflected better performance. These grades were recorded in a data sheet using identification codes rather than student names and served as the outcome variable in the correlational and regression analyses.

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2.5 Data Collection Procedure. Data collection followed several stages. First, the researcher secured written permission from the school principal and the head of the Science Department to conduct the study with junior high school learners. After approval, the researcher met with the selected class advisers to explain the objectives and procedures of the study and to schedule data collection sessions.

Students completed the self-concept questionnaire in their classrooms under the supervision of the researcher and the class adviser. They were instructed to read each item carefully and to respond honestly. The researcher collected the questionnaires immediately after completion and checked them for missing responses. After questionnaire administration, the researcher coordinated with the class advisers and the registrar to obtain the official Chemistry grades of participating students. These grades were matched to questionnaire data using identification codes. The merged dataset was entered into a password protected file and checked for data entry errors prior to analysis.

2.6 Data Analysis. Data analysis was carried out using a statistical software package. Descriptive statistics were first computed to summarize the levels and distributions of self-concept scores and Chemistry grades. For each variable, the mean, standard deviation, minimum, maximum, and measures of skewness and kurtosis were obtained. Graphical procedures, including histograms and Q Q plots, were examined to assess the approximate shape of the distributions.

Assumptions for correlational analysis were then evaluated. The Shapiro–Wilk test was applied to check for deviations from normality in each variable. Bivariate scatter plots were inspected to evaluate linearity and to identify any potential outliers. Because the study used naturally occurring data and no experimental manipulation, the assumption of independence of observations was considered satisfied by the classroom context in which each student contributed a single pair of scores.

To address the research question on the relationship between self-concept and academic performance in Chemistry, both Pearson product moment correlation and Spearman rank correlation coefficients were computed. Pearson's r estimated the strength and direction of the linear association between continuous self-concept scores and Chemistry grades under the assumption of approximate normality. Spearman's rho provided a nonparametric estimate of the monotonic association that was less sensitive to violations of normality and the presence of outliers. For both coefficients, two tailed significance tests were conducted at the 0.05 alpha level, and the magnitude of the correlations was interpreted using conventional benchmarks for small, moderate, and large effect sizes.

To examine prediction, simple linear regression analysis was performed with Chemistry grade as the dependent variable and self-concept score as the independent variable. The regression model estimated the extent to which variation in Chemistry grades could be accounted for by students' self-concept. Standard diagnostic checks were conducted, including inspection of residual plots to verify linearity and homoscedasticity and computation of residual statistics to assess the presence of influential cases. The coefficient of determination was used to quantify the proportion of variance in Chemistry grades explained by self-concept.

2.7 Ethical Considerations. The study adhered to ethical principles for research involving minors. Approval to conduct the research was obtained from the school administration. Participation was strictly voluntary, and students were informed that they could decline or withdraw at any point without academic penalty. Parental consent and student assent were secured prior to data collection. All data were treated as confidential; identification codes rather than student names were used on questionnaires and data files. Only the researcher had access to the raw data, which were stored in password protected electronic files and locked cabinets. Results were reported in aggregate form so that no individual student or class could be identified.

RESULTS AND DISCUSSION

Data from 496 junior high school students were initially available. After screening for completeness of responses and availability of official Chemistry grades, 196 cases with missing data on at least one key variable were excluded. The final analytic sample consisted of 300 students who had complete self-concept scores and Chemistry grades. All subsequent analyses were based on these 300 cases.

3.2 Descriptive statistics. Students' Chemistry grades were generally high with limited dispersion. Grades ranged from 64.00 to 99.00, with a mean of 85.74 and a standard deviation of 6.90. The interquartile range was 11.00 grade points, indicating that the middle fifty percent of students clustered within a narrow band around the mid-eighties to low nineties. The skewness coefficient for grades was slightly negative, which suggested a mild concentration of scores toward the higher end of the scale rather than a strictly symmetric distribution. Visual inspection of histograms and kernel density plots showed an approximately bell-shaped distribution with a small tail toward lower grades and very few extremely low or near perfect scores.

Self-concept scores in Chemistry showed greater variability and a different distributional shape. Scores ranged from 60.00 to 190.00, with a mean of 130.34 and a standard deviation of 23.58. The interquartile range was 21.00 points, which indicated that students differed more widely in how they perceived their competence in Chemistry than in their actual performance in the subject. The skewness coefficient was positive and substantial, which reflected a concentration of scores in the low to moderate range with a smaller number of students reporting very high self-concept. Histograms, density plots, and violin plots confirmed this pattern, with a pronounced right tail and a small group of high scoring cases at the upper end of the scale.

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Descriptive Statistics

	Mean Grades	Self-concept Score
Valid	300	300
Missing	196	196
Mode	75.000[a]	190.000[a]
Mean	85.740	130.343
Std. Deviation	6.900	23.580
IQR	11.000	21.000
Skewness	−0.240	0.963
Std. Error of Skewness	0.141	0.141
Range	35.000	130.000
Minimum	64.000	60.000
Maximum	99.000	190.000

[a] The mode is computed assuming that variables are discreet.

3.3 Assumption checks. Assumptions underlying the planned correlational and regression analyses were examined prior to hypothesis testing. Shapiro–Wilk tests indicated a significant departure from multivariate normality for the pair of variables, and the bivariate combination of Chemistry grades and self-concept scores also showed significant non normality. Q Q plots and density plots suggested that Chemistry grades were reasonably close to normal, with only minor deviations in the tails, whereas self-concept scores exhibited marked positive skew and a heavy upper tail consistent with a potential ceiling effect.

A scatter plot of self-concept scores against Chemistry grades showed an approximately linear trend with a positive slope. The cloud of points did not show evidence of distinct subgroups or extreme outliers. Visual inspection of the plot and associated smoothing lines suggested that a linear model provided an adequate first order description of the relationship across the observed range of scores. On this basis, Pearson product moment correlation was considered interpretable, but a nonparametric Spearman rank correlation was also estimated to provide a robustness check given the non-normal distribution of self-concept scores.

Shapiro-Wilk Test for Multivariate Normality

Shapiro-Wilk	p
0.936	< .001

Shapiro-Wilk Test for Bivariate Normality

			Shapiro-Wilk	p
Mean Grades	-	Self-concept Score	0.936	< .001

3.4 Correlational analysis. Correlation analysis showed a statistically significant moderate positive relationship between self-concept in Chemistry and academic performance in the subject. Pearson's correlation coefficient between self-concept scores and Chemistry grades was $r = 0.400$, $p < .001$, based on 300 cases. This coefficient indicated that students who reported more positive self-concept in Chemistry tended to obtain higher Chemistry grades. The corresponding coefficient of determination suggested that self-concept accounted for approximately 16 percent of the variance in Chemistry grades.

To address non normality and the ordinal nature of the Likert type self-concept measure, Spearman's rank correlation was also computed. The Spearman coefficient was slightly higher in magnitude but similar in direction, $\rho = 0.417$, $p < .001$, which confirmed that the positive association between self-concept and Chemistry grades was not an artifact of distributional assumptions or a few influential observations. Correlation heatmaps for Pearson and Spearman coefficients yielded the same pattern of a single moderate positive association between the two variables.

Correlation Table

				Pearson		Spearman	
			n	r	p	rho	p
Mean Grades	-	Self-concept Score	300	0.400	< .001	0.417	< .001

3.5 Regression Analysis. Simple linear regression was conducted to examine the extent to which self-concept in Chemistry predicted students' Chemistry grades. Self-concept scores served as the independent variable, and Chemistry grade served as the dependent variable. Consistent with the correlational findings, the regression model was statistically significant, $F(1, 298) \approx 56.76$, $p < .001$. The model accounted for approximately 16 percent of the variance in Chemistry grades, as indicated by the coefficient of determination.

The unstandardized regression coefficient for self-concept indicated that, on average, a one-point increase in self-concept score was associated with an increase of about 0.12 grade points in Chemistry. Equivalently, a student who scored one standard deviation above the sample mean on self-concept tended to have a Chemistry grade approximately 2.8 points higher than a student at the mean level of self-concept.

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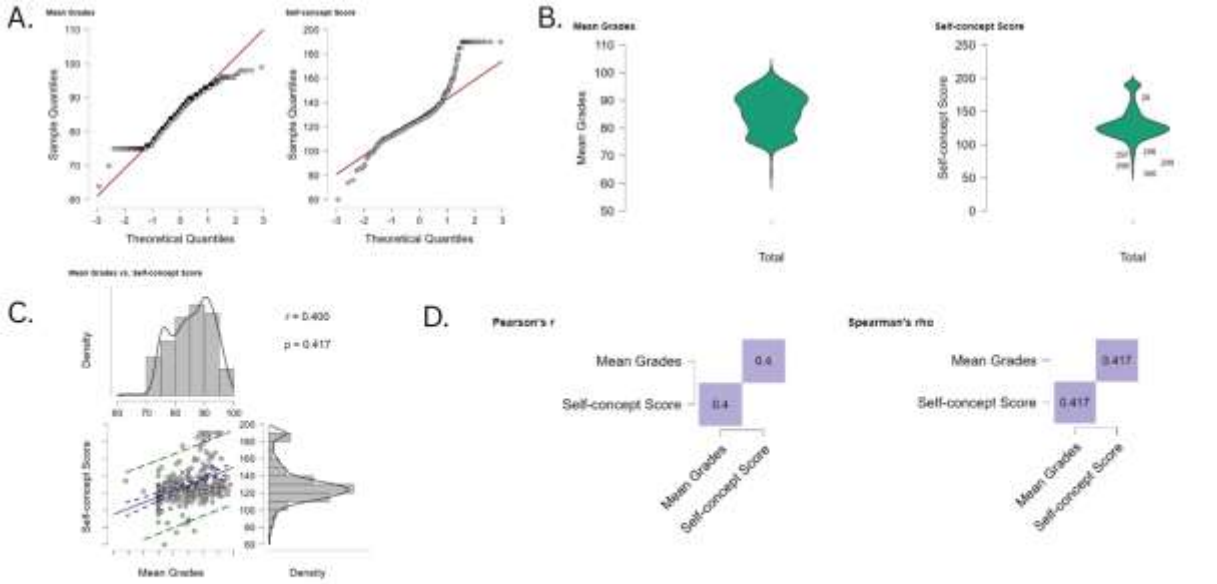

Figure 1.0 *The main assumption checks and correlation patterns between Chemistry grades and self concept. Panel A presented quantile quantile plots that indicated mean grades were approximately normal while self concept scores showed clear positive skew. Panel B displayed violin plots that summarized the distribution of each variable, with tightly clustered high grades and more dispersed self concept scores. Panel C showed a scatter plot with marginal histograms and a fitted regression line, illustrating a moderate positive association between mean grades and self concept scores, consistent with Pearson r = 0.400 and Spearman rho = 0.417. Panel D provided correlation heatmaps for Pearson and Spearman coefficients, both of which summarized the same moderate positive relationship between the two variables.*

Regression diagnostics based on residual plots did not reveal serious violations of linearity or homoscedasticity, and no individual case exerted undue influence on the estimates.

Overall, the results showed that self-concept in Chemistry and Chemistry achievement were moderately and positively related and that self-concept functioned as a statistically significant predictor of students' grades, although a substantial proportion of the variance in achievement remained unexplained by self-concept alone.

3.6 Discussion. This study examined the relationship between junior high school students' self-concept in Chemistry and their academic performance in the subject in a large Philippine public secondary school. The main findings indicated that students generally achieved high Chemistry grades with limited dispersion, while their self-concept scores were more variable and positively skewed. Statistical analyses further showed a moderate positive association between self-concept and Chemistry grades and demonstrated that self-concept significantly predicted achievement, explaining roughly one sixth of the variance in grades.

The magnitude and direction of the observed correlations were consistent with a substantial body of research that had linked academic self-concept with academic achievement in various domains. Prior studies had typically reported moderate positive correlations, suggesting that students who felt more competent academically tended to perform better, and that these two variables influenced one another over time (Guay et al., 2003; Marsh & Craven, 2006). The present results extended this pattern to the context of junior high school Chemistry in a Philippine public school, showing that domain specific self-concept in Chemistry was associated with subject specific performance in line with previous work on subject level self-beliefs (Jansen et al., 2015).

The regression analysis provided additional information about the practical significance of this relationship. Although self-concept in Chemistry explained only a modest portion of the variance in grades, the predicted difference of nearly three grade points for students one standard deviation apart in self-concept was educationally meaningful in a grading system where small differences could translate into changes in ranking, honors, or eligibility for specialized programs. At the same time, the fact that more than four fifths of the variance in Chemistry grades was not accounted for by self-concept underscored that many other factors, such as prior knowledge, instructional quality, home support, and broader motivational and affective variables, also influenced students' achievement (Hattie, 2009; Pintrich & De Groot, 1990).

The distributional patterns observed in this study were also noteworthy. Chemistry grades clustered tightly around a relatively high mean, which suggested that many students were able to meet or exceed the performance standards set in the subject. In contrast, self-concept scores displayed greater spread and a clear positive skew, with a large group of students reporting only low to moderate self-concept and a smaller group reporting very high self-concept. This mismatch indicated that there were students who performed adequately yet did not perceive themselves as particularly capable in Chemistry. Such a pattern had been noted in longitudinal research showing that academic self-concept often declined during the transition to secondary schooling even when achievement levels remained stable (Jacobs et al., 2002).

In collectivist and high expectation learning environments, students might also have been reluctant to endorse very

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positive self-statements because of modesty norms or fear of social comparison, which could contribute to lower reported self-concept despite strong performance (Bernardo, 2010). The present findings suggested that some junior high school students in this setting might have underestimated their competence in Chemistry, which could have implications for their willingness to enroll in advanced science courses or pursue science related careers. Addressing such discrepancies between actual performance and self-beliefs could therefore be an important target for school level interventions.

The results further supported the view that self-concept in specific subjects such as Chemistry represented a potentially malleable factor that could be influenced by classroom practices. Previous studies in science education had shown that cooperative learning, inquiry-based activities, and supportive feedback could improve both science achievement and science self-concept (Acar & Tarhan, 2008). In light of the present findings, Chemistry teachers might consider strategies that provide students with frequent, accurate feedback about their progress, emphasize mastery and improvement rather than comparison, and create opportunities for successful engagement with challenging tasks. Such practices could help students align their self-concept more closely with their demonstrated capabilities and might contribute to sustained engagement in Chemistry and other science subjects.

Several limitations of this study should be acknowledged. First, the research used a cross-sectional correlational design, which did not permit strong causal conclusions about the direction of influence between self-concept and achievement. Reciprocal effects models proposed in the literature suggested that self-concept and achievement might influence each other over time (Marsh & Craven, 2006), a possibility that could not be tested with a single time point. Second, data were drawn from one large public secondary school in an urban Philippine setting using intact classes, which limited the generalizability of the findings to other types of schools or regions. Third, self-concept was measured through a self-report questionnaire, which might have been subject to social desirability and response biases. Finally, only one grading period in Chemistry was used as the indicator of achievement, which might not have captured longer term performance trends.

CONCLUSION

This study examined the relationship between junior high school students' self-concept in Chemistry and their academic performance in the subject at a large Philippine public secondary school. Using a descriptive correlational design with 300 students who had complete data on both variables, the study found that Chemistry grades were generally high and clustered within a relatively narrow range, whereas self-concept scores were more widely dispersed and positively skewed. These distributional patterns indicated that while many students achieved satisfactorily in Chemistry, their perceptions of their own competence varied considerably, with a substantial proportion reporting only low to moderate self concept.

Correlation and regression analyses showed that self-concept in Chemistry was moderately and positively associated with Chemistry grades. Students who reported more positive self-concept tended to obtain higher grades, and self-concept emerged as a statistically significant predictor of academic performance in the subject. The proportion of variance in grades explained by self-concept was modest but educationally meaningful, suggesting that self-beliefs constituted one important influence among many factors that contributed to achievement in Chemistry. At the same time, the findings made clear that self-concept alone did not determine students' performance, since a large share of the variability in grades remained unexplained by this single variable.

These results had several implications for classroom practice and school level interventions. The combination of generally high grades with more uneven and sometimes low self-concept scores suggested that some students might have underestimated their actual capability in Chemistry. Addressing such discrepancies between performance and self-beliefs could be important for sustaining students' engagement with the subject and for supporting their decisions about pursuing further study in science. Classroom strategies that provided accurate, constructive feedback, emphasized mastery and improvement, and created opportunities for successful engagement with challenging tasks could help align students' self-concept more closely with their demonstrated competence.

Finally, the study highlighted the value of systematically monitoring both cognitive and noncognitive indicators in key subjects such as Chemistry. While the cross-sectional design did not allow causal conclusions, the evidence that self-concept and achievement were meaningfully linked supported the view that fostering accurate and adaptive self-beliefs should form part of broader efforts to improve academic outcomes in junior high school science. Future research that followed students over time and tested specific interventions would be needed to clarify the directional pathways between self-concept and performance and to identify the most effective practices for strengthening both in the Philippine basic education context.

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