

Science Identity as a Predictor of Agency in the Anthropocene among Preservice Science Teachers

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Abstract

This study aims to analyze science identity as a predictor of agency in the Anthropocene among prospective science teacher students at Medan State University. The study used a quantitative approach with a correlational-predictive design. The sample consisted of 71 fifth-semester prospective science teachers who were selected using purposive sampling. Data were collected through two self-report instruments, namely a science identity instrument covering the dimensions Performance, Competence, and Recognition, and an instrument of agency in the Anthropocene covering the dimensions Sense of Agency, Ecological Care, and Transformative Action. Both instruments used a four-point Likert scale with 18 items in each variable. Data were analyzed using descriptive statistics, normality test, linearity test, Pearson correlation, and simple linear regression. The results show that science identity has a mean of 57.90 (SD = 4.899), while agency in the Anthropocene has a mean of 61.66 (SD = 5.918). The correlation test shows a positive and significant relationship between science identity and agency in the Anthropocene ($r = 0.549$; $p < 0.001$). The regression results indicate that science identity is a significant predictor of agency in the Anthropocene ($B = 0.663$; $\beta = 0.549$; $t = 5.451$; $p < 0.001$), with a contribution of 30.1% ($R^2 = 0.301$). These findings highlight the importance of science identity in explaining the readiness of agency in the Anthropocene among prospective science teacher students.

Keywords

Science Identity; Agency In The Anthropocene; Prospective Science Teacher Students; Predictor; Science Education



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INTRODUCTION

Global environmental changes in the Anthropocene era require science education not only to equip learners with scientific knowledge and skills but also the ability to understand,

evaluate, and respond to socio-ecological issues. Climate change, environmental degradation, loss of biodiversity, and various sustainability challenges require individuals who can use scientific knowledge in decision making and action. In this context, science education plays a strategic role in preparing a generation capable of facing uncertainty and contributing to a sustainable future (Tan & White, 2023; White et al., 2025)

This orientation shift is also reflected in the PISA 2025 Science Framework, which broadens the goals of science education by emphasizing science identity and Agency in the Anthropocene. The framework regards science identity as a crucial aspect due to an individual's connection to science, beliefs about their abilities, and recognition as someone capable of engaging in science, seen as important to support agency and active citizenship. Meanwhile, Agency in the Anthropocene emphasizes the individual's ability to understand socio-ecological issues, evaluate diverse evidence and perspectives, and make decisions and actions to build a sustainable future (OECD, 2023; *OECD Skills Outlook 2025*, 2025). The concept is increasingly important because science education needs to move beyond mere conceptual mastery toward the ability to use science to address real-world problems and participate in socio-ecological change.

One aspect that potentially supports this readiness is science identity. Science identity refers to how an individual views themselves as someone capable of participating in science and how that identity is formed through experience, competence, performance, and recognition from the social environment. Carlone and Johnson (2007) , developing science identity through three main aspects, namely performance, competence, and recognition. Research shows that students' involvement in authentic science practices can be related to the development of identity, motivation, and STEM achievement (Starr et al., 2020), while learning experiences in an environment that provides various forms of participation and recognition can also support the development of science identity (Chung-parsons & Bailey, 2019; Jiang & Wei, 2023). Other research shows that science identity is also related to students' sense of belonging and success in science (Chen et al., 2021), whereas science learning self- efficacy and success in science can play a role in shaping science identity (Rozhnov et al., 2024).

For prospective science teachers' students, strengthening science identity becomes increasingly important because the identity built during teacher training can influence how they view science, science learning, and their role as educators. Research on prospective teachers shows that experience in science courses can contribute to the development of their identity as science teachers (Khoza, 2022; Ogundapo et al., 2025), while research on prospective science teachers shows that science identity and science teacher identity are interconnected constructs but do not always develop identically (Chung-parsons & Bailey, 2019). In the context of the Anthropocene, science identity becomes even more relevant because individuals who see themselves as part of the science world have a greater potential to use that knowledge and competence to respond to environmental issues. This perspective aligns with developments in science education that have begun to place social identity and empowerment as important components of education for transformation and collective action in the face of

climate crisis (Kranz et al., 2025).

Although science identity has been widely studied in relation to motivation, engagement, achievement, and the sustainability of participation in science, research that specifically examines the relationship between science identity and Agency in the Anthropocene, especially among prospective science teachers' students, is still limited. Yet, Agency in the Anthropocene requires more than environmental concern: empowerment, hope, efficacy, and the ability to translate scientific understanding into individual and collective action (Carlone & Johnson, 2007; Tan & White, 2023; White et al., 2025). Recent studies show that future-oriented science learning can increase environmental agency and future literacy (Chan & Erduran, 2025), but empirical evidence is still needed regarding personal factors that can predict Agency in the Anthropocene. Therefore, this study aims to analyze science identity as a predictor of agency in the Anthropocene among prospective science teachers' students at Universitas Negeri Medan. This research is expected to provide empirical contributions to the development of science teacher education that not only builds scientific competence, but also identity as a science individual who is ready to take part in meeting the challenges of the Anthropocene.

METHODS

This study used a quantitative approach with a correlational-predictive design to analyze science identity as a predictor of agency in the Anthropocene among Pre-Service science teachers' students at Universitas Negeri Medan. The research participants numbered 71 prospective science teachers' students in semester 5 who were selected using a purposive sampling technique. The selection of semester 5 students is based on the consideration that they have gained sufficient academic experience and science learning to develop science identity and readiness for agency in the Anthropocene. Data were collected using two instruments in the form of self-report questionnaires. The science identity instrument consists of 18 items across three dimensions, namely Performance, Competence, and Recognition, referring to the framework of Carlone and Johnson (2007). The agency in the Anthropocene instrument consists of 18 items covering three dimensions, namely Sense of Agency, Ecological Care, and Transformative Action, based on the adaptation of the OECD PISA 2025 framework. Both instruments use a 4-point Likert scale, namely Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1) for positive statements, while negative statements are scored reversely.

Data were analyzed using SPSS through descriptive statistics, normality test, linearity test, Pearson correlation, and simple linear regression. The normality test is used to ensure the data distribution assumptions are met, while the linearity test is used to ensure the relationship between the two variables is linear. Pearson correlation is used to determine the direction and strength of the relationship between science identity and agency in the Anthropocene, while simple linear regression is used to test the ability of science identity to predict agency in the Anthropocene. Hypothesis testing was carried out at a significance level of 0.05.

RESULTS AND DISCUSSION

Results

This study involved 71 prospective science teacher students in the fifth semester at Medan State University. Descriptive analysis was conducted to describe the scores of science identity and agency in the Anthropocene. The results indicate that both variables fall into the high category.

Descriptive Statistics

Table 1. Descriptive Statistics of Research Variables

Variable	N	Mean	SD
<i>Science Identity</i>	71	57,90	4,899
<i>Agency in the Anthropocene</i>	71	61,66	5,918

Normality Test

Normality tests were conducted using Kolmogorov-Smirnov and Shapiro-Wilk. The results show that all data are normally distributed ($p > 0.05$).

Tabel 2. Normality Test Results

Variable	K-S Sig.	S-W Sig.	Description
<i>Science Identity</i>	0,200	0,166	Normal
<i>Agency in the Anthropocene</i>	0,057	0,105	Normal

Linearity Test

The linearity test shows that the relationship between science identity and agency in the Anthropocene is linear.

Tabel 3. Results of Linearity Test

Source of Variation	F	Sig.
Deviation from Linearity	0,947	0,533

This result shows that there is no deviation from linearity ($p > 0.05$), so regression analysis can be performed..

Correlation Test

The Pearson correlation test results show a positive and significant relationship between science identity and agency in the Anthropocene

Tabel 4. Pearson Correlation Results

Variable	r	Sig.	N
<i>Science Identity ↔ Agency</i>	0,549	<0,001	71

This result shows that the relationship is in the medium category and statistically significant

Simple Linear Regression Test

Regression analysis shows that science identity is a significant predictor of agency in the Anthropocene.

Tabel 5. Results of Simple Linear Regression Analysis Science Identity on Agency in the Anthropocene

Predictor	B	SE	β	t	p	95% CI
Constant	23,288	7,064	—	3,296	0,002	[9,194; 37,381]
<i>Science Identity</i>	0,663	0,122	0,549	5,451	<0,001	[0,420; 0,905]

Model fit: $R = 0.549$; $R^2 = 0.301$; Adjusted $R^2 = 0.291$; $F(1,69) = 29.715$; $p < 0.001$.

Note. Dependent variable = Agency in the Anthropocene. B = unstandardized regression coefficient; SE = standard error; β = standardized regression coefficient; CI = confidence interval.

The regression equation obtained is: $Y = 23.288 + 0.663X$

This result shows that a one-unit increase in science identity will increase agency in the Anthropocene by 0.663 units. The regression model is statistically significant ($p < 0.001$) and can explain 30.1% of the variation in agency in the Anthropocene, while the rest is influenced by other factors outside the research model.

Discussion

The study results show that science identity and agency in the Anthropocene among pre-service science teacher students are at a relatively high level, with averages of 57.90 and 61.66 respectively. This finding indicates that students not only have a sufficiently strong identity in science learning, but also readiness to play a role in facing issues.) . socio-ecological. Science identity encompasses how individuals view themselves as someone capable of performing science activities (performance), possessing competence in science (competence), and gaining recognition as an individual connected to science (recognition) (Carlone & Johnson, 2007). Meanwhile, agency in the Anthropocene places individuals as part of a socio-ecological system that has the ability and empowerment to respond to various environmental challenges responsibly (Bartosch, 2025; White et al., 2025).

Correlation results show a positive and significant relationship between science identity and agency in the Anthropocene ($r = 0.549$; $p < 0.001$). This means students with a stronger science identity are more likely to have higher agency in the Anthropocene. This relationship can be explained by the fact that when students view themselves as capable of understanding and performing scientific activities and obtaining recognition in the academic environment, they have a stronger foundation to use their knowledge and competencies to respond to real-world issues. This view aligns with research on identity and agency in science learning, which shows that opportunities to take on roles, use knowledge, and engage in science practices can shape both identity and empowerment of learners. The development of

agency is increasingly relevant in science education as instruction is directed to prepare learners to face global challenges and make responsible decisions (Chan & Erduran, 2025; Tan & White, 2023)

The regression results strengthen these findings by showing that science identity is a positive and significant predictor of agency in the Anthropocene ($B = 0.663$; $\beta = 0.549$; $t = 5.451$; $p < 0.001$). $R^2 = 0.301$ indicates that science identity explains 30.1% of the variance in agency in the Anthropocene, while the remaining 69.9% relates to other factors not included in the model. This finding shows that developing science identity is an important aspect in building the preparedness and empowerment of preservice science teachers, but not the only factor. Agency in the Anthropocene is a complex construct because it relates to the ability to understand socio-ecological issues, environmental concern, hope, efficacy, and readiness to take action. White et al. (2024) emphasize that education plays a crucial role in building agency and collective action to address planetary health challenges, while Chan and Erduran (2025) show that future-oriented science learning can enhance environmental agency.

The findings have implications for science teacher education. Developing science identity should be integrated with learning experiences that give students the opportunity to analyze environmental problems, conduct investigations, design solutions, make decisions, and engage in real action. Thus, science education is not only about mastering concepts but also building students' capacity to become preservice teachers who can play a role in facing Anthropocene challenges. However, because this study used a correlational-predictive design and self-report with 71 students, the results should not be interpreted as causal relationships. Future research should test other factors that may explain agency in the Anthropocene, and use longitudinal or intervention designs to test whether strengthening science identity can indeed enhance agency

CONCLUSION

Based on the results, it can be concluded that science identity is a positive and significant predictor of agency in the Anthropocene among preservice science teachers at Universitas Negeri Medan. The analysis shows a positive and significant relationship between science identity and agency in the Anthropocene ($r = 0.549$; $p < 0.001$), with the contribution of science identity accounting for 30.1% of the variation in agency in the Anthropocene ($R^2 = 0.301$). Regression results also show that every one-unit increase in science identity is predicted to be followed by an increase in agency in the Anthropocene by 0.663 units ($B = 0.663$; $t = 5.451$; $p < 0.001$). Thus, the stronger science identity of students, the higher the readiness of agency in the Anthropocene which he/she has, although 69.9% of the variation in agency in the Anthropocene is still explained by factors outside the research model.

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