Multifaceted effects of self-efficacy on Taiwanese high school students' learning engagement

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Abstract

In the past, most empirical studies were concerned with the relations between a certain type of learning engagement and one single scale of self-efficacy, without a more comprehensive examination. By analyzing a total of 280 Taiwanese high school students' responses on the two quantitative instruments, the Science Learning Self-Efficacy (SLSE) instrument and the newly-developed Science Learning Engagement Instrument (SLEI), this study aims to differentiate the predictive powers of multi-faceted science learning self-efficacy on assorted forms of science learning engagement. The results indicated that, for *Behavioral engagement* and *Agentic engagement*, the SLSE dimensions of *Higher-order Cognitive Skills* and *Practical Work* are the positive predictors. Next, the two SLSE dimensions of *Everyday Application* and *Conceptual Understanding* can positively predict *Cognitive engagement*. Similarly, in addition to the SLSE dimensions of *Everyday Application* and *Conceptual Understanding*, the SLSE dimension of *Science Communication* can also positively predict *Emotional engagement*. Finally, for *Social engagement*, three SLSE dimensions, *Science Communication*, *Practical Work*, and *Conceptual Understanding,* are the positive predictors. The findings of this study could be informative for science educators and practitioners to adequately engage students in various aspects of science learning.

Introduction

- Self-efficacy can be defined as the perceptions of individuals as they judge their own capabilities to perform adequately in given tasks.
- Since science learning self-efficacy has been proven to be an influential predictor of a number of learning factors such as motivation, strategy use, performance, outcomes as well as engagement, adopting a more fine-grained conceptualization of science learning self-efficacy would be beneficial to inform educators and practitioners with more useful insights.
- It should be noted that most of the empirical studies are mainly concerned with the associations between a certain type of engagement (cognitive engagement mainly) and other crucial learning factors such as self-efficacy.

Research purpose

- The main purpose of this study is, first, to initially explore the relations between senior high school students' science learning self-efficacy and engagement from a multi-dimensional perspective, and second, to differentiate the predictive powers of multi-faceted science learning self-efficacy on various forms of science learning engagement.

Method

In this study, a total of 280 students from six senior high schools across Taiwan were selected. There were 163 males and 117 females. The age of these students ranged from 15 to 18 years old. The participants were invited to complete the two survey instruments with respect to science learning self-efficacy and engagement. In order to assess the students' science learning self-efficacy.

➢ **Science Learning Self-Efficacy (SLSE)** instrument (32 items) was developed by Lin and Tsai (2013).
- Five dimensions, namely:
  - "Conceptual Understanding,"
  - "Higher-order Cognitive Skills,"
  - "Practical Work,"
  - "Everyday Application,"
  - "Science Communication."

➢ **Science Learning Engagement Instrument (SLEI)** (27 items) This instrument was used to assess the students' five categorical dimensions of engagement:

- *Cognitive engagement* (5 items/ Before starting an assignment for science class, I try to figure out the best way to do it)
- *Behavioral engagement* (6 items/ I put a lot of effort into science class)
- *Emotional engagement* (5 items/ I enjoy learning new things in science class)
- *Social engagement* (4 items/ I try to work with others who can help me in science)
- *Agentic engagement* (7 items/ During science class, I express my preferences and opinions).

Both SLSE and SLEI questionnaires were presented with bipolar strongly agree/strongly disagree statements in a five-point Likert mode.

Findings

- The results of Pearson correlation analyses indicated that all five SLSE dimensions were correlated positively and significantly with the five distinct dimensions of SLEI ($r = 0.54 \sim 0.71$, $p < 0.01$).

- Stepwise multiple regression analyses were conducted to identify the predictive effects of the SLSE dimensions on the five engagement dimensions of the SLEI. For each regression analysis, the five SLSE dimensions served as predictor variables, while each dimension of the SLEI was processed as an outcome variable, as shown in Table 1.
  - For both the *Behavioral engagement* and *Agentic engagement* of the SLEI, the two SLSE dimensions of *Higher-order Cognitive Skills* (ß = 0.39, 0.39, respectively) and *Practical Work* (ß = 0.32, 0.31, respectively) are the significant and positive predictors.
  - The two SLSE dimensions of *Everyday Application* (ß = 0.44) and *Conceptual Understanding* (ß = 0.38) can significantly and positively predict the SLEI dimension of *Cognitive engagement*.
  - Similarly, in addition to the SLSE dimensions of *Everyday Application* (ß = 0.34) and *Conceptual Understanding* (ß = 0.30), the SLSE dimension of *Science Communication* (ß = 0.19) can also positively and significantly predict the SLEI dimension of *Emotional engagement*.
  - Finally, for the SLEI dimension of *Social engagement*, three SLSE dimensions, *Science Communication*, *Practical Work*, and *Conceptual Understanding,* are the positive and significant predictors (ß = 31, 0.27, 0.23, respectively).

SLEI (outcome)	Predictor(s)	β	Adjusted R^2	t	F
Behavioral Engagement	*Constant*		0.43	7.28^{***}	107.31^{***}
	HCS	0.39		5.84^{***}	
	PW	0.32		4.76^{***}	
Agentic Engagement	*Constant*		0.43	4.33^{***}	108.15^{***}
	HCS	0.39		5.88^{***}	
	PW	0.31		4.74^{***}	
Cognitive Engagement	*Constant*		0.58	5.23^{***}	194.75^{***}
	EA	0.44		7.68^{***}	
	CU	0.38		6.74^{***}	
Emotional Engagement	*Constant*		0.58	1.38^{***}	126.58^{***}
	EA	0.34		4.94^{***}	
	CU	0.30		4.67^{***}	
	SC	0.19		2.71^{**}	
Social Engagement	*Constant*		0.53	7.25^{***}	107.54^{***}
	SC	0.31		4.26^{***}	
	PW	0.27		4.21^{***}	
	CU	0.23		3.47^{**}	

$^{**}p < 0.01$, $^{***}p < 0.001$
Note: CU/Conceptual Understanding, HCS/Higher-order Cognitive Skills, EA/Everyday Application, PW/Practical Work, SC/Science Communication

Table 1. Stepwise regression model of predicting students' science learning engagement

Conclusion

- This study found that the Taiwanese high school students with greater confidence in demonstrating higher-order cognitive skills were prone to exert more efforts to participate through actions in their own learning.
- It is also interesting that the students who were more efficacious in accomplishing laboratory activities tended to be behaviorally engaged.
  - Students may need to exhibit proper conduct and act to successfully accomplish the declarative, procedural, and operational aspects of practical work activities (e.g., Lin & Tsai, 2013).
- Agentic engagement occurs when students proactively create, enhance, and personalize the learning conditions in the classroom and request the alteration of instruction flow.
  - The students who were confident in employing higher-order thinking skills tended to be more engaged in actively contributing to the flow of instruction.
  - It should be noted that students' agentic engagement also occurred more often while they were confident in performing laboratory activities.
  - In Taiwan, the common laboratory activities may still be dominated by "recipe-style" tasks. It is possible that the students may be tired of merely following the standard procedures and attempt to proactively advance their laboratory learning experiences by making contributions during the flow of instruction.
- In addition to the confidence in using fundamental cognitive skills, confidence in applying learned knowledge in school to real life is the main source to enhance the students' cognitive engagement.
  - By anchoring learning in real-life and authentic contexts, students may profoundly engage in adopting self-regulation strategies such as planning, monitoring, or evaluating.
- The results of this study suggest that, to activate students' positive emotional reactions in science learning activities, educators and practitioners should pay considerable attention to not only equipping students with proper conceptual understanding of scientific concepts and theories but, more importantly, providing opportunities to link learned knowledge with real-life contexts that allow them to develop relevant experiences.
- The students who were efficacious in communicating scientifically with others tended to enhance their prosocial behavior and involvement.
  - Laboratory activities also allow them to form groups with peers, giving them more opportunities to share ideas, contribute to others' ideas, and think about others' perspectives. Undoubtedly, the familiarity of science content material is also essential to ensure the social forms of engagement.
- In sum, the preliminary findings of this study provide evidence that, in order to deeply engage learners in science learning, promoting their science learning self-efficacy is of great importance.
- Also, this study further identified the multifaceted effects of self-efficacy on the manifold aspects of learning engagement in the literature.
- The results of this study could be informative for science educators and practitioners to adequately engage students in various aspects of science learning.

Main Reference

- Lin, T.-J., & Tsai, C.-C. (2013). A multi-dimensional instrument for evaluating Taiwan high school students' learning self-efficacy in relation to their approaches to learning science. *International Journal of Science and Mathematics Education*, *11*, 1275-1301.