

1. **Citation:** Tzou, W. S., Yeh, Y. *, Ma, C. H., Simarmatab, M. T. A. (July, 2026). Achievement goal motivation and self-efficacy in AI-supported collaborative programming: Mediating roles of growth mindset and mastery experience. *International Journal of Engineering Pedagogy*, 16(5). <https://doi.org/10.3991/ijep.v16i5.62296>

程式設計心向量表
Inventory of Programming Mindset

「程式設計學習動機」量表發展

Study 1-4: Development of “Inventory of Motivations in Learning Programming”

4.1.1 Development of the IPMo

EFA results for the IPMo revealed a two-factor structure—Mastery goal and Performance goal—across nine items. Factor loadings ranged from .697 to .966, accounting for 75.606% of the total variance (see Table 1). The correlation between the two factors was .575 ($p < .001$), and the correlations between each factor and the total score were .892 and .883 ($ps < .001$). Cronbach’s α coefficients indicated strong internal consistency, with values of .913 for the overall scale, .897 for the Mastery goal, and .916 for the Performance goal. Item–total correlations ranged from .591 to .788, further supporting the reliability of the scale.

CFA further supported the two-factor structure of the IPMo. The model fit indices were: χ^2 ($N = 193$, $df = 26$) = 124.151, $p < .001$; goodness-of-fit index (GFI) = .877; adjusted goodness-of-fit index (AGFI) = .788; standardized root mean square residual (SRMR) = .059; root mean square error of approximation (RMSEA) = .140; comparative fit index (CFI) = .926; and normed fit index (NFI) = .909. The composite reliability (CR) values for the Mastery goal and Performance goal factors were .895 and .917, respectively, and the average variance extracted (AVE) values were .647 for Mastery goal and .738 for Performance goal.

Table 7. The factor loadings of the IMLP

New No	Factors and items 學習程式設計時(During the learning of programing,)	Factor loadings	
		1	2
	Factor 1: Mastery goal ($\alpha = .897$)		
3	6. 我努力避免遺漏學習重要的概念。 I strive to avoid missing any important concepts during my learning.	.923	
2	5. 我盡我所能，多多學習上課重要概念。 I do my best to learn as many important concepts from class as possible.	.893	
6	9. 我努力將所學融會貫通，期盼能加以應用。 I make an effort to integrate what I’ve learned, hoping to apply it effectively.	.876	
1	2. 我盡力避免敷衍了事，才不會降低學習成效。 I try hard not to take a perfunctory approach, so as not to reduce the effectiveness of my learning.	.802	

7	10. 我努力避免表面的理解，以致無法融會貫通。 I strive to avoid superficial understanding that prevents true comprehension and integration.	.697
Factor 2: Performance goal ($\alpha = .916$)		
9	12. 我盡力追求好表現，避免讓他人瞧不起我。 I put in great effort to perform well so others won't look down on me.	.966
5	8. 我努力表現，避免他人嘲笑我。 I work hard to avoid being ridiculed by others.	.912
8	11. 我盡力追求好表現，以便讓他人刮目相看。 I strive to perform well in order to impress others.	.908
4	7. 我努力表現，希望能贏得他人的肯定。 I make an effort to perform well in hopes of gaining others' recognition.	.717

Table 8. The correlation between the four factors and the total score

	(1)	(2)	(3)
(1) Total scores	1.000		
(2) Mastery	.892***	1.000	
(3) Performance	.883***	.575**	1.000

*** $p < .001$. ** $p < .01$

3.2. Reliability analysis

The Cronbach's α of IMPo and the two factors were .913, .897 (Mastery), and .916 (Performance). Moreover, the item-total correlation coefficients ranged from .591 to .788.

New No	Items	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
1	2. 我盡力避免敷衍了事，才不會降低學習成效。	.591	.486	.909
2	5. 我盡我所能，多多學習上課重要概念。	.708	.700	.901
3	6. 我努力避免遺漏學習重要的概念。	.733	.737	.900
4	7. 我努力表現，希望能贏得他人的肯定。	.788	.740	.895
5	8. 我努力表現，避免他人嘲笑我。	.640	.654	.907
6	9. 我努力將所學融會貫通，期盼能加以應用。	.741	.738	.899
7	10. 我努力避免表面的理解，以致無法融會貫通。	.630	.507	.906
8	11. 我盡力追求好表現，以便讓他人刮目相看。	.715	.738	.900
9	12. 我盡力追求好表現，避免讓他人瞧不起我。	.732	.787	.899

3.3. Confirmatory factor analysis

The two-factor structure with 9 items extracted from EFA was validated by CFA with maximum likelihood estimation. CFA results indicated that the inventory had good construct validity and reliability, $\chi^2(N = 193, df = 26) = 124.151$ ($p < .000$), the goodness-of-fit index (GFI) = .877, the adjusted goodness-of-fit index (AGFI) = .788, the standardized root mean square residual (SRMR)

= .059, root mean square error of approximation (RMSEA) = .140, the comparative fit index (CFI) = .926, and the normed fit index (NFI) = 0.909. Moreover, the composite reliability values for factors 1 (Mastery) and 2 (Performance) were .895 and .917, while the average variance extracted values were .647 and .738, respectively. Discriminant validity was also established with a value of .634.