

**Proficiency Indicators  
for Philippine STEAM  
(Science, Technology,  
Engineering, Agri-  
Fisheries, Mathematics)  
Educators**

# Abstract

- ▶ The study aimed to develop a self-rating tool to determine the proficiency of Philippine Higher Education (PHE) STEAM (Science, Technology, Engineering, Agri-Fisheries, Mathematics) Educators. This design and development research emphasized elaborations of the Philippine Professional Standards for Teachers (PPST) in the tertiary STEAM education aligned with the Policies, Standards, and Guidelines (PSGs) of 46 STEAM programs (science - 22, technology - 7, engineering - 10, agriculture - 5, and mathematics - 2). The crafted indicators went through expert and statistical validations and analyses to establish the indicators' content validity, construct validity, and reliability. The experts assessed the indicators' similarity and variance, appropriateness, phraseology, and ambiguity of items and found that most items from the first version (90 items) suit the criteria and the country's context. Principal axis factor (PAF) analysis showed that only 60 items represent the seven factor loadings generated from the analysis. These seven factors matched the seven TPCK dimensions: Factor 1 (TPACK [Technological Pedagogical Content Knowledge]), Factor 2 (TPK [Technological Pedagogical Knowledge]), Factor 3 (TCK [Technological Content Knowledge]), Factor 4 (PCK [Pedagogical Content Knowledge]), Factor 5 (TK [Technological Knowledge]), Factor 6 (PK [Pedagogical Knowledge]), and Factor 7 (CK [Content Knowledge]). The first four factors with a majority of the generated 60 indicators already explained more than half of the variance as per PAF. Furthermore, all seven factors and the entire set of 60 indicators obtained above standard reliability indices as per Cronbach's alpha analysis, thus incurring valid and reliable 60 indicators of proficiency for PHE STEAM educators that may be utilized for reflective practice and policy inputs to Philippine STEAM Education.

# Objectives of the Study:

- ▶ The study aimed to design, develop, and validate a standard self-rating proficiency indicator tool for PHE STEAM educators.
- ▶ SPECIFIC OBJECTIVES:
  - ▶ 1. To design and develop the SELF-RATING PROFICIENCY INDICATORS for PHE STEAM Educators anchored on the PSGs and PPST; and
  - ▶ 2. To validate the SELF-RATING PROFICIENCY INDICATORS for PHE STEAM Educators

# METHODS

- ▶ Design and Development Research
- ▶ PSGs of CHED for STEAM degree programs
  - ▶ Contains core competencies expected of every graduate in the Philippines, from which PHE institutions reference their curricular decisions and programs alongside their specific contexts and institutional missions.
  - ▶ 46 STEAM degree programs
- ▶ PPST
  - ▶ Provided vital information that outlines the needed competencies and skills of quality teachers across and in all education levels to enable them to manage and handle emerging global frameworks.
  - ▶ With seven major domains with 37 strands/indicators per domain.

# Self-Rating Proficiency Indicators

- ▶ 90-item initial draft of the Instrument underwent two-tier validation process of its structural and psychometric properties
- ▶ Obtaining Expert Opinions for assuring Content Validity
- ▶ 86 indicators for version 2
- ▶ Pilot Testing of the Proficiency Indicators
  - ▶ 102 STEAM teachers from several privately-owned colleges and government-supervised universities representing 3 major islands of the Philippines

# METHODS

**Table 1.** Sample Proficiency Indicators for Philippine STEAM educators drawn from PSG and PPST.

PSG Competency	PPST Standard	Proficiency Indicator(s)	PPST Domain
Apply knowledge of physical, social, natural, and health science in the practice of Nursing <i>(from the PSG of BS Nursing Program)</i>	Model exemplary practice to improve the applications of content knowledge within and across curriculum teaching areas	Possesses Content Knowledge on STEAM Content Courses and STEAM-related fields	Domain 1: Content Knowledge and Pedagogy
Facilities and Equipment <ul style="list-style-type: none"> <li>a. Class size</li> <li>b. Educational Technology Center</li> <li>c. Laboratory requirements</li> <li>d. Classroom requirements</li> </ul> Assist in waste management for environmental safety  <i>(from the PSG of BS Mathematics and Food Technology Programs)</i>	Exhibit effective strategies that ensure safe and secure learning environments to enhance learning through the consistent implementation of policies, guidelines, and procedures	Ensures a safe STEAM learning environment  Observes precautionary measures in the laboratory rooms and classrooms (fire extinguishers, fire alarm system) and campus security	Domain 2: Learning Environment
Develop an instructional plan appropriate to identified learners, as follows: students; patients (age group, cognitive, and communication considerations); family and caregivers; general public (social status, education status, and gender considerations); peers; and other healthcare providers and professionals.  <i>(from the PSG of BS Physical Therapy Program)</i>	Model exemplary teaching practices that recognize and affirm diverse linguistic, cultural, socioeconomic, and religious backgrounds to promote learner success	Develops instructional plan appropriate to the identified learner  Facilitates lessons and activities that are suited to the students' interests and individual differences and do not discriminate any cultural groups and are sensitive to students' needs	Domain 3: Differentiation of Learners
Communicate decisions to stakeholders  <i>(from the PSG of BS Statistics Program)</i>	Lead colleagues to explore, design, and implement effective practices and programs using information derived from assessment data	Utilizes student data to recognize behavioral problems and plan for appropriate action	Domain 5: Assessment and Reporting
Develop a mature, sensitive, and effective ethical relationship (compassion, integrity,	Lead colleagues in the regular review of	Practices STEAM profession in accordance with the existing laws, legal, ethical, and	Domain 6: Community

# RESULTS

**Table 2.** Item distribution in the initial draft of the Self-Rating Proficiency Indicators for Philippine STEAM Educators.

PPST Domain	No. of Items
Domain 1: <i>Content Knowledge and Pedagogy</i>	22
Domain 2: <i>Learning Environment</i>	17
Domain 3: <i>Diversity of Learners</i>	13
Domain 4: <i>Curriculum and Planning</i>	12
Domain 5: <i>Assessment and Reporting</i>	10
Domain 6: <i>Community Linkages and Professional Engagement</i>	8
Domain 7: <i>Personal Growth and Professional Development</i>	8
<b>TOTAL</b>	<b>90</b>

**Table 3.** Items in the draft instrument with the highest and lowest mean appropriateness rating as evaluated by the research collaborators.

Item No.	Statement	Mean
2	Possesses content knowledge on STEAM Content Courses	4.0
3	Acquires content knowledge on STEAM-related fields	4.0
19	Facilitates development of reflective and critical thinking among students	4.0
17	Communicates effectively across multiple platforms both oral and written, especially in English language	3.9
31	Promotes seamless transition of topics and establishes relevant relationship of concepts	3.8
35	Utilizes teaching strategies suited to diverse learners	3.7
81	Models existing general policies, rules, and regulations to promote welfare of STEAM profession	3.6
28	Facilitates lectures in plenary classes	3.0
62	Designs, communicates, and implements STEAM-related activities in partnership with the community	2.9
43	Develops gender-sensitive instructional materials	2.7



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**Table 4. Results of the KMO measure and Bartlett's test of sphericity.**

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<b>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</b>		<b>0.698</b>
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<b>Bartlett's Test of Sphericity</b>	<b>Approx. Chi-Square</b>	<b>10539.114</b>
	<b>df</b>	<b>3655</b>
	<b>Sig.</b>	<b>.000</b>

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**Table 5.** The initial eigenvalues and the total variance explained.

Factor	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative (%)	Total	% of Variance	Cumulative (%)
1	40.012	46.526	46.526	17.361	20.187	20.187
2	5.474	6.365	52.890	11.339	13.185	33.372
3	3.441	4.002	56.892	10.492	12.200	45.572
4	2.335	2.715	59.607	6.679	7.767	53.339
5	1.965	2.237	61.892	4.492	5.227	58.565
6	1.923	2.100	64.128	2.459	2.859	61.425
7	1.806	1.951	66.229	1.615	1.878	63.302

**Table 6.** Summary of factors and indicators.

Factor	Theme (same sequence as item number)	Domain(s)	Item #	Reliability Index (Cronbach's $\alpha$ )
Factor 1 (46.526%)	TPC, TPC, TPC, TPC, TPC, TPC, TPC, TPC, TPC, TPC, TPC, TPC, TPC (TPCK)	D6 = 5 D7 = 4 D2 = 3 D5 = 1	25, 27, 37, 63, 67, 78, 79, 80, 81, 82, 85, 86, 89, 90 (14, 23.3%)	.933
Factor 2 (6.365%)	TP, TP, TP, TP, TP, TP (TPK)	D3 = 3 D4 = 2 D1 = 1	17, 41, 43, 45, 56, 64 (6, 10%)	.820
Factor 3 (4.002%)	TC, TC, TC, TC, TC, TC, TC, TC, TC, TC (TCK)	D1 = 8 D4 = 1 D5 = 1	7, 8, 10, 11, 12, 14, 15, 18, 65 (9, 15%)	.898
Factor 4 (2.715%)	PC, PC, PC, PC, PC, PC, PC, PC, PC, PC, PC (PCK)	D1 = 5 D4 = 3 D6 = 1 D5 = 1 D2 = 1	3, 6, 20, 21, 31, 54, 57, 62, 69, 76 77 (11, 18.3%)	.892
Factor 5 (2.237%)	T, T, T, T (TK)	D2 = 2 D7 = 1 D1 = 1	4, 24, 30, 88 (4, 6.67%)	.758
Factor 6 (2.100%)	P, P, P, P, P, P, P, P, P, P, P (PK)	D3 = 4 D1 = 2 D2 = 4 D4 = 3 D5 = 1	19, 22, 28, 36, 35, 38, 42, 44, 48, 50, 53, 55, 58 (13, 21.6%)	.924
Factor 7 (1.951%)	C, C, PC (CK)	D1 = 3	1, 2, 5 (3, 5%)	.691
Overall/Total			60	.985

Notes: D1 – Content Knowledge and Pedagogy, D2 – Learning Environment, D3 – Diversity of Learners, D4 – Curriculum and Planning, D5 – Assessment and Reporting, D6 – Community Linkages and Professional Engagement, D7 – Personal Growth and Professional Development

# CONCLUSIONS

- ▶ The study come up with a valid, reliable, and standardized content with 60 indicators of STEAM education proficiency clustered into 7 major components based on experts and statistical validation.
- ▶ The crafted indicators suit the culture and context of PHE STEAM Educators, which make a self-rating tool an appropriate assessment tool mapped within the 7 dimensions of TPCK framework.
- ▶ The study endorses accentuating on assessment and feedback system in HE to specifically track the progressive improvement of learners in developing them to achieve the intended STEAM learning outcomes and be part of the strong workforce 4.0 of the country.