



TPACK IN PHILIPPINE STEAM EDUCATION

National Forum for STEAM in Higher Education

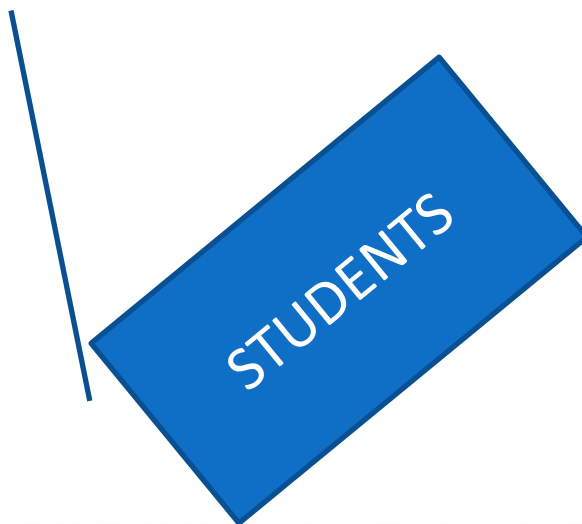
“Modelling TPACK in Philippine STEAM Education”

April 25-26, 2019, Heritage Hotel, Manila, Philippines



TPACK in Philippine STEAM Education

2 Major Players/Actors



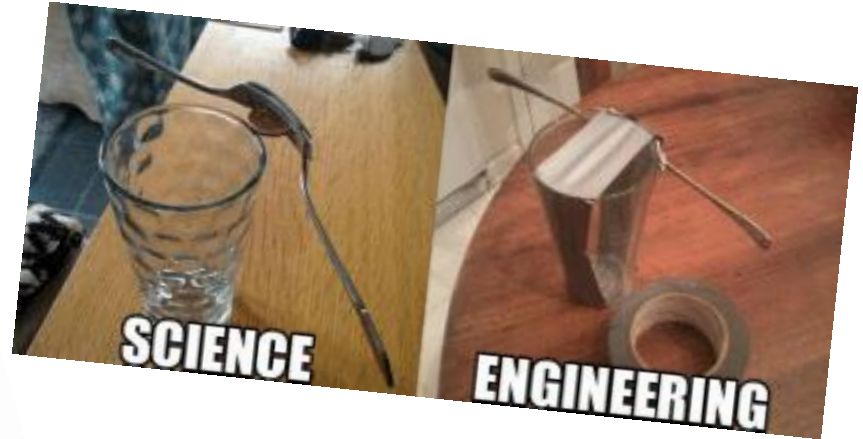
STEAM STUDENTS

Model Students



STEAM STUDENTS

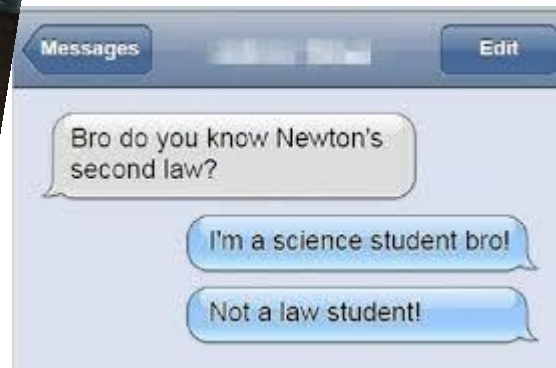
Training
IS HARD



YOU MATTER.

Until you multiply
yourself times the speed
of light squared.
Then you Energy.

STEAM STUDENTS

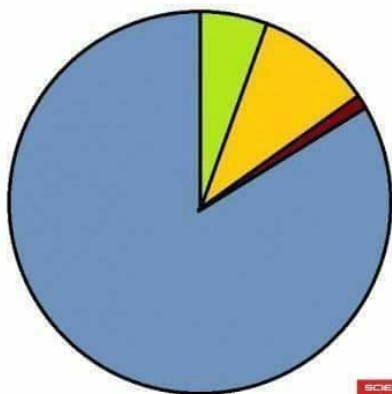


STEAM STUDENTS



Things I learned in Organic Chemistry

- Interesting Reactions
- Deadly compounds
- Nomenclature
- How to draw hexagons



me staring at my own skin

Asan ba settings neto? Lalakasan ko yung brightness 😂

@TweetsAndVideos



Mak-mak ⚡
@immakmakdoooo

*Naka 99 sa science.

*Chinat ang Volcano dahil active.

RTTM /RANDOM TWEETS THAT MATTER

STEAM TEACHERS

*How do we
teach?*

*How do we engage our
STEAM Students?*

*What kind of STEAM
Educators are we?*

STEAM TEACHERS

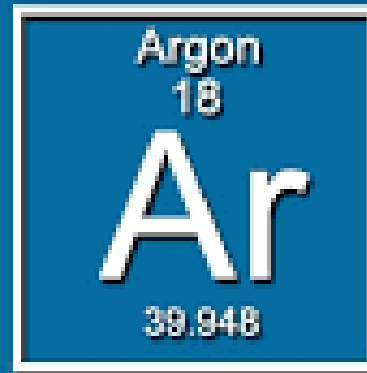
The Scientist!



STEAM TEACHERS

The Joker!

I MAKE BAD SCIENCE JOKES
BECAUSE ALL THE GOOD ONES....



STEAM TEACHERS

*The
Joker!*

**IF YOU'RE NOT PART
OF THE SOLUTION**



**THEN YOU'RE PART
OF THE PRECIPITATE**

STEAM TEACHERS

*The
Joker!*

**DON'T EXPECT
PERFECTION
FROM GEOLOGISTS;
THEY ALL HAVE
THEIR FAULTS.**

STEAM TEACHERS

WHAT DO YOU CALL AN
ACID WITH AN ATTITUDE?

The
Joker!

gimme ur lunch



A-mean-oh acid.



STEAM TEACHERS

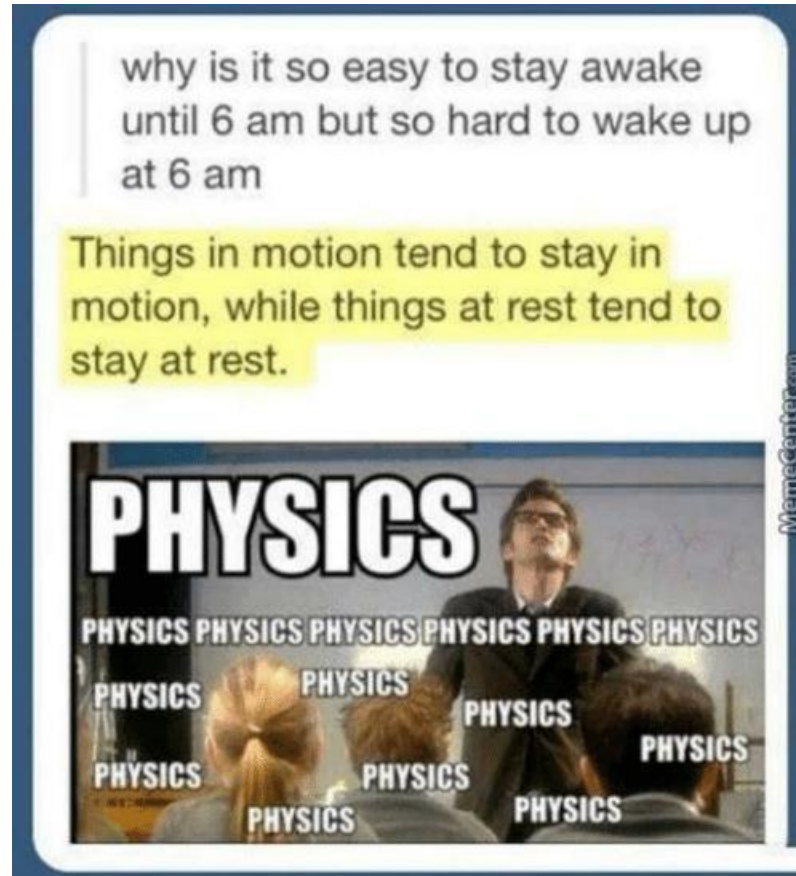
*The Hero
for these learners!*



The Tech-savy

STEAM TEACHERS

The Science Learner



The science of student life.

STEAM TEACHERS

The Engineer

Newton Asked : How To Write 4 In Between 5 ?

1) Medicine students

Said : Joke !

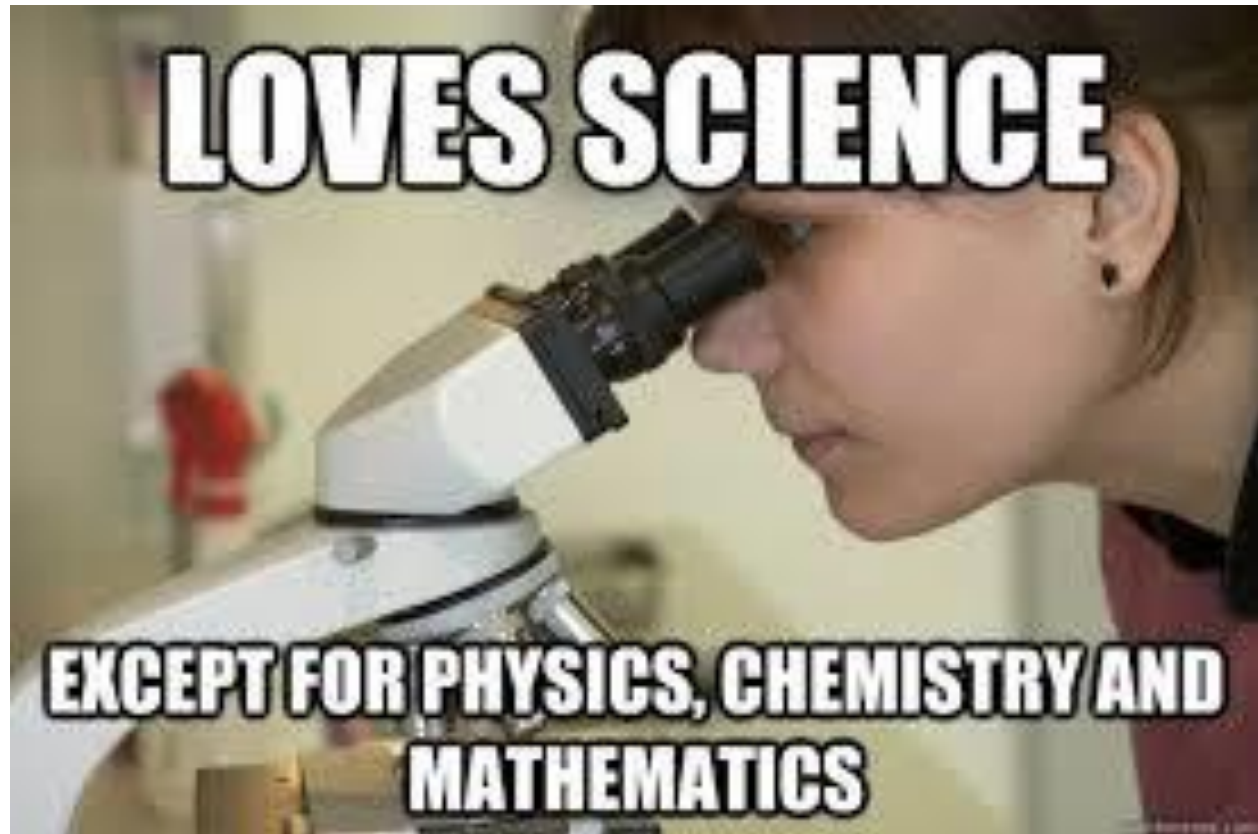
2) Science students Said : Impossible !

3) Management students Said : Not Found On The Internet

4) Engineering students Said: "F(IV)E"

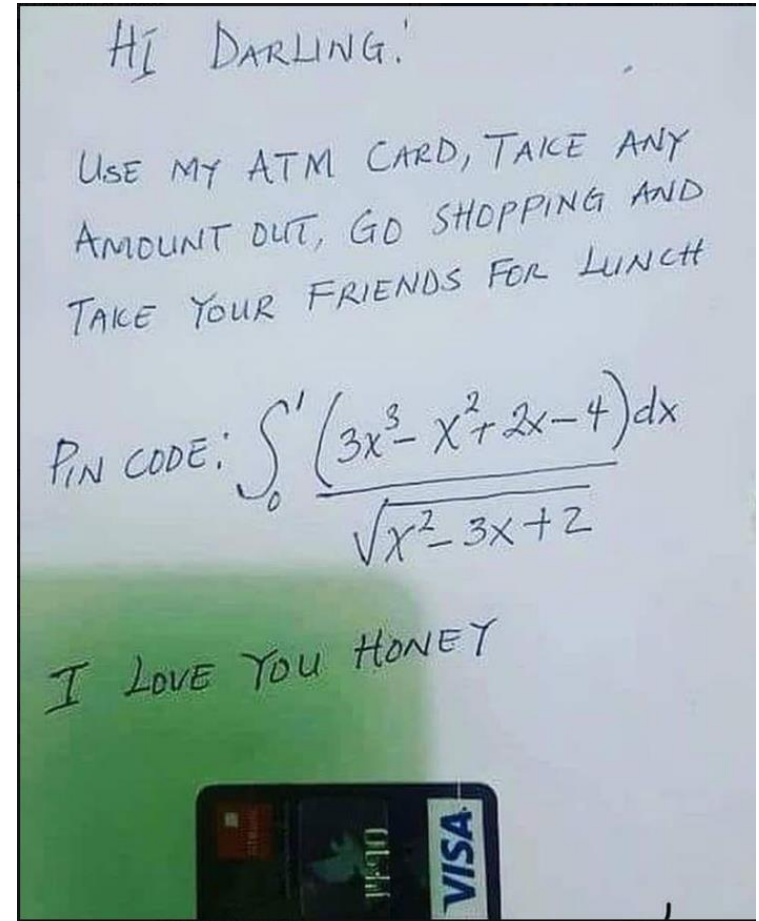
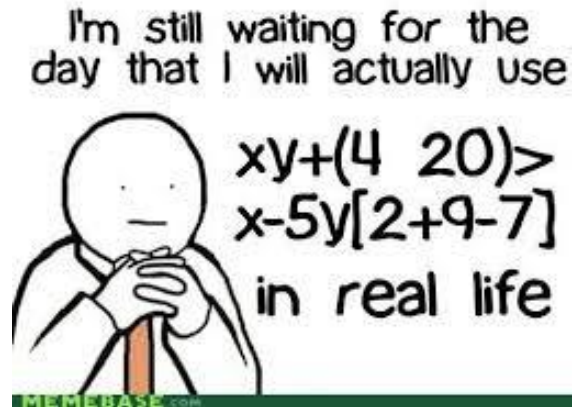
STEAM TEACHERS

The Bio/Agr/Fishery



STEAM TEACHERS

The Mathematician



It's TPACK for Us!!!



TPACK Framework as we know it...

Technological Pedagogical Content Knowledge (TPACK)



What is TPACK?

TPACK is a framework that teachers can use to help them identify knowledge they might need to focus on to be able to teach effectively with technology.

It builds upon the work of Shulman's idea of Pedagogical Content Knowledge: http://en.wikipedia.org/wiki/Lee_Shulman.

Using their Venn diagram the aim is to equally apply the three separate areas of knowledge.

Technological Knowledge

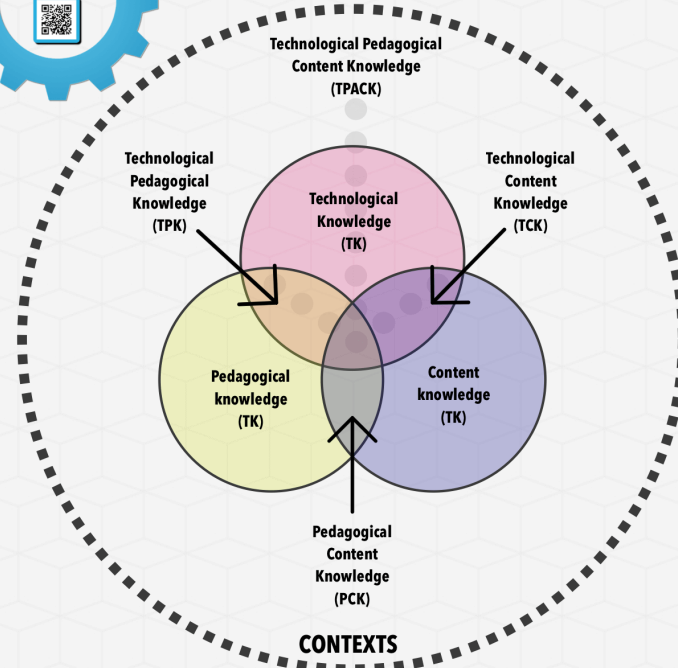
This is the knowledge and mastery of technology so that an educator can use & confidently plan use of technology in the classroom including when it is not required.

Pedagogical Knowledge

This is the knowledge and practice of teaching & learning that an educator can use such as classroom management, taxonomies, planning & assessment..

Content Knowledge

This is the knowledge of subject content such as concepts, theories, ideas, frameworks, evidence & proof and established practices including ways to develop such knowledge.



Pedagogical Content Knowledge

PCK links together the pedagogical and content knowledge to bring about learning that is built upon strong subject knowledge and teaching & learning strategies.

Technological Content Knowledge

TCK links together technology and content knowledge to bring about learning that is built upon strong subject knowledge and a mastery of "more than the subject they teach."*

Technological Pedagogical Knowledge

TPK is "an understanding of how teaching & learning can change when particular technologies are used in particular ways."* Knowing a range of tools & their appropriateness within different strategies.

Technological Pedagogical Content Knowledge TPACK

This is truly meaningful, deeply skilled teaching with or without (because sometimes this can be the best choice) technology. It differs from three individual concepts because to embrace all three simultaneously requires a deep understanding of how all three can work together to bring about the best technologically and pedagogically sound learning based upon a deep understanding of subject matter.

An example of this might be a lesson plan based upon assessment (PK) which looks at the content matter (CK) which examines how technology (TK) could transform learning.

TPACK is truly meaningful, deeply skilled teaching with or without (because sometimes this can be the best choice) technology.

DEVELOPED FROM THE TPACK MODEL BY KOEHLER & MISHRA - ORIGINAL FOUND @ WWW.TPACK.ORG

* Koehler & Mishra, 2009

Let's see how we fair...

Indicators	Yes	No
Acquires content knowledge on core science and mathematics courses.		
Possesses content knowledge on STEAM (Science, Technology, Engineering, Agriculture, and Mathematics)		
Possesses knowledge on related industry/community as service providers.		
(CK-3)		
Acquires (Demonstrates) knowledge on applicable laboratory/clinical skills.		
Observes precautionary measures in the laboratory rooms and classrooms (fire extinguishers, fire force) alarm systems, and campus security		
Monitors (Promotes) proper care and handling of laboratory instruments, tools, equipment, online systems, virtual laboratories, and software		
Uses appropriate modern techniques and tools necessary for the practice of STEAM profession in order to be globally competitive"		
(TK-4)		
Facilitates development of reflective and critical thinking among students.		
Allows flexible channels of communication to get across students of different abilities and comprehension skills and even allows occasional use of mother tongue to help express themselves or their answers better (then translate it to a common language for everyone to appreciate and learn from).		
Facilitates lectures in plenary classes. (Exhibits capability to facilitate large classes)		
Utilizes teaching strategies suited to diverse learners		
Monitors each student by establishing eye contact, walking around the area, being aware of what's happening in the class during sessions, site visits, field trips, tours, and other supervised visits.		
Demonstrates (Promotes) the concept of voluntary service by making students carry out classroom-related duties (e.g., monitoring cleanliness and orderliness in the classroom)		
Arranges opportunities for students to learn by allowing them to form varied group structures (solo, pair, groups, and teams).		
Takes into consideration the cultural, social, and emotional differences among students.		
Facilitates peer learning to support other students cognitively and affectively.		
Listens skillfully, reasonably, and patiently to his or her students (during consultation).		
Possesses knowledge on curricular programs including goals and framework.		
Ensures that the learning outcomes are attained		
(PK-12)		

Let's see how we fair...

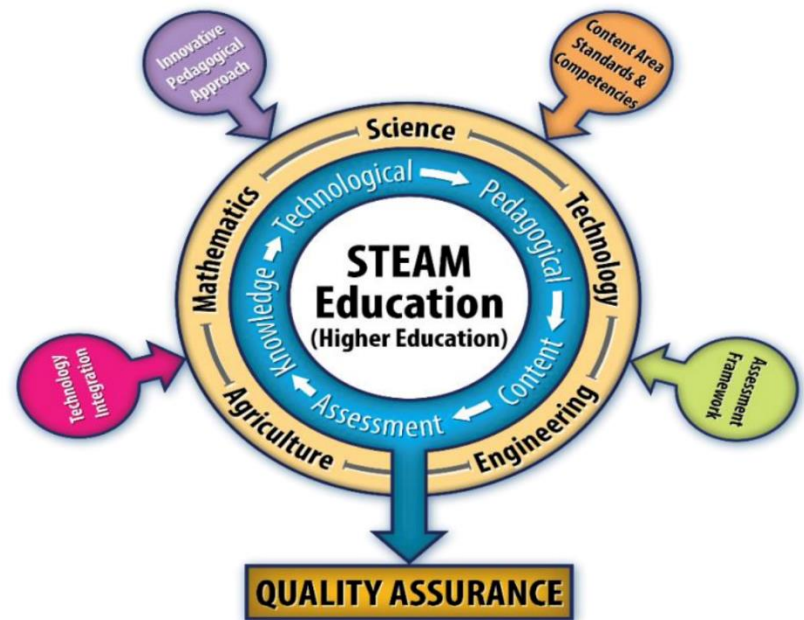
Indicators	Yes	No
Acquires (Demonstrates) content knowledge on STEAM-related fields.		
Promotes inquiry attitude through questioning.		
Facilitates active classroom discussion using inquiry learning strategies (project-based, problem-based, product-based)		
Promotes seamless transition of topics and establishes relevant relationship of concepts		
Engages the students in planning and achieving the learning outcomes.		
Uses updated syllabi and teaching methods to meet the desired learning outcomes		
Designs, communicates, and implements STEAM-related activities in partnership with the community/(industry)		
Possesses skills in using assessment results when making decisions about individual students, planning teaching, developing curriculum, and school improvement."		
Understands (Emphasizes)the effects and impacts of the STEAM profession in the community and society.		
Conducts STEAM-related activities involving the learners, parents and the community.		
(PCK-10)		
Plans and conducts research, and disseminates STEAM related research.		
Designs, improves, innovates, and supervises (basic to advanced) systems or procedures as solutions to local and global problems within realistic constraints.		
Utilizes research outputs to enhance professional practice and to address national and global concerns.		
Develops/(Improvises) new technology (software, laboratory equipment, and teaching materials) using locally available resources to advance effective and efficient practice of the profession.		
Uses modern statistical and computing techniques and tools in predicting future trends and processes of STEAM.		
Familiarizes with database relevant to the STEAM profession.		
Uses (advanced) and research-based techniques and tools in teaching STEAM content knowledge.		
Seeks out information about subject related research, e.g., via journals or by attending conferences.		
Designs and implements monitoring tools to ensure the desired learning outcomes are met		
Selects standard assessment methods appropriate for instructional decisions.		
(TCK-10)		

Let's see how we fair...

Indicators	Yes	No
Communicates effectively across multiple platforms, both oral and written, especially in the English language.		
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.		
Develops gender-sensitive instructional materials.		
Prepares materials and lessons appropriate to specific learning capability.		
Applies current trends, practices, and innovations in the teaching process.		
Adapts and utilizes STEAM technologies in the teaching and learning process.		
(TPK-6)		
Acquires (Exhibits) knowledge on STEAM fields (content and skills) responsive to national goals and global concerns.		
Facilitates ethical use of online resources.		
Promotes working effectively in multidisciplinary and multi-cultural teams		
Models various scientific attitudes and STEAM professional traits		
Uses multimedia and other learning resources like journals and online materials in the teaching and learning process.		
Recognizes unethical, illegal and otherwise inappropriate assessment methods and uses of assessment information."		
Demonstrates dedication and commitment to work with honesty and integrity		
Recognizes and understands the professional, social and ethical responsibilities of the STEM profession		
Practices STEAM profession in accordance with the existing laws, legal, ethical and moral standards		
Models the existing general policies, rules and regulations to promote the welfare of the STEAM professions.		
Evaluates (Observes) the existing policies to better serve the students, the school, and the community.		
Maintains reputation as a pedagogical leader.		
Participates in seminars and conferences that may provide valuable inputs to make STEAM teaching relevant and responsive to the changing times.		
Pursues higher learning (ex. graduate studies or short term courses) and accomplish higher goals to advance in one's career stage.		
Engages in professional activities other than teaching (publish articles, conduct valuable and impactful research, take part in the curriculum development, re-echo seminars etc.) to further improve teaching competencies as well as leadership qualities and make a distinction in the field of science		
(TPCK-15)		

Our Framework...

- Grounded on:
 - CHED Policies, Standards and Guidelines (**CHED-PSGs**) for 45 STEAM programs (80% are OBTEC-compliant)
 - Philippine Professional Standards for Teachers (**PPST**)
 - **TPACK** Framework



Aiming at TPACK framework...

The attempt is to model the Philippine Higher STEAM Education and check how far we are from the global standards. Specifically, the study sought concrete retorts to the following objectives:

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model
4. Design and Develop the TPACK Model for Philippine Higher STEAM Education
5. Designing the Philippine STEAM Education Model.

Aiming at TPACK framework...

Objectives

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model

Research Design

- Exploratory Design
- Employed both quantitative (through survey) and qualitative (through interviews and classroom observations) approaches.

Aiming at TPACK framework...

Objectives

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model

Participants

Tier 1 (Sampling)

- At confidence level of 95%
- Randomly selected 220 [156 (71%) private and 64 (29%) public] HEIs (10% of the population) from 17 regions through stratified sampling.
- Positive response from 123 schools (56% of the sampled HEIs).

Aiming at TPACK framework...

Objectives

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model

Participants

Tier 2 (Sampling)

- Spawned 33 schools (27%) with at least one representative school and a maximum of three per region (a total of 17 regions),

Criteria:

1. inclusion of STEAM disciplines in their curricular offerings,
2. schools are either clustered as SUC (1 and 2), LUC or private colleges and universities, and
3. the places or provinces where the schools are located are most accessible to any means of transportation.

Aiming at TPACK framework...

Objectives

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model

Participants

Table 1. Summary of the number of STEAM teachers observed and interviewed per region

Region	Number of Schools	Number of STEAM teachers
National Capital Region (NCR)	5	10
Cordillera Administrative Region (CAR: Kalinga-Apayao)	1	4
Region 1 (Ilocos Sur)	2	5
Region 2 (Batanes)	1	4
Region 3 (Aurora, Bulacan, Pampanga)	3	15
Region 4 (Laguna, Quezon)	3	16
Region 5 (Camarines Sur, Camarines Norte, Masbate)	3	9
Region 6 (Negros Occidental, Iloilo)	2	10
Region 7 (Bohol, Siquijor)	2	4
Region 8 (Southern Leyte)	1	5
Region 9 (Zamboanga del Norte)	1	5
Region 10 (Camiguin, Misamis Occidental)	2	4
Region 11 (Davao del Norte, Davao del Sur)	2	7
Region 12 (North Cotabato)	2	8
Region 13 (Agusan del Norte)	1	0
Total	31	106

Aiming at TPACK framework...

Objectives

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model

Instruments

Classroom Observation Protocol for STEAM

- This is a pack containing five different instruments:
 1. STEAM Classroom Observation Rating Scale (a 48-item, 6-point Likert scale tool),
 2. Classroom Observation Notes (includes questions clustered into the dimensions of TPACK designed for use of the researcher for qualitative observations),
 3. TPACK interview protocol (6-item, main questions with corresponding probing questions clustered in themes,
 4. Technology Integration checklist, and
 5. Assessment Checklist.

Aiming at TPACK framework...

Objectives

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model

Data Collection

Preliminaries

- Letters to the school heads or university presidents thru the HEI representative (field researcher) for accomplishment of set of forms:
 1. participating institution's reply form specifying the time and day or date of the interviews and classroom observations,
 2. pre-observation questions (which should be accomplished by the recommended STEAM teachers),
 3. Technology integration checklist
 4. Session guide.

Aiming at TPACK framework...

Objectives

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model

Data Collection

School Visit

- *Courtesy call*
- Consent forms to all interviewees and to all STEAM teachers for classroom observation
- *Interviews* (audio-taped) with the head of the department or the dean of the college of the STEAM disciplines for about an hour
- *Classroom Observation*
- *Post-Conference (with observed STEAM Teacher)*

Aiming at TPACK framework...

Objectives

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model

Data Analysis

- Virtual folders per HEI for all accomplished forms
 - pre-observation and interview,
 - accomplished classroom observation rating scales,
 - classroom observation notes,
 - video and audio recordings in a virtual folder allotted per HEI.

Aiming at TPACK framework...

Objectives

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model

Data Analysis

- Transcriptions of all collected qualitative data
- Summary Tables with descriptive statistics for classroom observation rating scale
- Summary table for Technology Integration checklist
- Farmed all organized data to cells (Pedagogy, Technology Integration, Assessment) for coding and further analysis

Aiming at TPACK framework...

Objectives

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model

Data Analysis

- *Three Tier Coding (aided with a software) per research cell to come up with individual models*
- Two rounds of Validation, Critiquing and Revision of Models
- Consolidation of model constructs and generated themes and plugged into TPACK Framework

Aiming at TPACK framework...

Objectives

4. *Design and Develop the TPACK Model for Philippine Higher STEAM Education*
5. *Designing the Philippine STEAM Education Model.*

Data Collection and Analysis

- Workshops for Model Analysis
- Validation of TPACK Framework (Presentation, Critiquing, and Revisions)
- Redefining the aims of the research program/project to accommodate unique themes and constructs.
- Checking and Recoding
- Developing the Philippine STEAM Education Model

Aiming at TPACK framework...

Objectives

4. *Design and Develop the TPACK Model for Philippine Higher STEAM Education*
5. *Designing the Philippine STEAM Education (PSE) Model.*

Data Collection and Analysis

- Workshop for Validation (February 25, 2019) of PSE Model (Presentation, Critiquing, Revisions, and inputs from STEAM educators of COEs and CODs)
- Developing the emerging Philippine STEAM Education Model
- Validation by 113 STEAM Educators (March 19-21, 2019) with Lesson Exemplars
- Revision and Finalization of Models

Aiming at TPACK framework...

Objectives

1. Develop the Philippine Higher STEAM Education Pedagogical Model
2. Develop the Philippine Higher STEAM Education Assessment Framework
3. Develop the Philippine Higher STEAM Education Technology Integration Model

Results and Discussion

Aiming at TPACK framework...

Objectives

- Design and Develop the TPACK Model for Philippine Higher STEAM Education

Results and Discussion

TPACK MATRIX MODEL - PEDAGOGICAL MODEL								
	TPCK	TPK	PCK	TPK	T	C	P	Others
GENERAL PEDAGOGICAL PROCESSES								
Institutional: Pedagogical Culture							Institutional Practices 1. Planning the pedagogical process 2. Documenting pedagogical practices 3. Evaluating pedagogical practice	Institutional practices 1. Instructional support to pedagogical processes in a faculty development Teacher's Pedagogical beliefs 1. Teacher acknowledges the diversity of teaching strategies
Teacher: Pedagogical Character			Pedagogical practices 1 Teacher models learning 1.2. teacher checks his experiences 1.3. teacher links practice and teaching 1.4. teacher demonstrates critical and reflective thinking 1.5. asks probing questions 1.6. asks open-ended questions 1.7. integrates revision 1.8. asks HOTS questions					
STEAM PEDAGOGICAL PROCESSES								
Employs STEAM Appropriate Teaching Strategies	Current practices of STEAM teachers 1. Model-Based Learning (Scaffolding, Modeling, Practice, Application, Integration of values) 2. Open-Ended Learning 3. Service-Learning 4. Collaborative Learning							
Monitors Learners' Acquisition of Knowledge	Relies on knowledge Develops learners' communication skills					Teacher presents the learning outcomes to the learners at the beginning of the lesson	Teacher prepares tests Teacher selects the learners to different materials	
Provides Mentoring Period and Facility	Address learners' difficulty 1. provides a team dedicated for mentoring lesson 2. teacher is open to monitor any student's anxiety 3. consultation time is structured beforehand to curriculum							
Manages the Classroom Processes							1. classroom organization 2. imposition of classroom rules and regulations 3. Clearing classroom routines 4. Monitoring learners during discussion and class activities	

Aiming at TPACK framework...

A	B	C	D	E	F	G	H	I
TPACK MATRIX MODEL - PEDAGOGICAL MODEL								
DRIVERS OF PEDAGOGICAL PROCESSES	TPCK	TPK	PCK	TCK	T	C	P	Others
Institutional Pedagogical Culture							Institutional Practices 1. Planning the pedagogical practices 2. Disseminating pedagogical practices 3. Evaluating pedagogical practices	Institutional practices 1. Institutional support to pedagogical processes (e.g. faculty development)
Teacher Pedagogical Character			Pedagogical practices 1. Teacher models learning 1.a. teacher shares his experiences 1.b. teacher links practice and teaching 1.c. teacher demonstrates critical and reflective thinking 1.d. asks probing questions 1.e. uses impromptu questions 1.f. integrates recitation 1.g. asks HOTS questions					Teacher's Epistemological beliefs 1. teacher acknowledges the diversity of teaching strategies
STEAM PEDAGOGICAL PROCESSES								
Employs STEAM Appropriate Teaching Strategies	Current practices of STEAM teachers 1. Inquiry-Based Learning (Scaffolding, Modelling, Real-life applications, integration of values) 2. Outputs-Based Learning 3. Lecture Method 4. Collaborative Learning Elicits prior knowledge Strengthens learners' communication skills							
Monitors Learners' Acquisition of Knowledge						Teacher presents the learning outcomes to the learners at the beginning of the lesson	Teacher prepares tests Teacher subjects the learners to different materials	
Provides Mentoring Period and Facility	Address learner's difficulty 1. provides a room dedicated for mentoring session 2. teacher is open to mentor any student anytime 3. consultation time is structured (reference to curriculum)							
Manages the Classroom Processes							1. classroom organization 2. imposition of classroom rules and regulations 3. Observing classroom routines 4. Monitoring learners during discussion and class activities	

Aiming at TPACK framework...

Content	Pedagogy	Technology	Other Comments	Notes
General and Inorganic Chemistry	Lecture-Discussion	ppt to show problems		recognize/appreciates technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy
Mathematics	Socratic Approach (Uses Template questions for students to easily draw patterns in creating answers)	PPT only used to aid teaching		recognize/appreciates technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy
Laws in Electrical Engineering, Contracts, and Ethics	Reporting with teacher input during the reporting process Discussion of all reports	PPT		recognize/appreciates technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy
Fundamentals of Material Science and Engineering	Reporting with teacher input during the reporting process Discussion of all reports	PPT	Teacher is not confident with her ideas. The teacher needs to improve on lesson delivery and	knowledge of technology and propobale use in the classroom

Aiming at TPACK framework...

knowledge of technology and propobale use in the classroom

recognize/appreciates technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy

recognize/appreciates use of multiple technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy

recognize/appreciates use of multiple technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy

knowledge of technology and propobale use in the classroom

knowledge of technology and propobale use in the classroom

recognize/appreciates use of multiple technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy

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knowledge of technology and propobale use in the classroom

knowledge of technology and propobale use in the classroom

knowledge of technology and propobale use in the classroom

Aiming at TPACK framework...

recognize/appreciates use of multiple technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy

recognize/appreciates use of multiple technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy

knowledge of technology and propobale use in the classroom

limited knowledge on the appropriate use of the identified technology

recognize/appreciates technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy

recognize/appreciates use of multiple technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy

limited to using traditional technology

recognize/appreciates use of multiple technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy

active integration of tehcnology in the teaching and learning of the content or STEAM lessons weaved with appropriate pedagogy

active integration of tehcnology in the teaching and learning of the content or STEAM lessons weaved with appropriate pedagogy

limited to using traditional technology

active integration of multiple tehcnology in the teaching and learning of the content or STEAM lessons weaved with appropriate pedagogy

limited to using traditional technology

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limited to using traditional technology

limited to using traditional technology

Aiming at TPACK framework...

Notes	Pedagogical Model	Technology Integration	Assessment	TPDK (TPACK Model for University Setting (TechnoPedagogical Disciplinary Knowledge))
recognize/appreciates technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy	Drivers of Pedagogical Processes 1. Institutional Support to Pedagogical Processes 2. Institutional Pedagogical Culture 3. Teacher's Pedagogical Character 4. Teacher's Pedagogical Beliefs 5. Institutional Support for Faculty Development 6. Monitoring and Evaluation of Pedagogical Processes 7. Institutional Planning for Pedagogical Processes	Teacher Technological Knowledge 1. Lesson Structure 2. Content Based a. Engaged b. Enhanced c. Extended	Three variables: 1) Enablers of STEAM Assessment 2) Drivers of STEAM Assessment 3) Process of STEAM Assessment	Disciplinary Specific 1. Pedagogy-Discipline (PCK) 2. Technology-Pedagogy-Discipline (TPCK) 3. Technology - Discipline (TC) 4. Technology -Pedagogy (TP) 5. Technology-Discipline-Epistemology 6. Discipline-Epistemology
recognize/appreciates technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy	STEAM Pedagogical Processes 1. Employs Inquiry-Based Learning Approach 2. Emphasizes Output over Process 3. Values Feelings and Emotions in the Pedagogical Processes 4. Utilizes Lecture Method 5. Employs Modeling as a Teaching Strategy 6. Demonstrates Ability to Develop Tests 7. Maintains a Positive Learning Environment 8. Monitors Learners' Acquisition of Knowledge 9. Orients the Learners with Assessment Standards 10. Monitors the Learners' Construction of Knowledge	Administrative Support 1. Capacity Building 2. Tehcnology Architecture, System and Design	I. ENABLERS of STEAM Assessment A. Institutional Affordances 1. Curriculum development 2. Institutional identities 3. Agency and empowerment B. Sustainability 1. Quality assurance 2. Research undertakings 3. Policies and programs II. DRIVERS of STEAM Assessment A. Ensuring Equity 1. Gender sensitivity	Personal Epistemology <i>(teacher's beliefs about knowledge and the act of knowing, beliefs about how people learn in general and about the relative value of knowledge)</i> 1. Pedagogy-Epistemology 2. Technology-Epistemology 3. Discipline-Epistemology 4. Pedagogy-Epistemology-Discipline 5. Technology-Discipline-Epistemology 6. Technology-Pedagogy-Epistemology
recognize/appreciates technology appropriate to the content of the lesson (STEAM) -- knowledge of technology in relation to content and pedagogy	Outcomes of STEAM Pedagogical Processes 1. Graduates are Critical Thinkers 2. Graduates Pass the Licensure Examinations 3. Graduates are Employable	Quality of Technology 1. Availability 2. Affordability 3. Appropriateness		Pedagogical Knowledge 1. Pedagogy-Epistemology 2. Pedagogy-Discipline (PC) 3. Technology-Pedagogy (TP) 4. Pedagogy-Epistemology-Discipline 5. Technology-Pedagogy-Discipline (TPCK) 6. Technology-Pedagogy-Epistemology
knowledge of technology and propobale use in the classroom				Technological Knowledge 1. Technology-Pedagogy (TP) 2. Technology-Discipline (TC) 3. Technology-Pedagogy-Discipline (TPCK) 4. Technology-Pedagogy-Epistemology
recognize/appreciates technology appropriate to the content				

We even tried.....TPDK from Literature...

Aiming at TPACK framework...

A	B	C	D
DIMENSIONS OF TPACK MODEL			
Outcomes	Drivers	Institutional Support	Processes
1. Critical Thinking 2. Performance in Licensure Examination 3. Employability	Pedagogical Model		
	Institutional Pedagogical Culture		Planning the Pedagogical Processes
	Teacher Pedagogical Character		Employing STEAM Appropriate Teaching Strategies
			Monitoring Learners' Acquisition of Knowledge
			Mentoring Mechanisms for Students
			Classroom Management
	Technology Integration		
	Teacher Technological Knowledge		Technological Architecture
	1. Lesson Structure	Availability	
	2. Content-Driven		
	Administrative Support	Affordability	Capacity Building
	1. Technological Architecture	Appropriateness	
	Assessment Model		
	TP	Institutional Affordances	Planning and Preparation
Ensuring Equity	Sustainability	Implementation	
Promoting Collaboration		Rating	
		Reporting	
		Reflection	

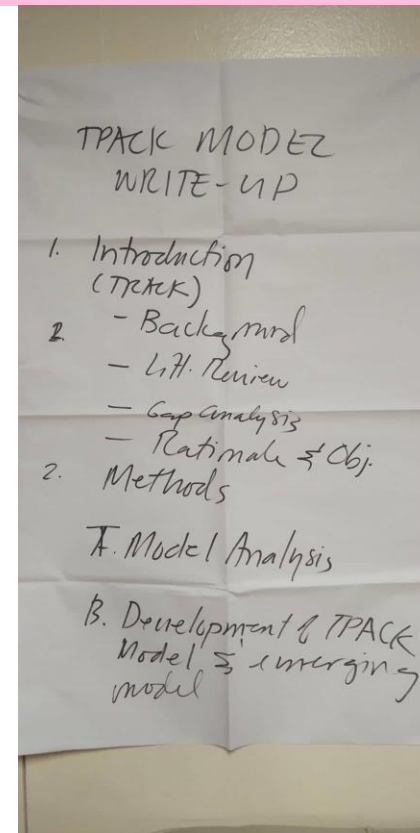
Model Re-analysis...

Aiming at TPACK framework...

Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Results and Discussion

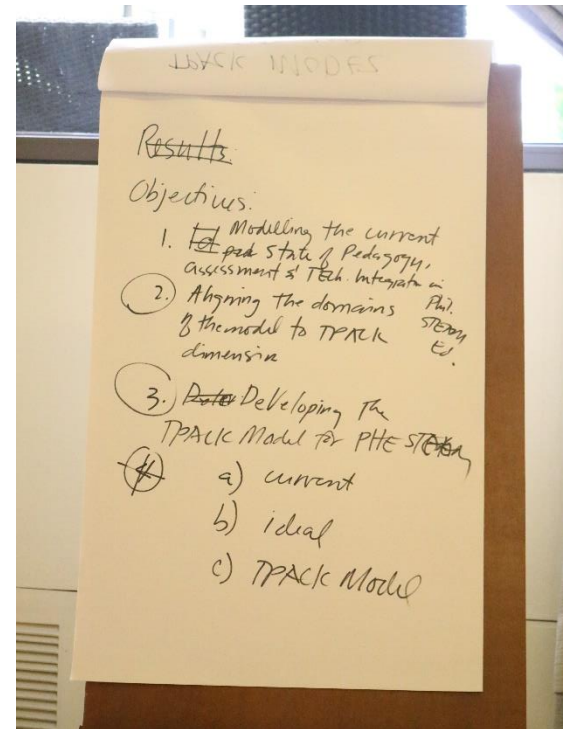


Aiming at TPACK framework...

Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Results and Discussion

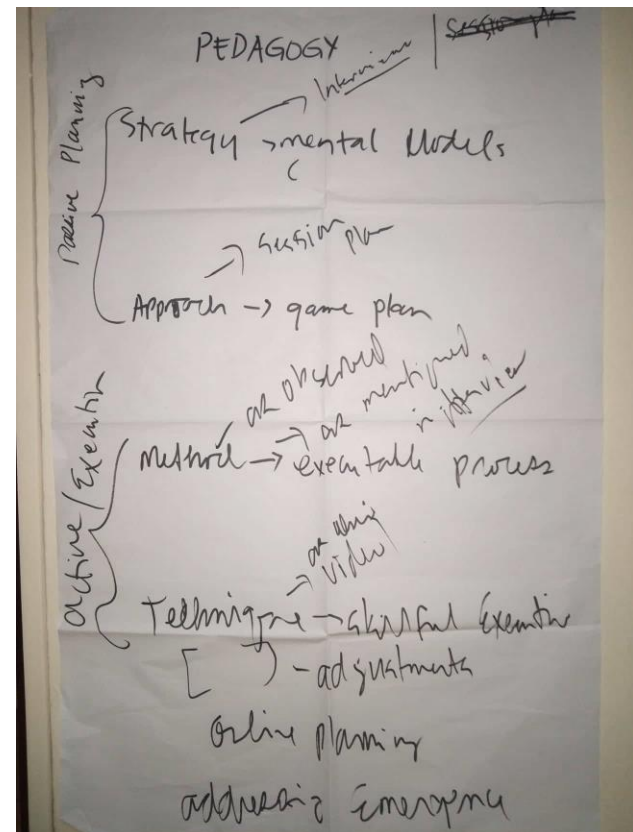


Aiming at TPACK framework...

Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Results and Discussion



PSE Model w/ TPACK framework...

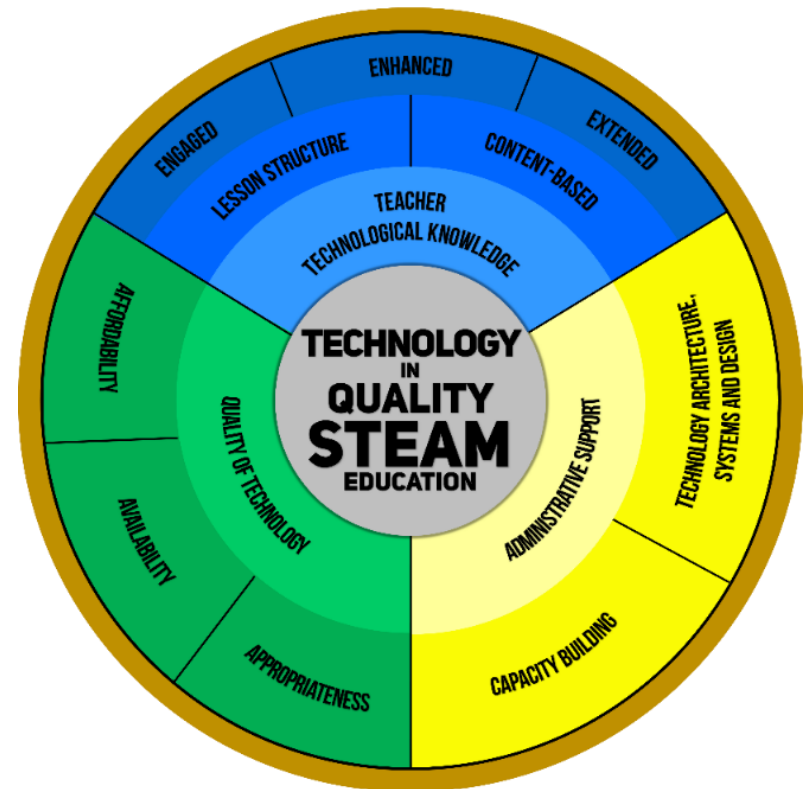
A	B	C
Outcomes	Drivers	TPACK Framework
	Institutional Pedagogical Culture	Institutional Practices: 1. Planning Pedagogical Practices 2. Disseminating Pedagogical Practices 3. Evaluating Pedagogical Practices Institutional Support to Pedagogical Practices (e.g., faculty development)
	Teacher Pedagogical Character	Pedagogical Practices: 1. Teacher models learning 1.a. Teacher shares his experiences 1.b. Teacher links practices 1.c. Teacher demonstrates critical and reflective thinking 1.d. Asks probing questions 1.e. Uses impromptu questions 1.f. Integrates recitation 1.g. Asks HOTS questions
1. Lesson Structure	Teacher Technological Knowledge	Teaching and Learning Experience Teachers' understanding of the affordance of technology 1. Laboratory activity or simulation activity 2. Applicability to the topic Lesson objectives/topics Knowledge on the different types of technology 1. chalkboard 2. power point 3. movie, documentary, youtubes, videos 4. overhead projector 1. Productive discussions 2. Increase relevance of the subject Teaching objectives

Aiming at TPACK framework...

Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Draft Technology Integration Model

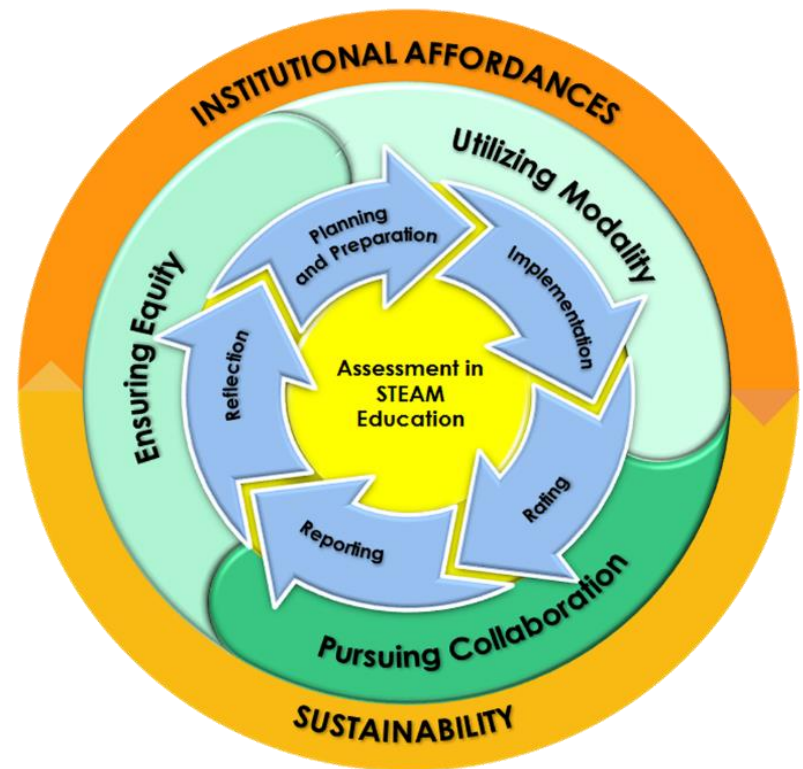


Aiming at TPACK framework...

Objectives

5. *Designing the Philippine STEAM Education (PSE) Model.*

Draft Assessment Model

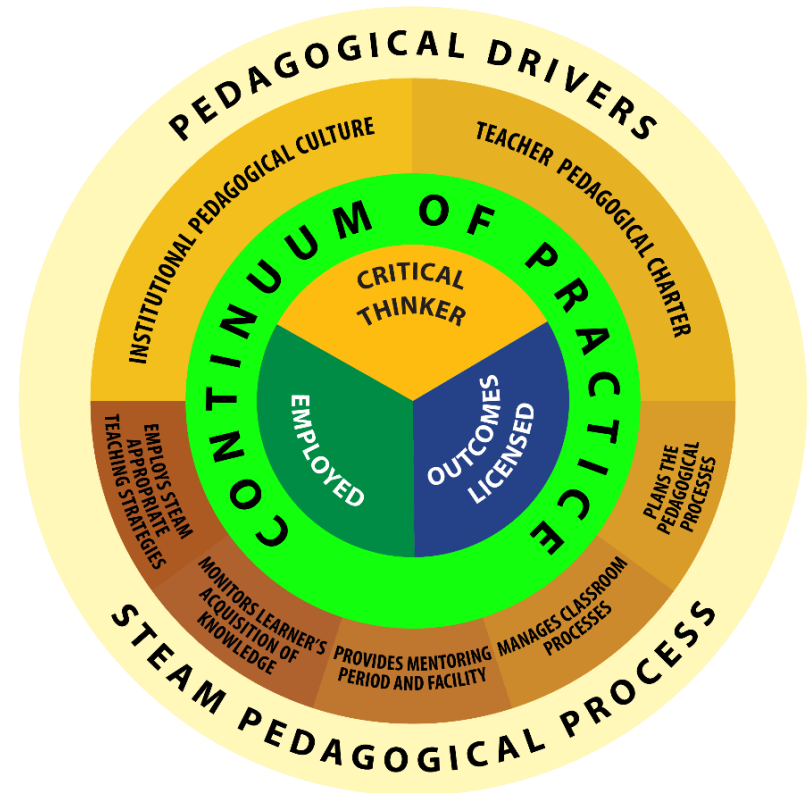


Aiming at TPACK framework...

Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Draft Pedagogical Model

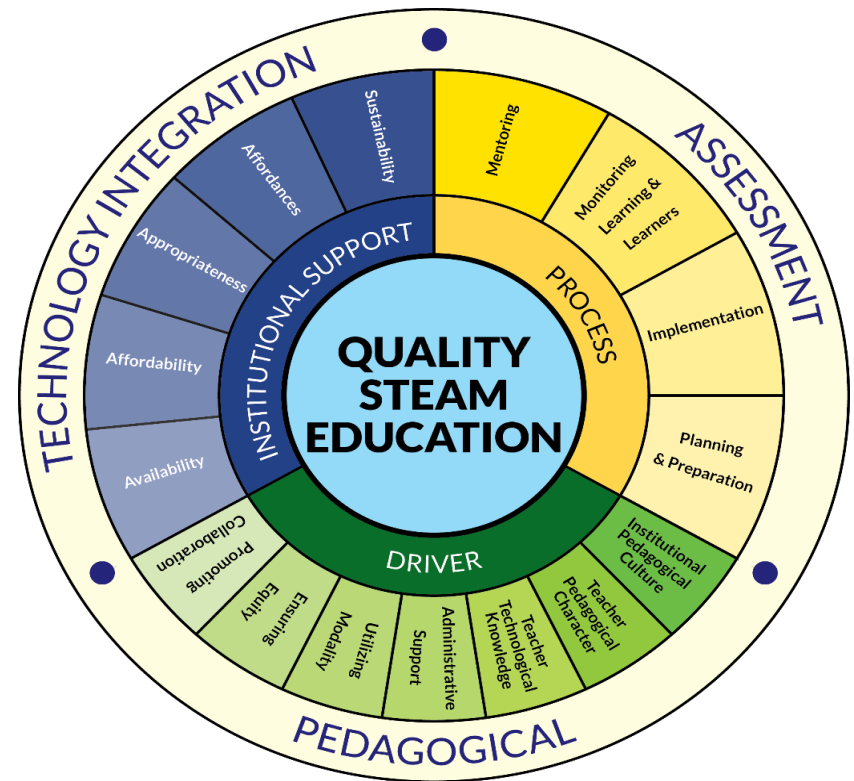


Aiming at TPACK framework...

Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Draft PSE Model

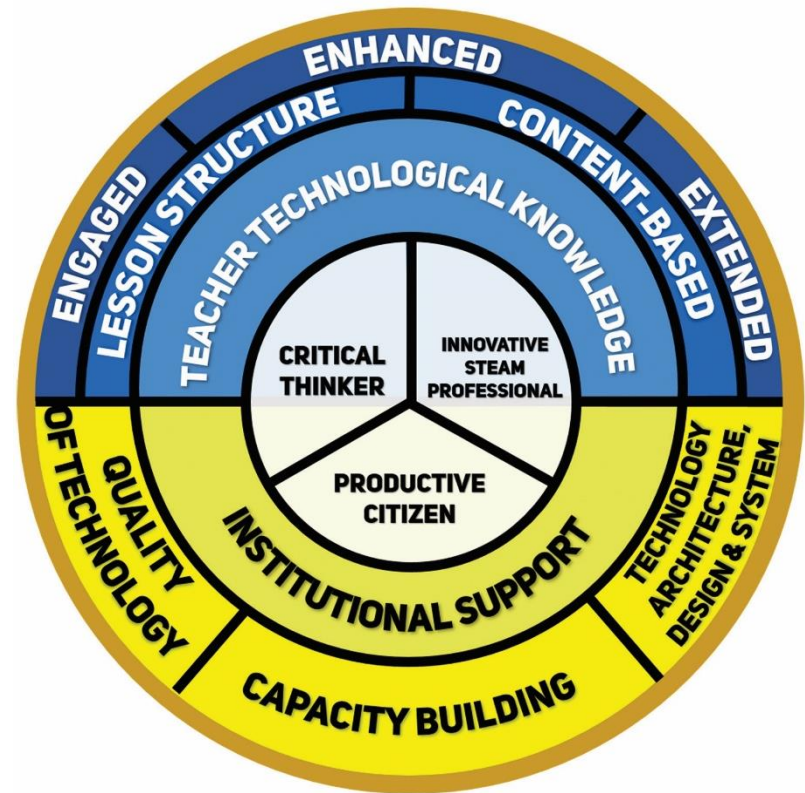


Aiming at TPACK framework...

Objectives

Validated/Emerging Tech Integration Model-T1

5. *Designing the Philippine STEAM Education (PSE) Model.*



Aiming at TPACK framework...

Objectives

5. *Designing the Philippine STEAM Education (PSE) Model.*

Validated Assessment Model-T1

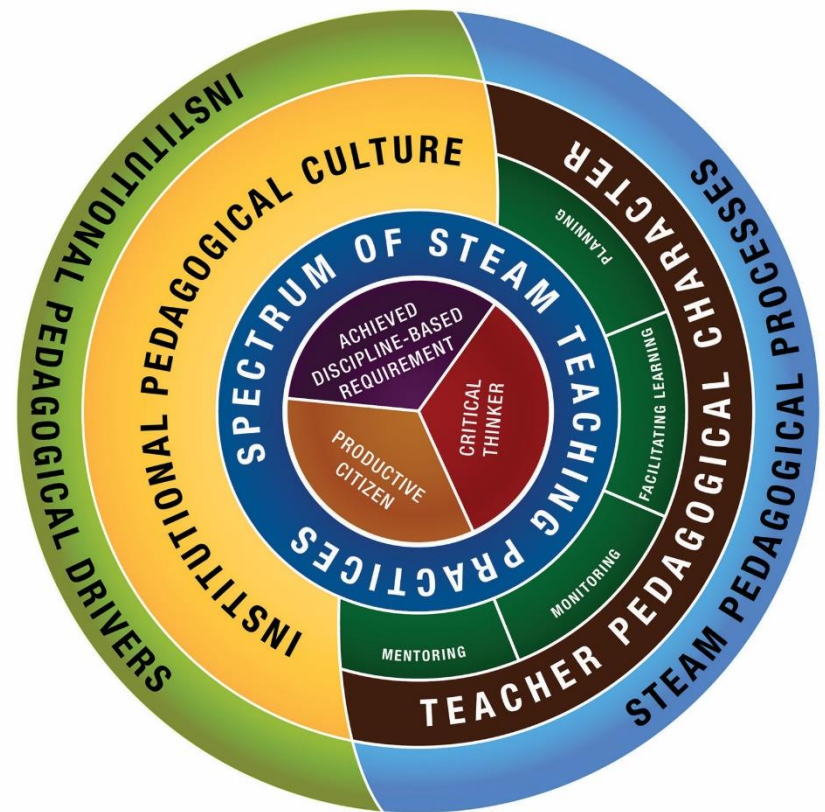


Aiming at TPACK framework...

Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Validated Pedagogical Model-T1

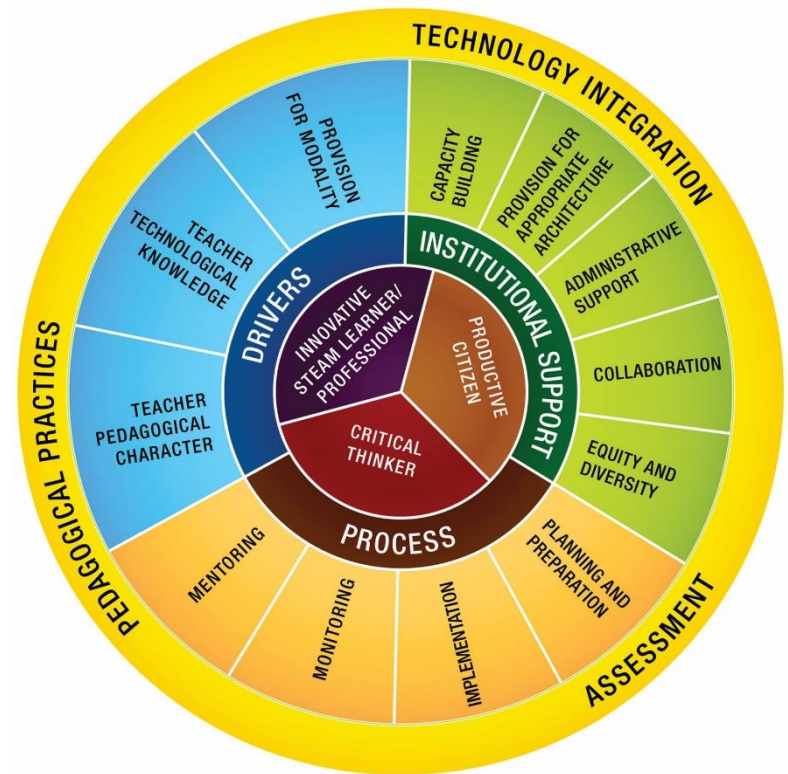


Aiming at TPACK framework...

Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Validated PSE Model-T1

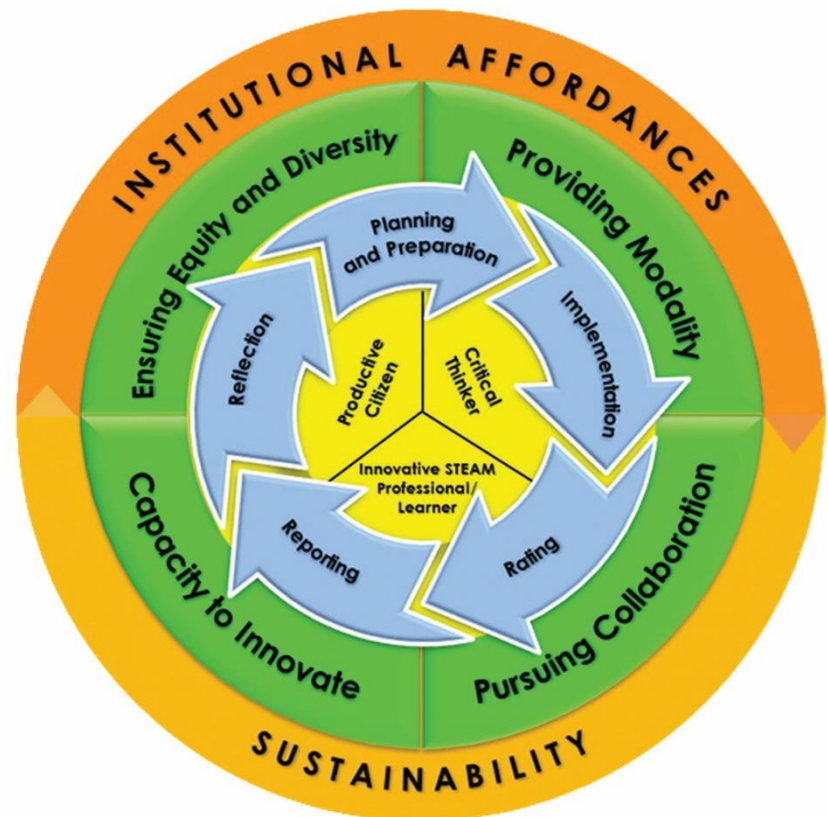


Aiming at TPACK framework...

Objectives

5. *Designing the Philippine STEAM Education (PSE) Model.*

Emerging Assessment Model-T1

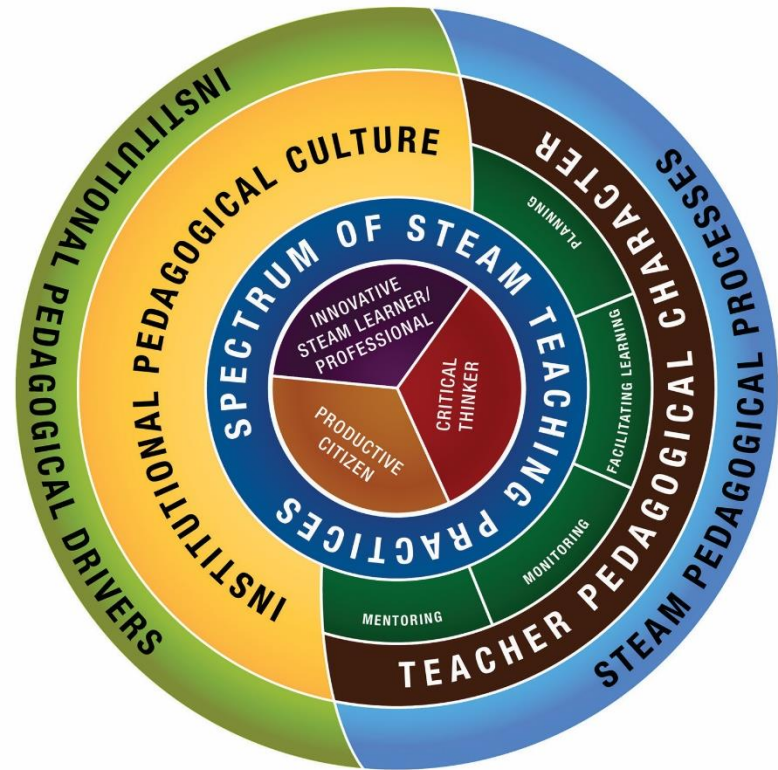


Aiming at TPACK framework...

Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Emerging Pedagogical Model-T1

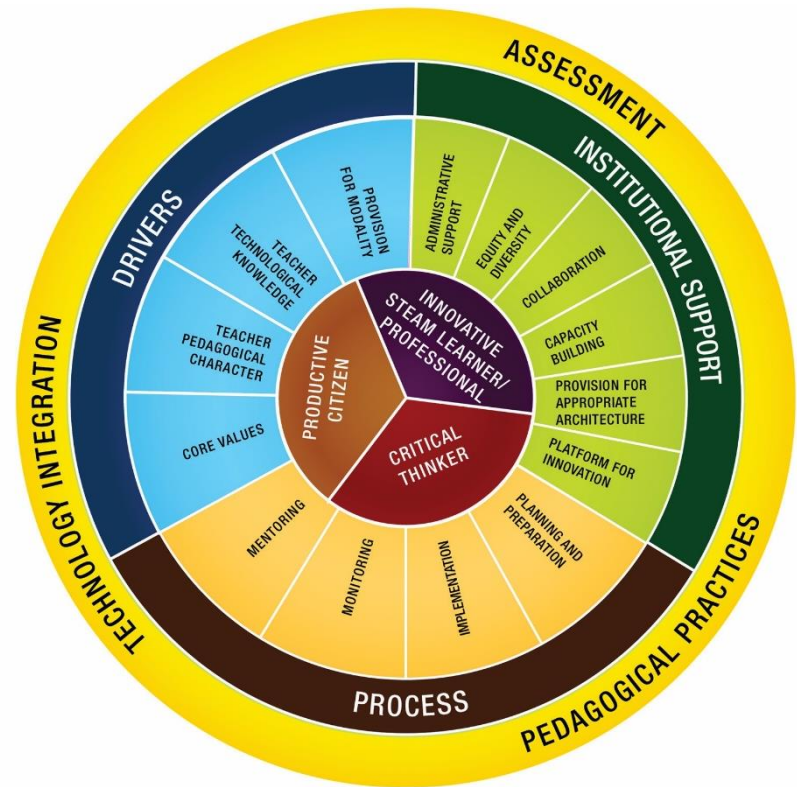


Aiming at TPACK framework...

Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Emerging PSE Model-T1

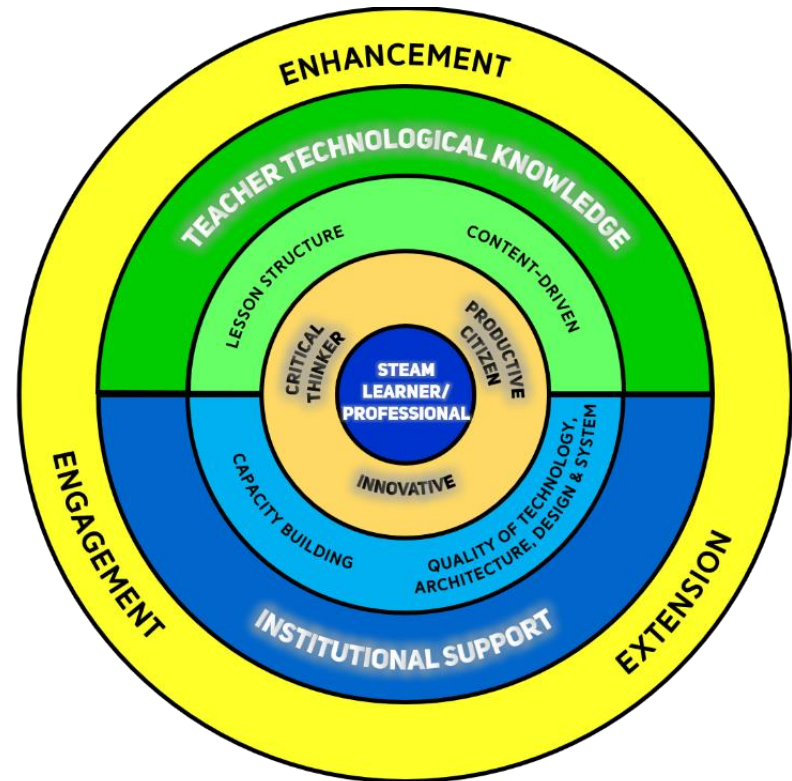


Aiming at TPACK framework...

Objectives

5. *Designing the Philippine STEAM Education (PSE) Model.*

Validated Tech Integration Model-T2 (Final)

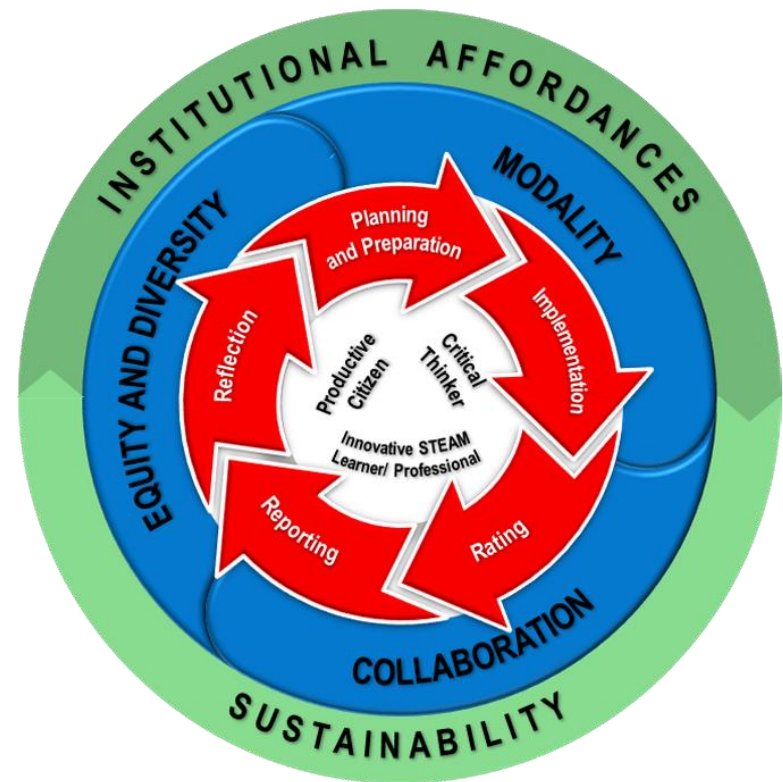


Aiming at TPACK framework...

Objectives

5. *Designing the Philippine STEAM Education (PSE) Model.*

Validated Assessment Model-T2 (Final)

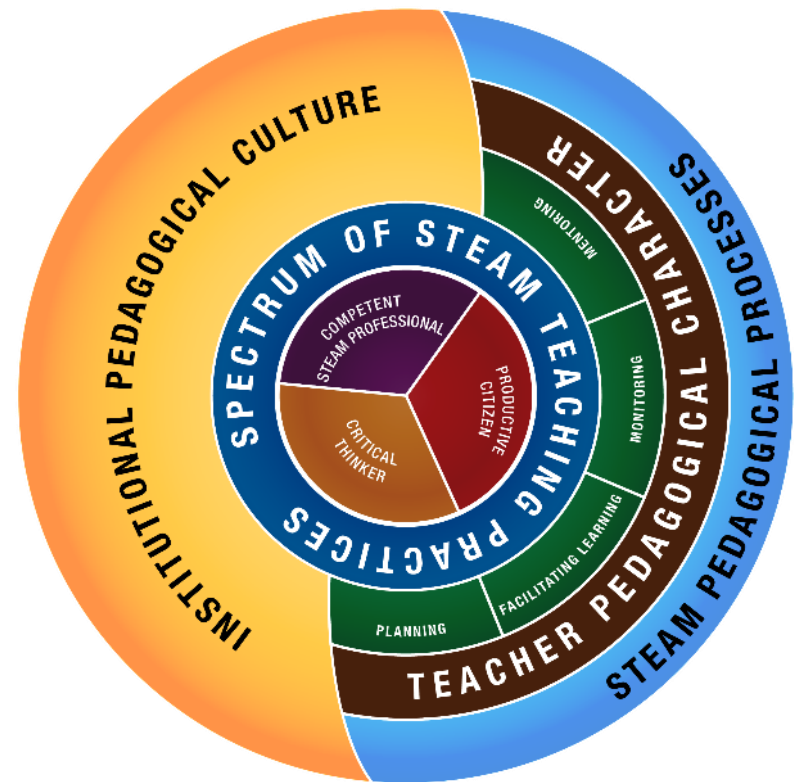


Aiming at TPACK framework...

Objectives

5. *Designing the Philippine STEAM Education (PSE) Model.*

Validated Pedagogical Model-T2 (Final)

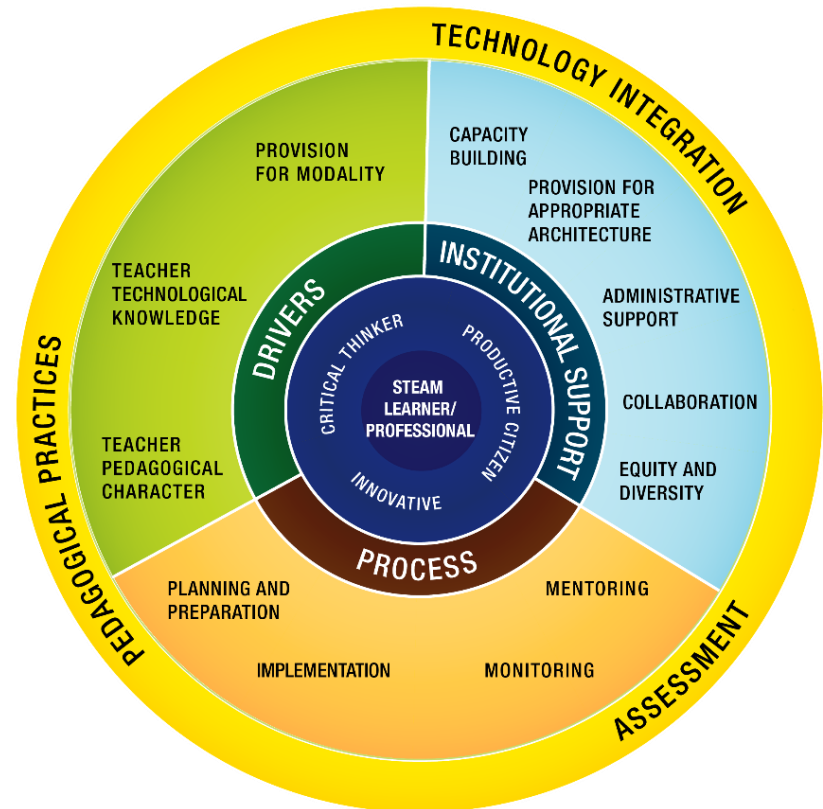


Aiming at TPACK framework...

Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Validated PSE Model-T2 (Final)

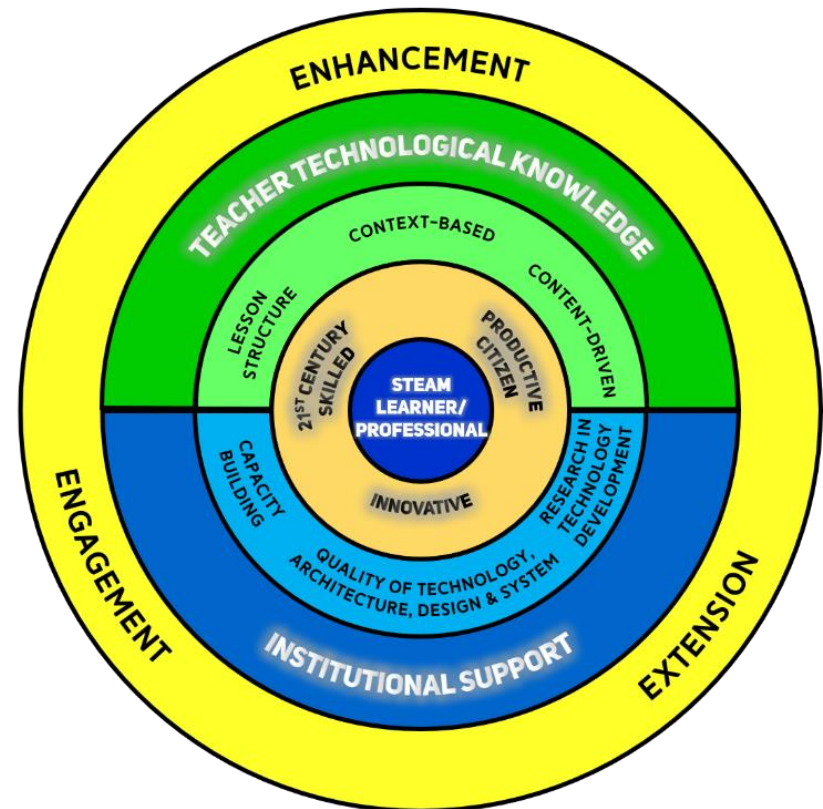


Aiming at TPACK framework...

Objectives

5. *Designing the Philippine STEAM Education (PSE) Model.*

Emerging Tech Integration Model-T2 (Final)



Aiming at TPACK framework...

Objectives

5. *Designing the Philippine STEAM Education (PSE) Model.*

Emerging Assessment Model-T2 (Final)

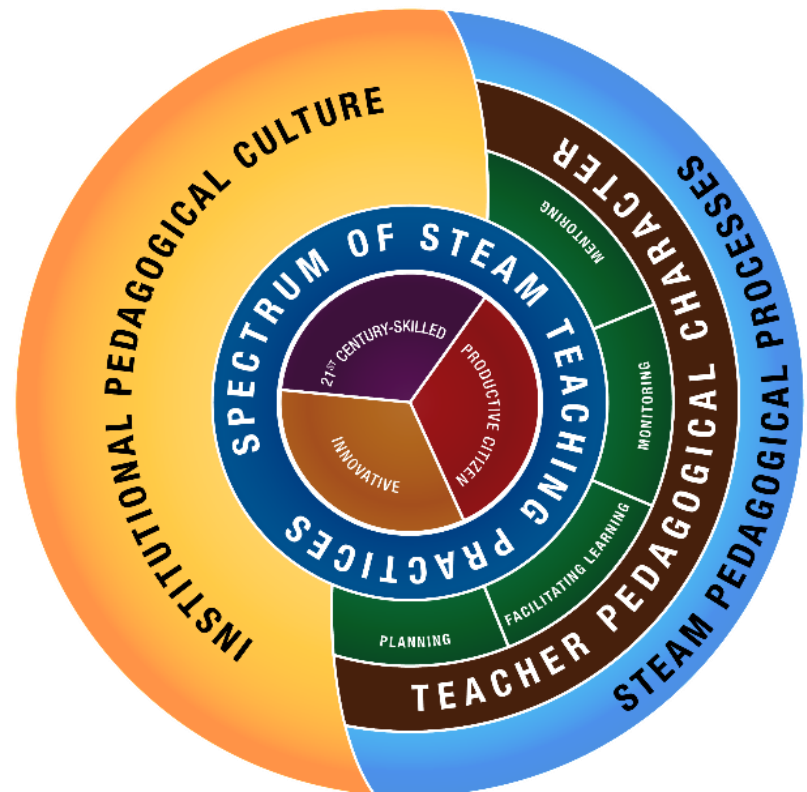


Aiming at TPACK framework...

Objectives

5. *Designing the Philippine STEAM Education (PSE) Model.*

Emerging Pedagogical Model-T2 (Final)

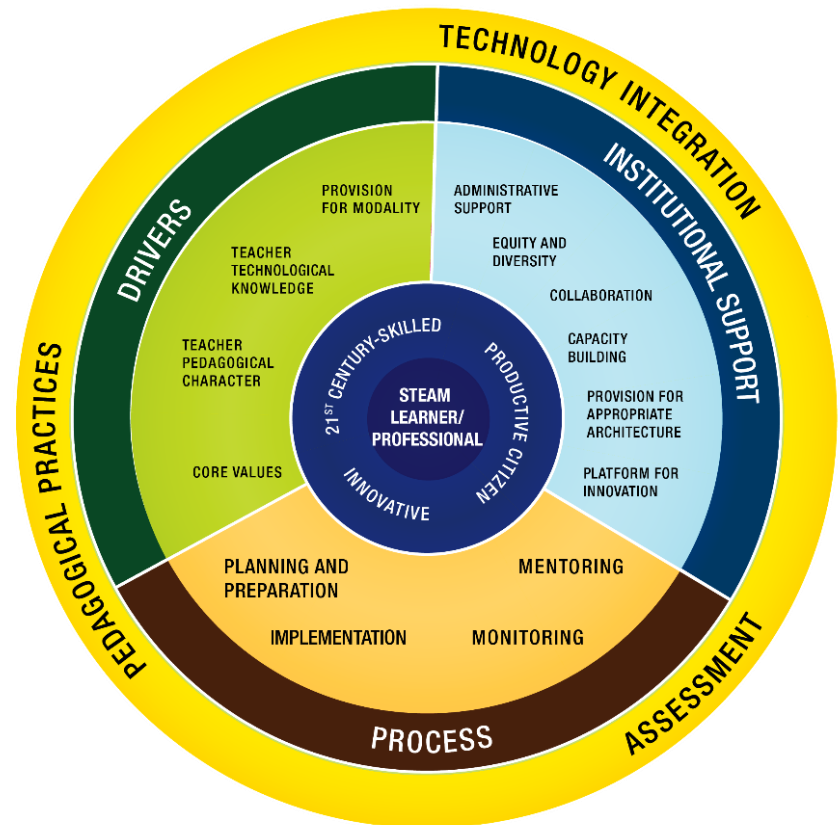


Aiming at TPACK framework...

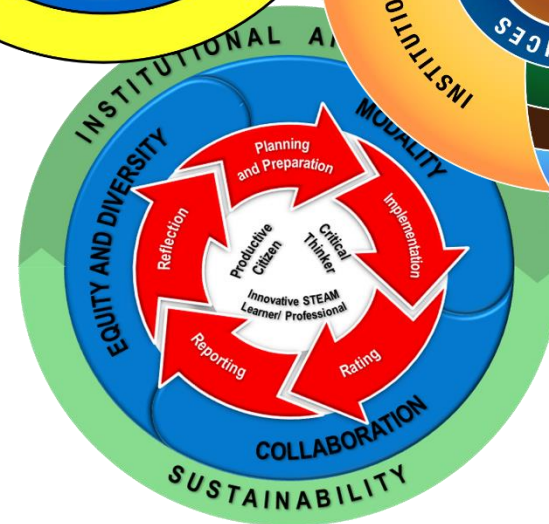
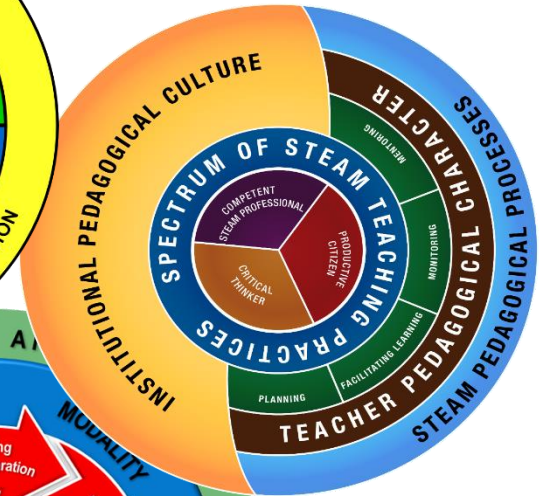
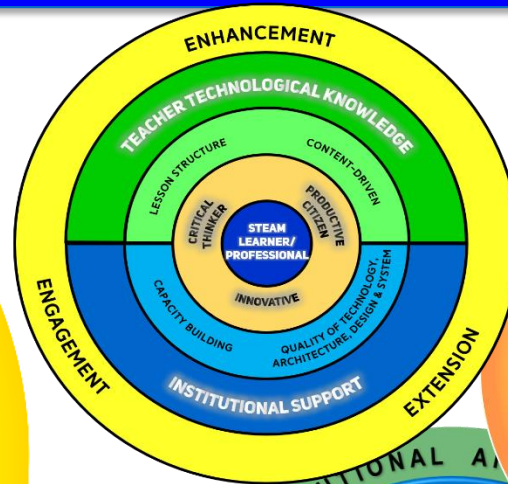
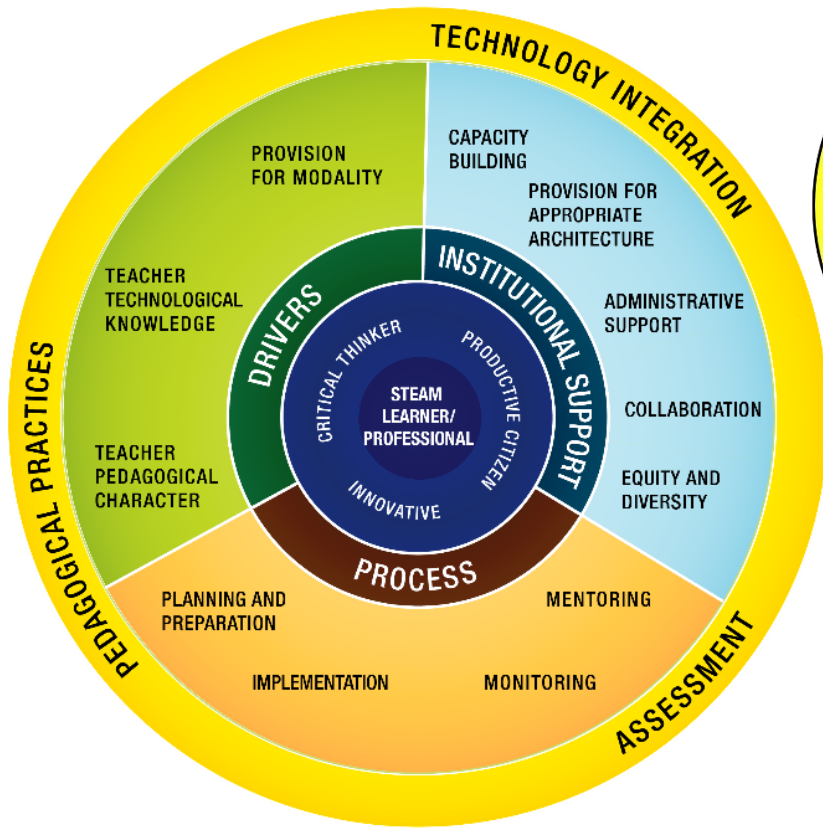
Objectives

5. Designing the Philippine STEAM Education (PSE) Model.

Emerging PSE Model-T2 (Final)

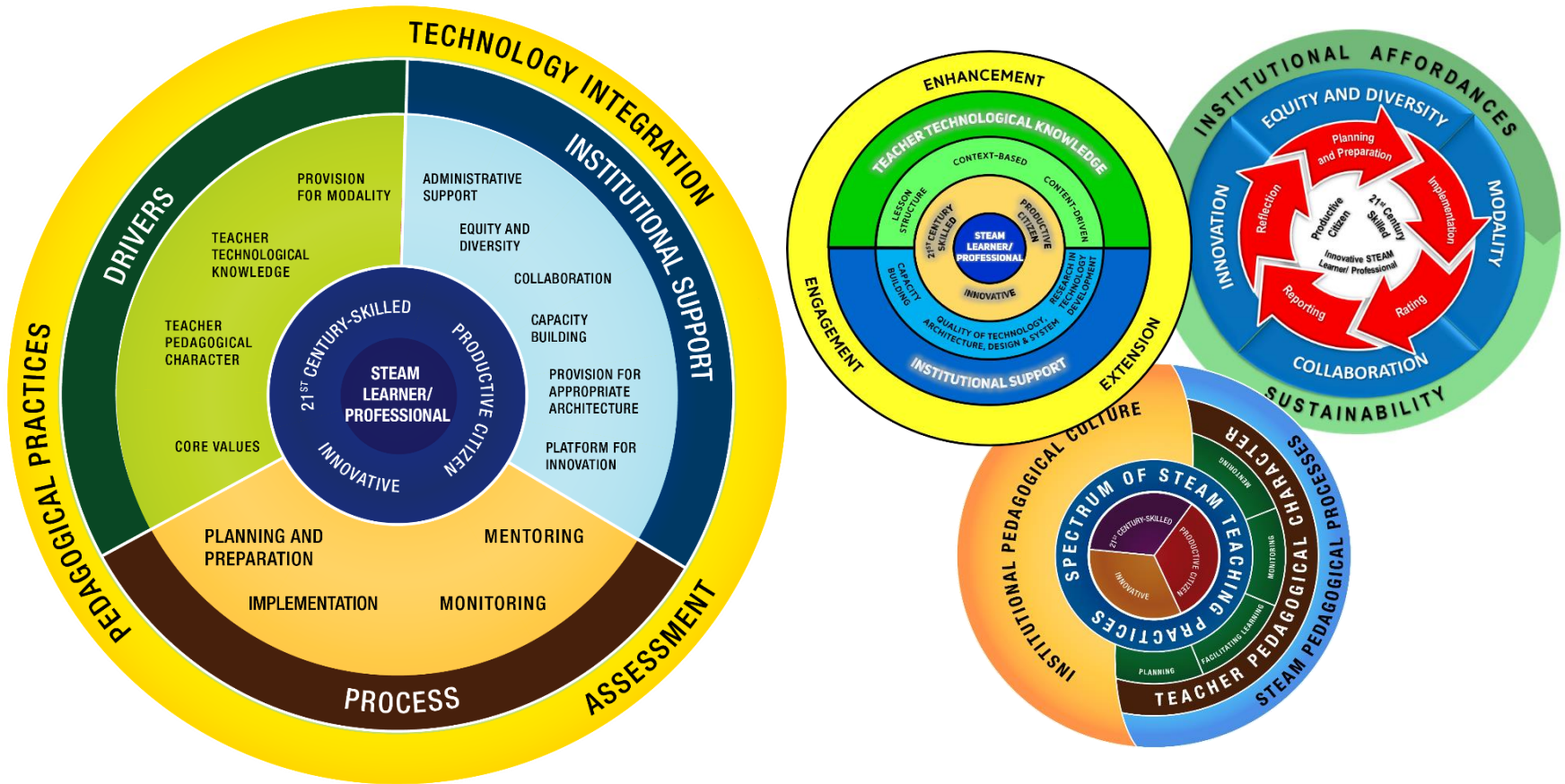


Our Products...



Validated Models...

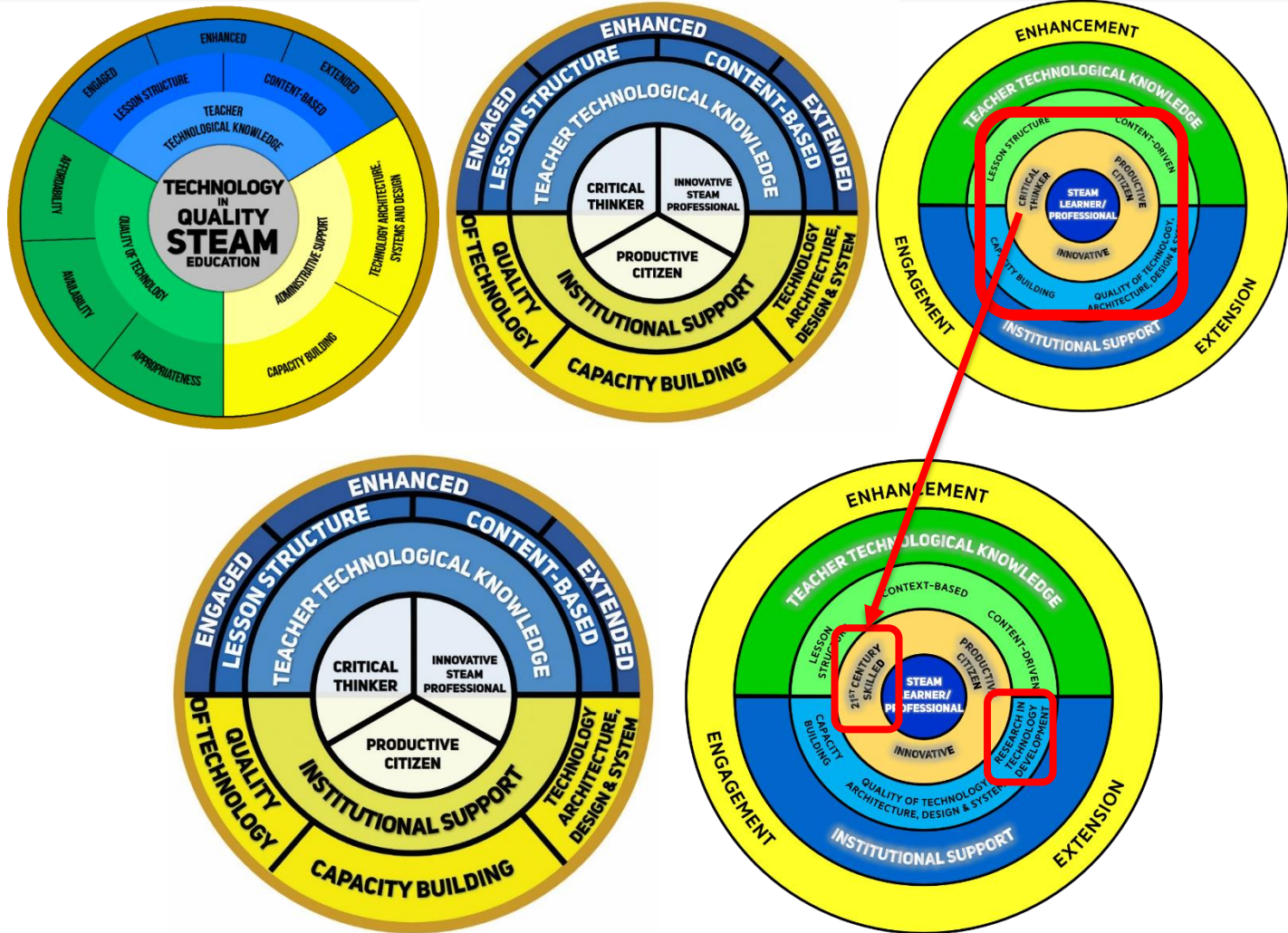
Our Products...



Emerging Models...

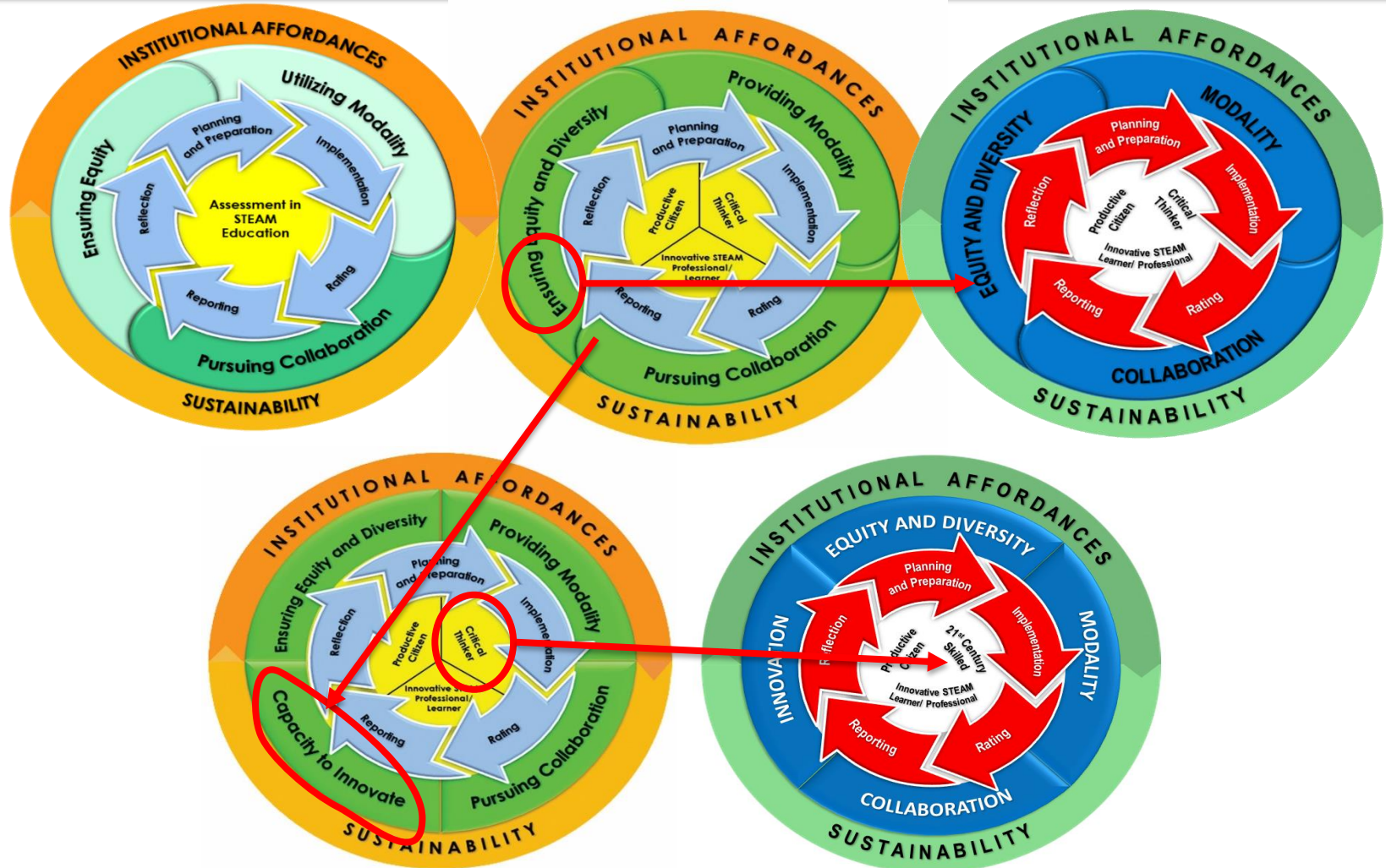
Analyzing our Products...

Technology Integration Model...



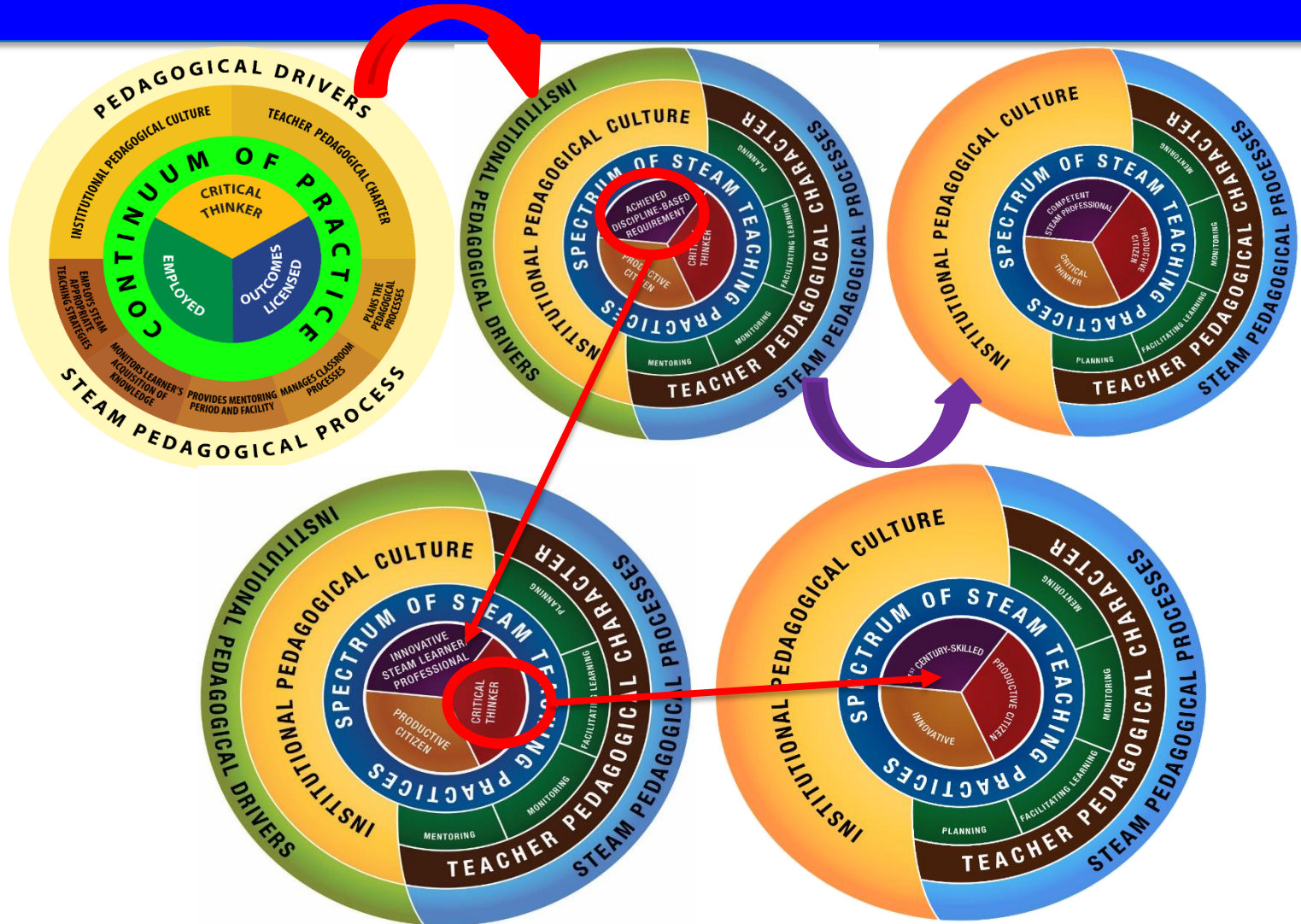
Analyzing our Products...

Assessment Model



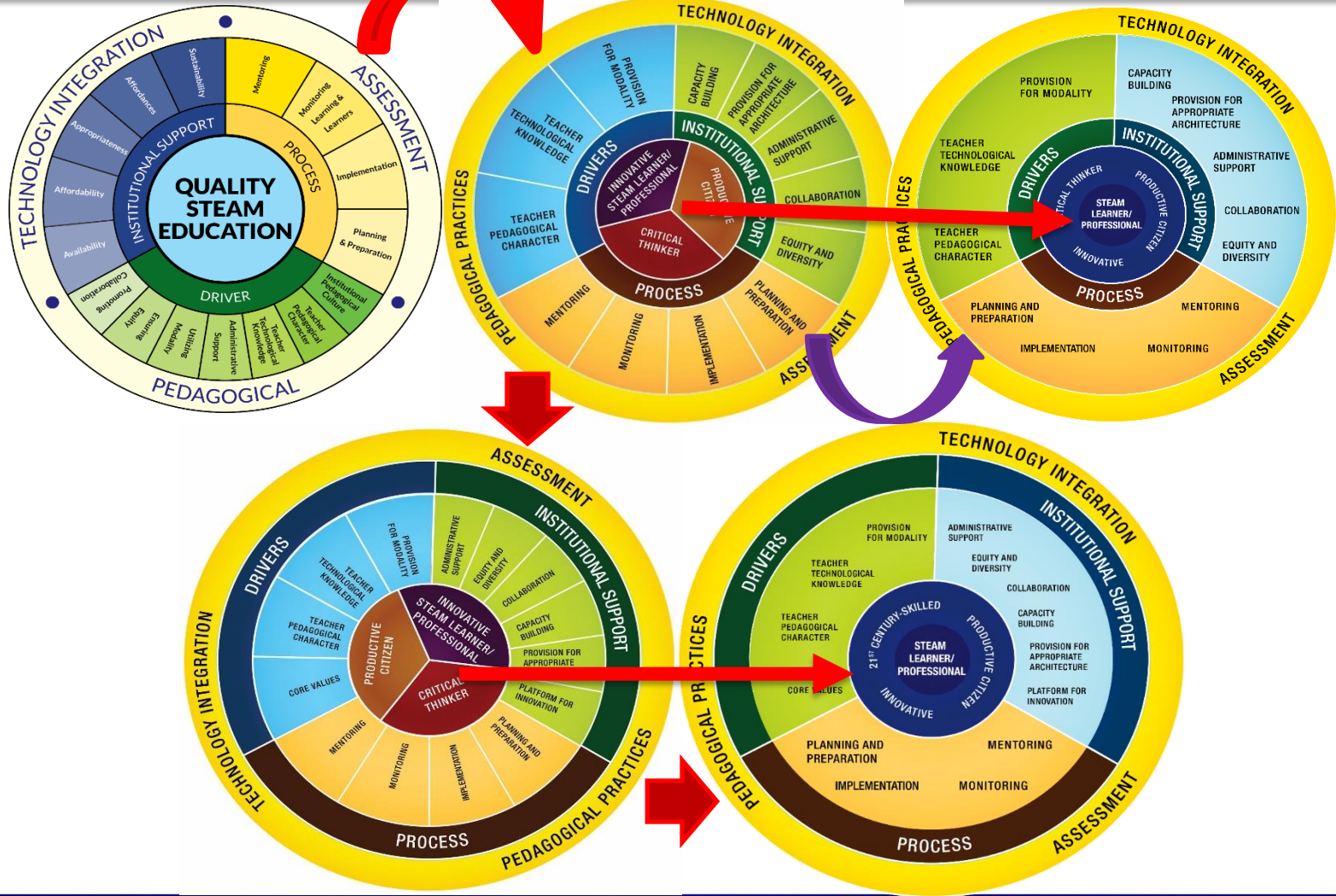
Analyzing our Products...

Pedagogical Model

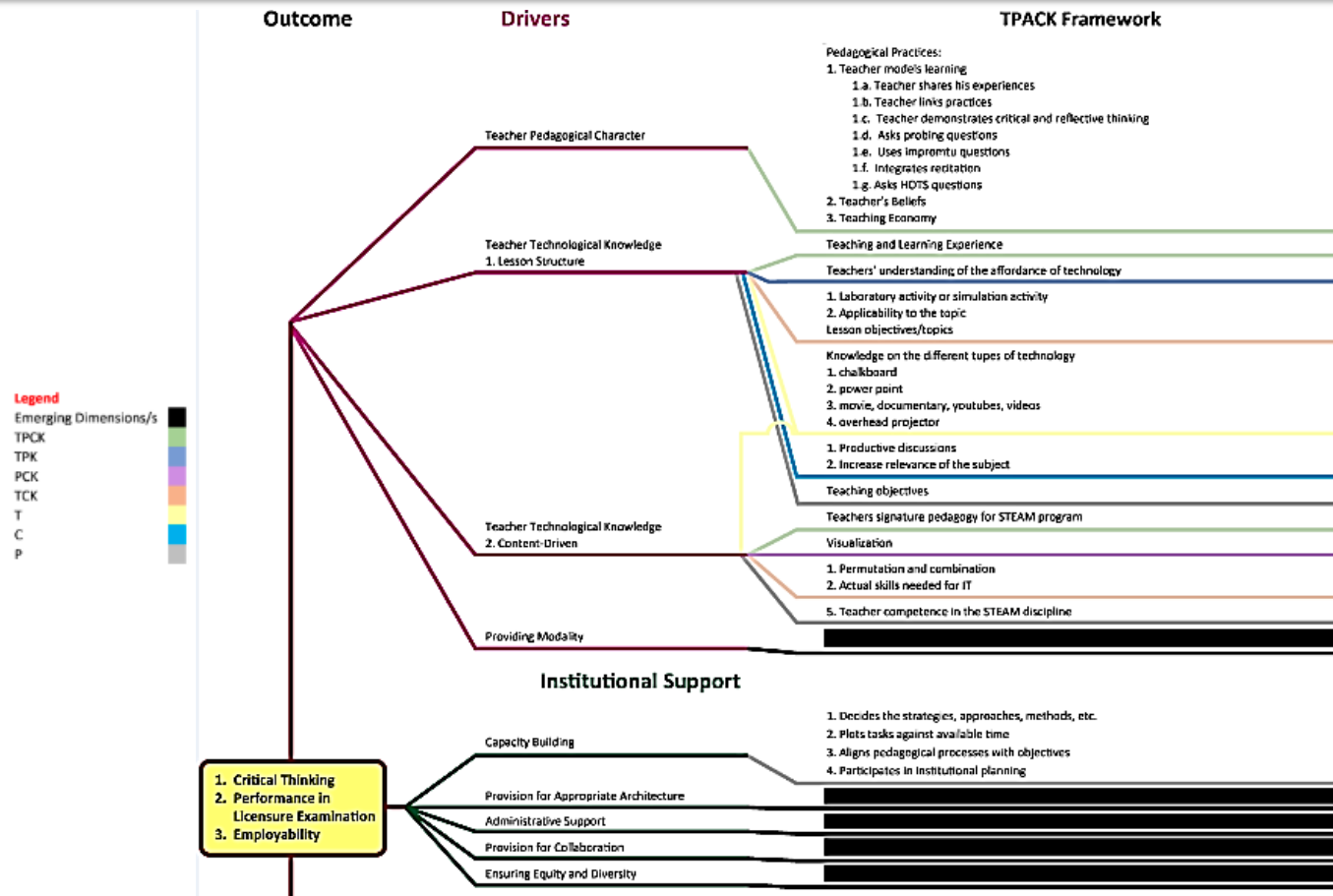


Analyzing our Products...

PSE Model



Our Products...



TPACK Framework...

Our Products...

<p>TPACK Lesson Exemplar in Physical Science</p>	<p>Unit Title: TPACK in Physical Science Department: Science/STEM/HS/Grade 12 Topic: Thermodynamics Level: 12-Grade/12-Grade Lesson Number: 1 out of 1</p> <p>TPACK Lesson Exemplar</p> <p>DP The TPACK Lesson Plan SE The Exemplar Process DP The Exemplar Process</p>	<p>Learning Outcomes</p> <p>At the end of an interactive metacognitive lesson, the learners are expected to attain the following:</p> <ol style="list-style-type: none"> state the laws of thermodynamics operationally; apply the laws to analyze different thermodynamic processes; and relate the laws of thermodynamics to the different societal issues (thermal pollution, global warming and energy resources). 	<p>Target Audience</p> <p>The target audience for this lesson are 3rd Year SSE – Science Majors of Mahatma State University during the 2nd semester of SY 2010 -2020, who are digital 21st Century learners mainly manipulative, visual, tech savvy, interactive, creative, reflective, diverse, innovative and confident to understand the value of collaboration and the relationship of effort to results, and the need to continually grow.</p>	<p>Target Audience</p> <p>A few of the class members are academically resilient due to problems in developing their problem solving skills and their use of mathematical skills. There are three students in the class who have learning challenges (1 nearsighted, 1 dyslexia and 1 dyscalculia).</p>	<p>Pedagogies</p> <p>This lesson shall be presented using constructionism and neurocognitive – based teaching model wherein the students will be the one to develop their own understanding of the concepts.</p>
1	2	3	4	5	6
<p>Pedagogies</p> <p>In the motivation part and in the cognitive assessment, an interactive online presentation will be used. In the lesson development, powerpoint presentation, video, and an interactive online laboratory (virtual reality using Physlets) using problem – based learning and inquiry approach will be utilized.</p>	<p>Pedagogies</p> <p>The exposure to the different technologies allow the students to boost attention, gather information, understanding of concepts, organization of thoughts, idea clarification or looking for something new and students' re – engineering of concepts learned.</p>	<p>Technology</p> <p>Technology Used by Teacher:</p> <p>Technology Used by Student:</p>	<p>Lesson Strategy and Required Materials</p> <p>In the activities part we will use the assessment, an open interactive presentation to elicit students' understanding of terms related to thermodynamics forming a word cloud. Each student, using their smartphones will give a word associated to "Thermodynamic" to this online link http://www.wordgenerator.com/s/93/aa/7e41f69916/427648777c538010184659476/.</p>	<p>Lesson Strategy and Required Materials</p> <p>Students will be grouped into 5 with 5 members each. Then, allow the students to deduce laws of thermodynamics in the following systems using a 5 – minute video clips presented by the teacher.</p> <ul style="list-style-type: none"> Heat engine (car engine) Heat pump (air conditioner/refrigerator) Human being as thermodynamic system A rock falling on the ground Earth as a thermodynamic system Perfect crystal 	<p>Lesson Strategy and Required Materials</p> <p>Students will answer the guide questions that would elicit their conclusion about the laws of thermodynamics. Further, the students will answer the following questions, based on the assignment given:</p> <p>Prior to the viewing, the questions will be projected on screen.</p>
7	8	9	10	11	12
<p>Lesson Strategy and Required Materials</p> <p>The teacher process the students' understanding on thermal equilibrium, the first law in terms of conservation of energy, irreversibility of natural processes and entropy. Then students will write the deduced statements of the laws of thermodynamics.</p>	<p>Lesson Strategy and Required Materials</p> <p>Students will give practical activities or daily activities, which are considered as thermodynamic involving the laws of thermodynamics. The teacher demonstrate also to the class using PhET simulations and allow the students to analyze the situation what law of thermodynamics is applicable to the situation.</p>	<p>Lesson Strategy and Required Materials</p> <p>The students will collaborate in a laboratory activity on the <i>statistical interpretation of entropy</i>.</p>	<p>Lesson Strategy and Required Materials</p> <p>The teacher will present the different societal issues (thermal pollution, global warming and energy resources) case study, which has been previously distributed. A class argumentation activity or SSI (Socio-scientific Issues) within 15 minutes will be conducted.</p>	<p>Assessment</p> <p>Students for Learning Strategy</p> <p>Feedback Strategy</p> <p>In the motivation, by using interactive presentation, the teacher will further the most clear general idea for the topic activity.</p> <p>Students' answers to the activities and their feedback will provide the answer provided by the teacher through questions.</p>	<p>Assessment</p> <p>Assessment of Learning (CLOs) and an assignment question?</p> <p>Assessment</p> <p>How do you think of the assessment and the presentation of the lesson activity?</p> <p>How do you think of the assessment and the presentation of the lesson activity?</p> <p>The student's answer to the guide questions to the laboratory activity.</p> <p>Answer: answer to the guide questions. Answer will come from group members presentation to the class presentation.</p>
13	14	15	16	17	18

Lesson Exemplar...

Our Products...



1 ★

Learning Outcome(s)

At the end of the lesson, students will

1. recognize Fibonacci sequence;
2. determine the nth term in the Fibonacci sequence;
3. identify Fibonacci sequence in nature;
4. express appreciation of Fibonacci sequence in nature.

2 ★

Target Audience

- > Students with different learning styles will be catered.
- > First year students are coming from different backgrounds and different learning styles.
- > The topic will be able to respond to visual learners and auditory learners through the video that will be presented.

3 ★

Target Audience

- > Kinesthetic learners will appreciate the examples in nature that illustrates Fibonacci number.
- > Students with numerical intelligences will be challenged in the activities.

4 ★

Pedagogies

1. Students will be given a problem (The Rabbit Problem) shown through PPT presentation. Students will discuss among themselves the solution to the problem and will be asked to give their answers and how it was arrived at. Students can use their scientific calculators or cellphone calculators as they can work efficiently.
2. The teacher will provide the answer illustrating the pattern of numbers and will introduce the concept of Fibonacci number and formula.

5 ★

Pedagogies

3. Students will have a problem exercise about finding the nth term in the Fibonacci sequence.
4. Objects in nature illustrating Fibonacci numbers will be shown through pictures and video clip.
5. Students will be asked to write a reflection paper about the video they watched.
6. Students will be given an assignment that targets multiple intelligences.

6 ★

Technology Being Used

By students <ul style="list-style-type: none"> • computers/ laptops • cellphones • scientific calculators 	By teachers <ul style="list-style-type: none"> • computers/ laptops • cellphones • scientific calculators • LCD projector
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7 ★

Lesson Strategies

- In the Rabbit Problem, the students will be able to discuss among themselves possible solutions to the problem by scaffolding: think-alouds or group work.
- The proper use of the calculator will be done by demonstration.

8 ★

Required Materials

- The lesson will be delivered through PowerPoint presentation using computer/laptop and the LCD projector.
- To illustrate the solution, the board and marker will be utilized.

9 ★

Required Materials

- The calculator will be used to provide alternative solution in finding the nth number in the Fibonacci sequence.
- The video clip (Nature by Numbers by Cristóbal Vila) will be shown using the laptop, speaker and LCD projector.

10 ★

Assessment for Learning

Formative Strategy <ul style="list-style-type: none"> • Students will be asked randomly to fill in a series of numbers with the missing Fibonacci number. • Problem exercise in finding the nth term in the Fibonacci sequence. • Students will be randomly asked to give examples of Fibonacci sequence in the environment that starts by Fibonacci number. • The students will be asked questions and given their reflections on the case presented about Fibonacci sequence. 	Feedback Strategy <ul style="list-style-type: none"> • Provide students' misconceptions that often occur and will be addressed by illustrating examples of math in nature. • Provide students' difficulty in the proper use of calculator for computation of the nth number in the Fibonacci sequence can be addressed by immediate explanation, peer-teaching, and guided inquiry.
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11 ★

Assessment of Learning

- Performance task given as an assignment specific to each of the multiple intelligences of the students (linguistic, naturalistic, spatial, and music).
- Students will be asked to take pictures of objects found in nature that exhibits Fibonacci numbers. The work will be presented in class and will be graded using a rubric.
- Students will be required to bring a piece of their face which will be measured to illustrate the Golden Ratio. This will provide realization on the application of the Fibonacci number as a golden ratio in the human body.

12 ★

Reflection

- Identify appropriate strategies suited to the needs of the 21st century learners.
- Be able to handle/overcome technical problems/issues due to limitations in technology use.

Modifications/Enrichments

- Modify teaching strategies

13 ★



14 ★

Lesson Exemplar...

We saw...We envision...

- Big shifts from draft model to Tier 1 Validation
- Minimal changes (placement of constructs, colors, constructs, deletion of adverbs/verbs) from Tier 1 to Tier 2 Validation in all models
- Several drastic changes though from Validated to Emerging in Tier 1, specifically in Pedagogical Model and PSE Model.
- Significant changes to encapsulate envisioned STEAM Education are visible from Tier 1-Emerging to Tier 2-Emerging

We envision...

- Influence of the model to Philippine Higher Education STEAM Curricula
- Crafting of policies sourced from the inputs provided by the generated models.
- Consequent programs and projects from the Models
 - Professional Development Programs
 - Research Grants to develop assessment tools and training tools
 - Research Grants to polish STEAM Curricula
 - Research Grants to develop more Lesson Exemplars

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