Problem Crafting

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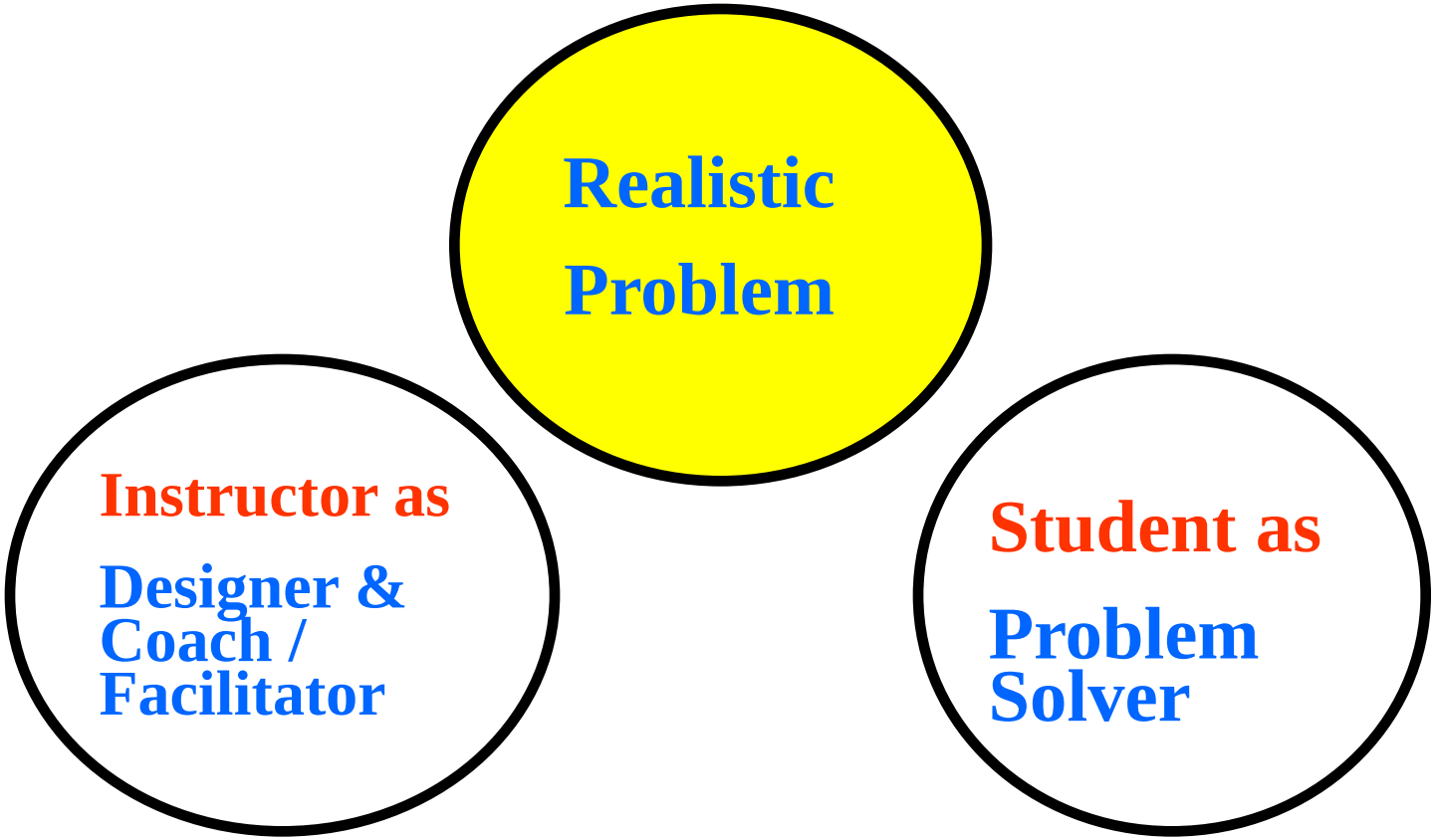
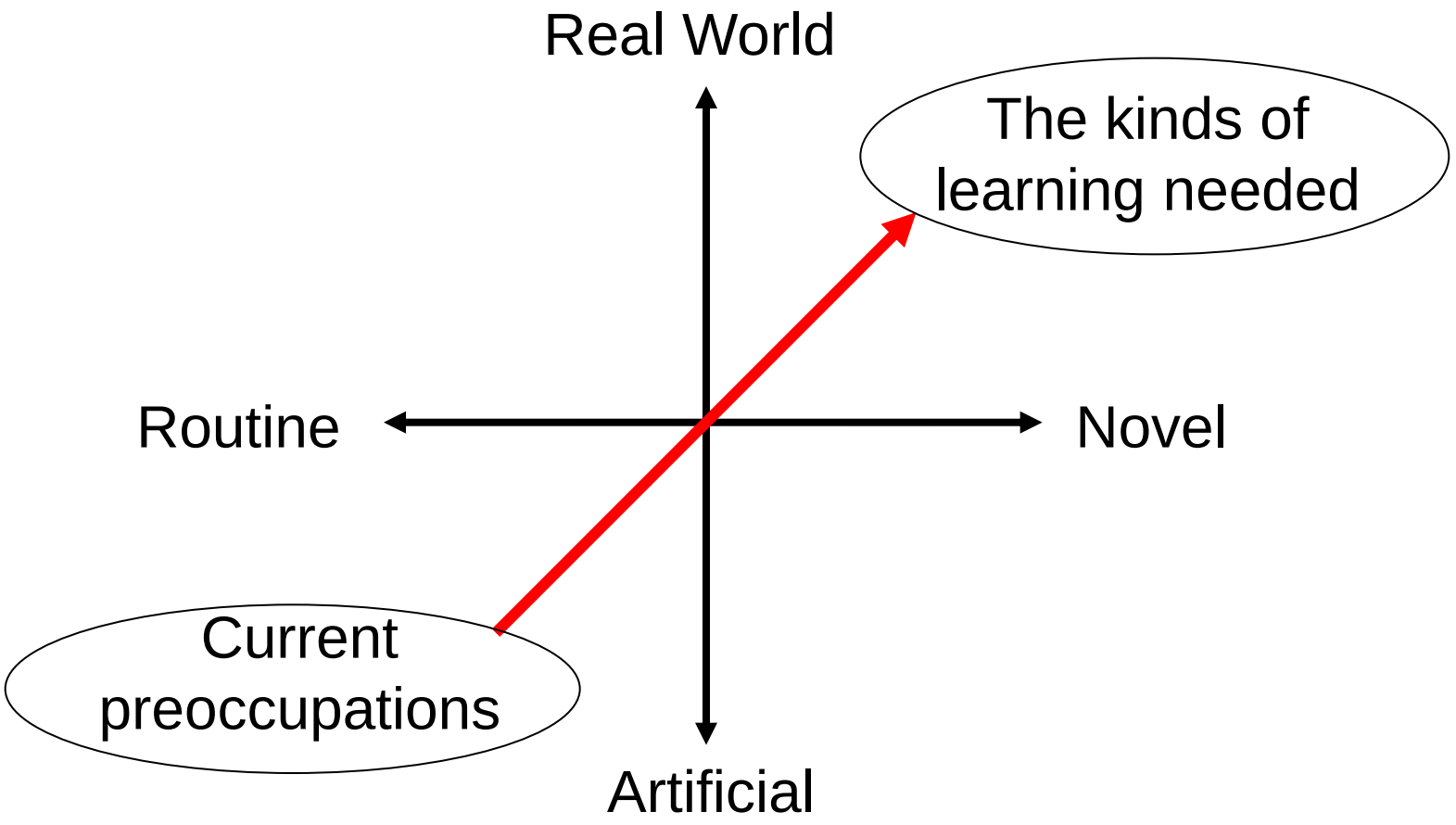
Outline

- What and Why …?
- Underpinning principles for crafting problems
- Steps in problem crafting
- How? Taking the scholarly approach
- Example: Research on CPBL – impact and practical aspects

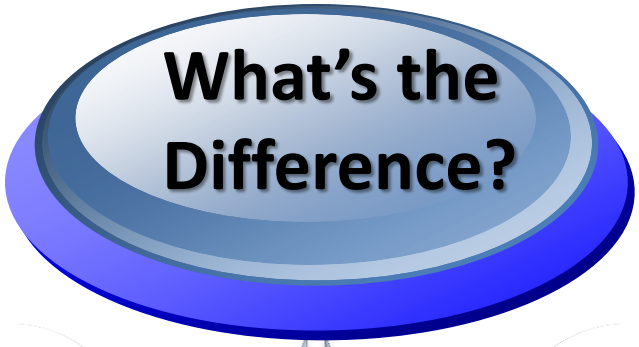
Problem Crafting



Types of Problems in Curricula (Tan 2003)



Problem Solving Topology



Problem Solving

- Process to obtain best answer to an unknown, subject to constraints
- Ill defined
- Novel
- No explicit statement
- More than one approach
- Algorithm to solve unclear
- Integration of knowledge
- Strong skills of presenting results

Exercise Solving

- Process obtain the one and only answer
- Well defined
- Encounter similar problem before
- Explicit, hints given
- Usually one approach to one answer
- Recall familiar solutions – usual method
- Subject by subject
- Presentation skills not required

Problem as driving force for learning

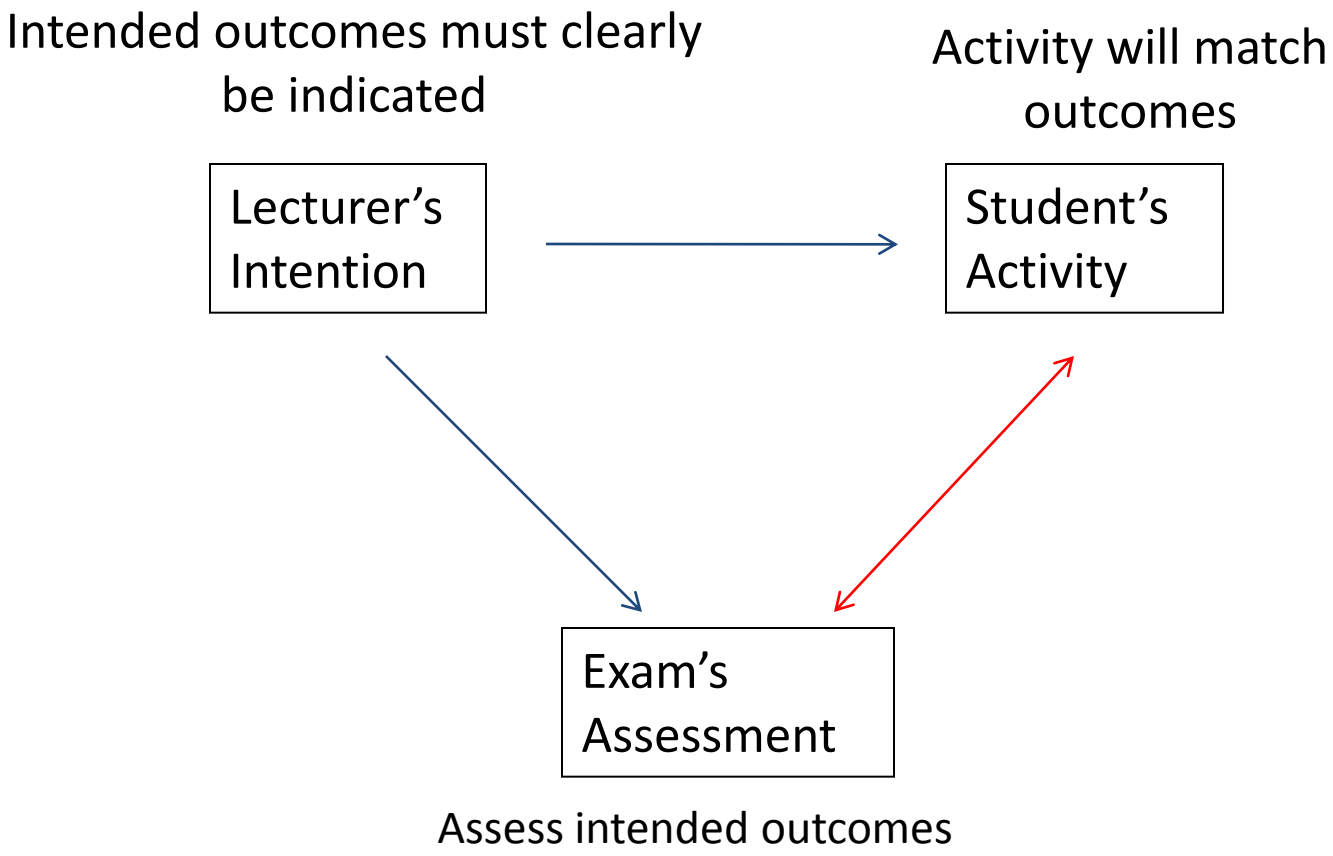
1. Deliver the intended learning outcomes
2. Assess learning process and the achievement of learning outcomes
3. Provide context of learning as well as professional practices
4. Stimulate and train thinking skills
5. Cater for teaching and learning activities

Duffy and Cunningham (1996)

Knowing all this, what kind of problems do we actually need to craft?

Constructive Alignment

(Biggs, 1996)



Constructive Alignment

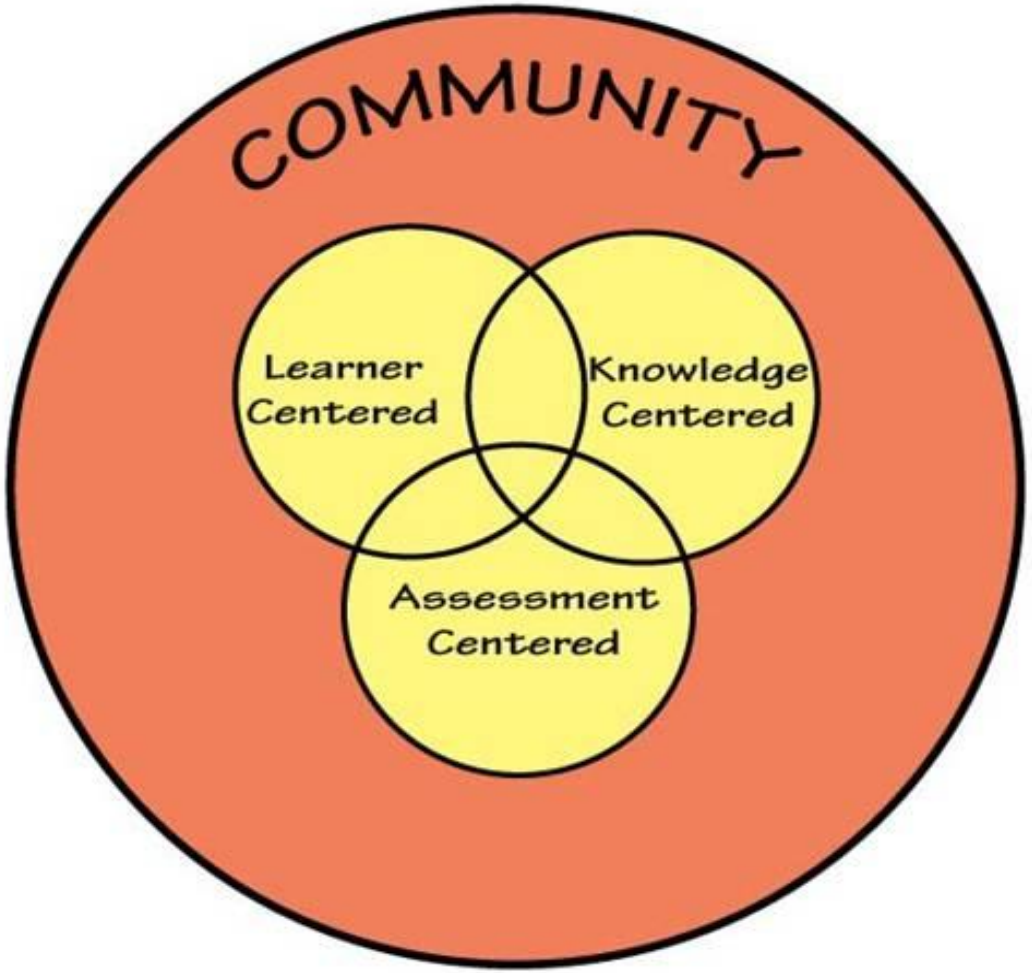
- Based on 2 premises:
  - constructivism, where the learner constructs meaning through his learning activities, rather than what is transmitted.
  - instructional design that aligns learning outcomes to teaching and learning activities, as well as assessment tasks.

J. Biggs, *Enhancing Teaching Through Constructive Alignment*, Higher Education, 32, 347-364, 1996

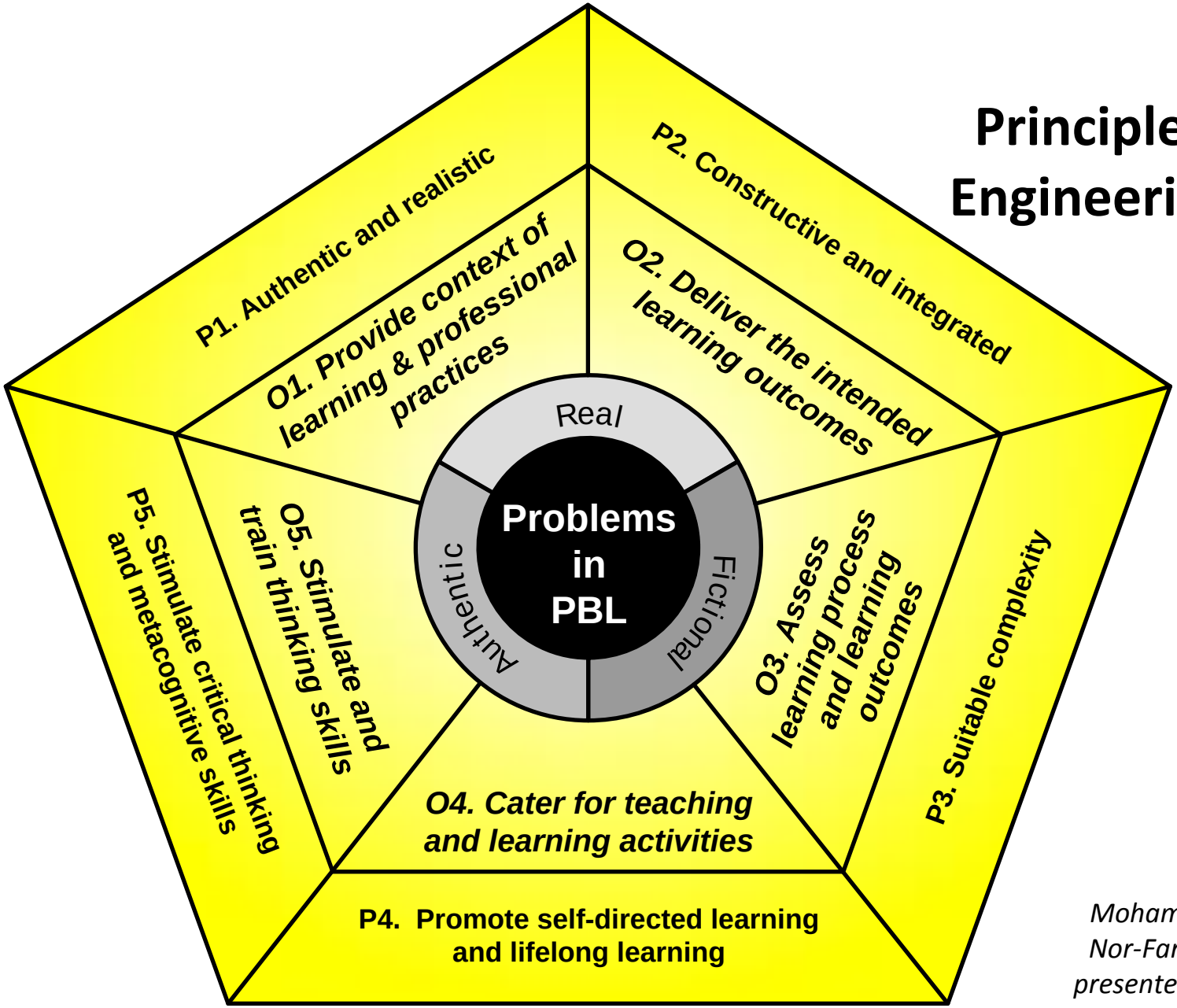
Constructive Alignment

- Teachers **align assessment and learning activities** to the intended **learning outcomes**
- Students **construct meaning** from what they do to **learn**

How People Learn (HPL) Framework (Bransford, 2004)



Principles of Crafting Engineering Problems



Mohammad-Zamry, Khairiyah, Nor-Farida, Syed Ahmad Helmi presented in RCEE&RHEd (2010)

Sample

- **The scenario** – a team of third-year students who will be attending a *team interview for industrial training placements*
- **Mode of delivery** – *offer letter* for interview session from a petrochemical company

PSM
Polystyrene (M) Sdn. Bhd.

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Dear candidates,

The selection committee of Polystyrene (M) Sdn. Bhd. is very interested in interviewing your team for the opportunity to undergo industrial training at our company. The interview session is scheduled on 28th December 2009, from 10 a.m. to 12 noon, in the meeting room, Human Resource Department, Polystyrene (M) Sdn. Bhd.

With regards to the interview session, we would like you to demonstrate your understanding on one of our processing plants, the HDA Process, in a 3-5 page report. Please systematically describe the process from a system's point of view. Be sure to include the input and output variables involved in the process. Explain all the automatic control systems: classify the variables, identify the control objective, and identify the control configuration used for each control loop. Please comment if the control configurations used are sufficient to tackle the disturbances. Enclosed are the process description and a simplified P&ID of the HDA Process for your reference.

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Problem Crafting Process

Let’s craft a problem that contextualize the outcomes desired based on the workplace

We will start with a group activity to craft a problem

Problem Crafting Process

1. Identify learning outcomes, also list of concepts already known, and concepts from other disciplines/courses developed

   - start with the most essential and fundamental ones that are required. Several learning outcomes may be combined if they naturally fit in within the context of a problem at the workplace

   * if the gap in knowledge and skills in the problem is considerably large, then break them into parts (Why?)

2. Designing Problems for workplace context

2.1 Identify actual situation/problem and work setting where the learning outcomes fit

- think of knowledge, skills and attitude that is required in the workplace

2.2 Identify demand at the workplace that require the students to make response

- What kind of scenario or setting in the workplace where the outcome is most commonly required?

Problem Crafting Process (cont'd)

3.1 Write the first draft – infuse the learning outcomes into the problem as intermediates between problem and demand at the workplace:

- use present tense
- provide context of time, place, specific role of practitioner
- contains objective rather than interpretive data
- request student to make a response (demand at the workplace), i.e. make a decision to take an action, prepare a technical reports, make a proposal, attend an interview, etc.

3.2 Identify and prepare resources needed – process description, datasheets, diagrams, charts, etc.

3.3 If necessary, recommend approach to deal with the problem and suggest learning resources and references

Problem Crafting Process (cont'd)

4. Prepare solution guidelines and grading rubric for assessment of outcomes achievement

5. Package the problem for presentation in a way that fits the workplace setting:
   - Add value to the problem e.g. data and calculation sheets with mock company heading and logo
   - Choose suitable mode of delivery e.g. letter, email, memo, conversation, phone call, etc.

6. Review, revise and refine - ensure that the problem is solvable and can be solved by the students in a the given timeframe

7. Delivery

Some Feedback from Students

- *"I think from what I have learnt from the control class, it is a good start for me to **prepare myself as an engineer**. The technical knowledge that I gain from this class is absolutely useful for me especially if I join the process control field one day later."*
- *"I have realized that, learning process is not about getting the right answer, but it is actually the **process where you gain your knowledge, understand it eventually and demonstrate it by solving the problem.**"*

- *“Besides, it also make me realise that the important of master all knowledge that gained. We need to* ***integrate all these technical knowledge in order for us to solve real life problems****. This encourage me change my learning style from performance based to the mastery based because I really want to do well as a future chemical engineer.”*

- *"**As for my problem solving skills, there are significant improvements.** The time requires getting to the problem statement gets shorter. This indicates that I know what my problem is and where I should head and what I should do. Even though that is the case, it is rather hard to judge this skill because it is rather abstract. Maybe because of we are to use to the flash drum therefore we know where the problem lies. But the most interesting part is when completing final phase. That is the time where I can connect all the knowledge to one small design. I know where to begin and what to do. For instance, in order to create a new control loop, I actually identified the objective of the control loop before proceeding to other matters. Then I will identify with my team the variables and classify them. Propose a suitable control configuration is then performed. Here is where we will start to brainstorm every possibility of the control configuration in the control loop. Then only we pick the best after the justification and suitability of the control configuration. Therefore, in the nutshell, I would say that **my problem solving skills has been improved comparing with the previous case study!!**"*