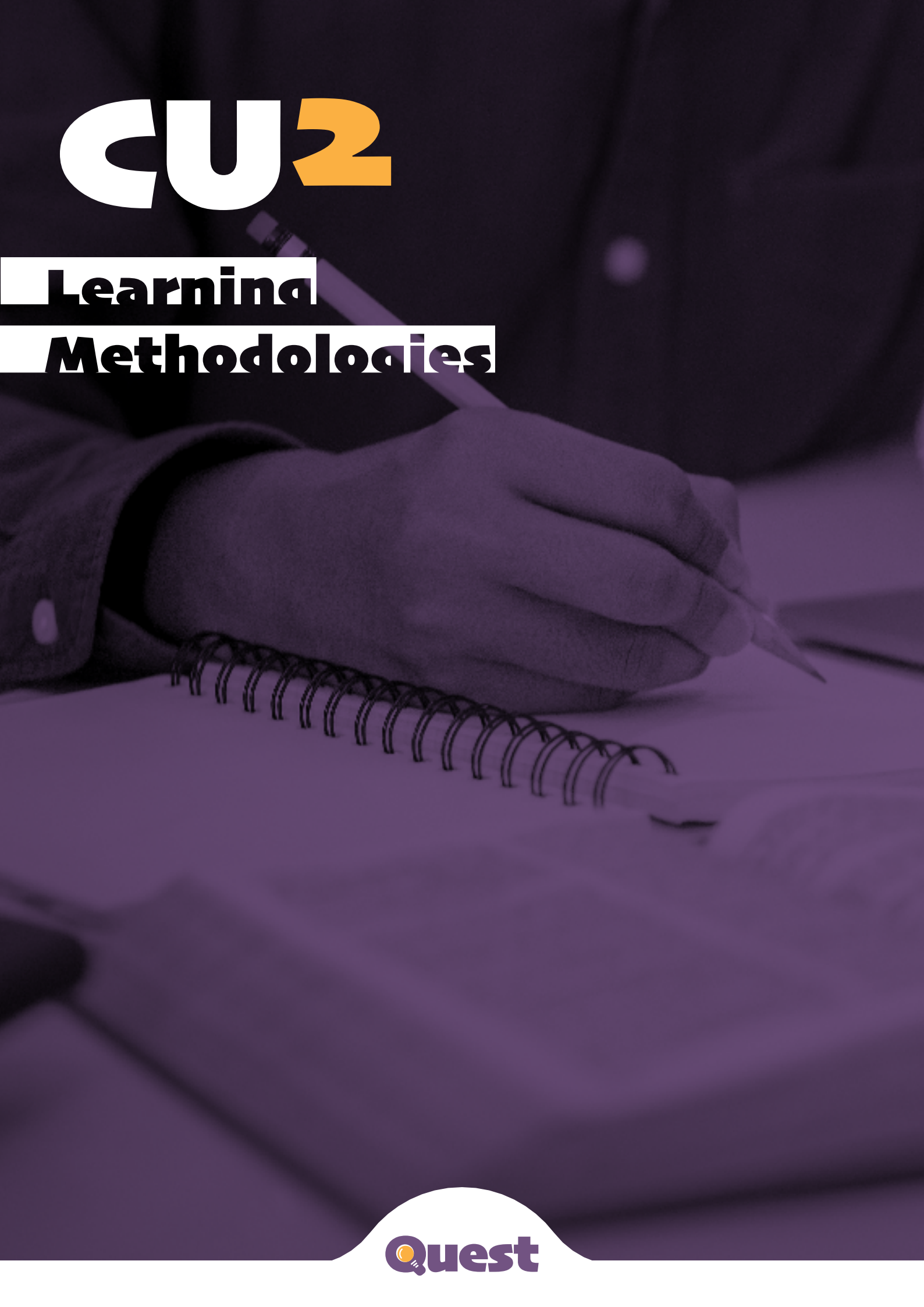




CU2

Learning

Methodologies

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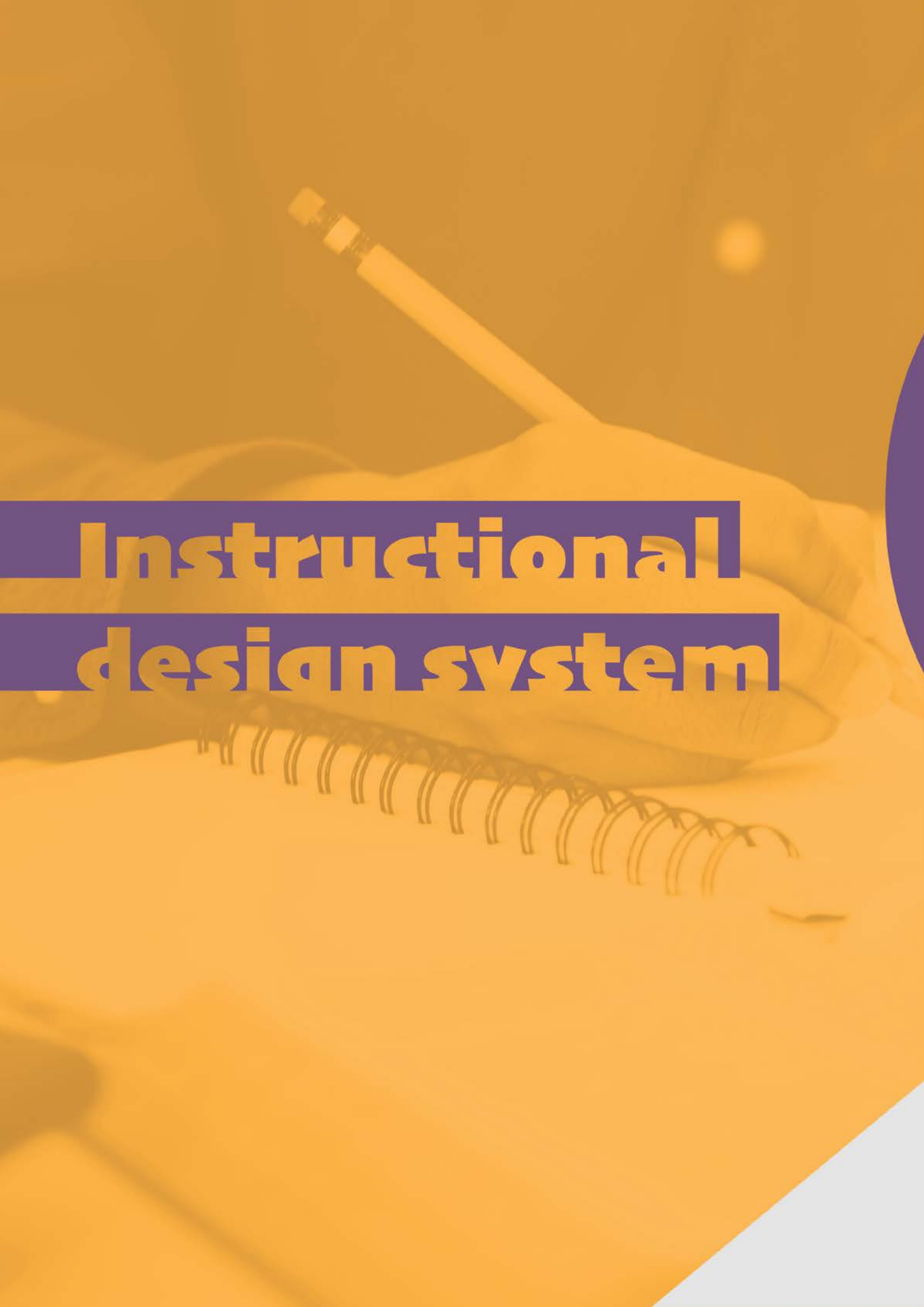
Introduction

Competence Unit (CU) 2 - Learning methodologies- introduces a system of practices and procedures that instructional designers use to develop functional instructional solutions. The instructional solution involves learning methodologies that create rich learning journeys for learners to achieve learning objectives within a specific instructional context. At the end of CU2, you are expected to:

- ❶ Understand how to translate client's requirements to learning needs and learning objectives within a specific instructional context
- ❷ Understand how to generate effective instructional solutions based on learning and instructional design theories through an iterative problem-solving process
- ❸ Understand the process of converting the instructional solution into learning paths for detailing the instructional design
- ❹ Develop the awareness of instructional designer identity as a reflective and collaborative problem solver engaging in systematic and culture-sensitive design with the assistance of technology

Regarding the learning objectives, this document presents the following five topics:

- Instructional design system
- Instructional situation
- Instructional solutions
- Instructional solution in instructional design project
- Instructional designer competencies



Instructional design system



➤ Instructional Design System

Learning methodologies refer to various instructional practices and procedures that instructional designers and teachers use to enrich the learning journeys for learners. Different **learning methodologies (i.e., learning modes and instructional methods)** vary in how, when and where they engage learners in different types of learning. Based on **learning objectives**, instructional designers select and integrate appropriate learning methodologies to generate **instructional solutions**., also known as lesson/course/training plans, that can be developed into a functional instruction. Generating functional instructional solutions within a specific **instructional context** requires considerations of the following design alignments.

Learning Modes

Learning modes includes face-to-face learning, electronic learning (eLearning) and blended learning (bLearning)

Instructional Methods

Instructional methods, also known as pedagogical approach, refer to different methodologies to engage learners in different types of learning, such as problem-based learning, collaborative learning, etc.

Instructional Solutions

Instructional solutions refer to the structure of the instructions, including learning objectives, and learning modes, instructional methods and assessments that aligned with learning objectives.

Instructional Context

Instructional context refers to the context with multiple dimensions of constraints, including client's requirements, users characteristics, existing environment and available resources.

Instructional Components

Instructional components refer to essential components for designing functional instruction, including the learning objectives, instructional methods, learning modes, and assessments and feedback.

The alignment of instructional components in instructional solutions:

A practical and functional instructional solution is composed of the ideas of learning modes, instructional methods, and assessments. Instructional designers rely on **learning theories and instructional design theories** to (1) analyze the central learning content and task performance to set up **learning objectives**, (2) select and integrate suitable instructional **learning modes** and **instructional methods** to engage learners in learning activities, and (3) select and develop appropriate **assessment methods** to assess learners' performance. All these components (i.e.,

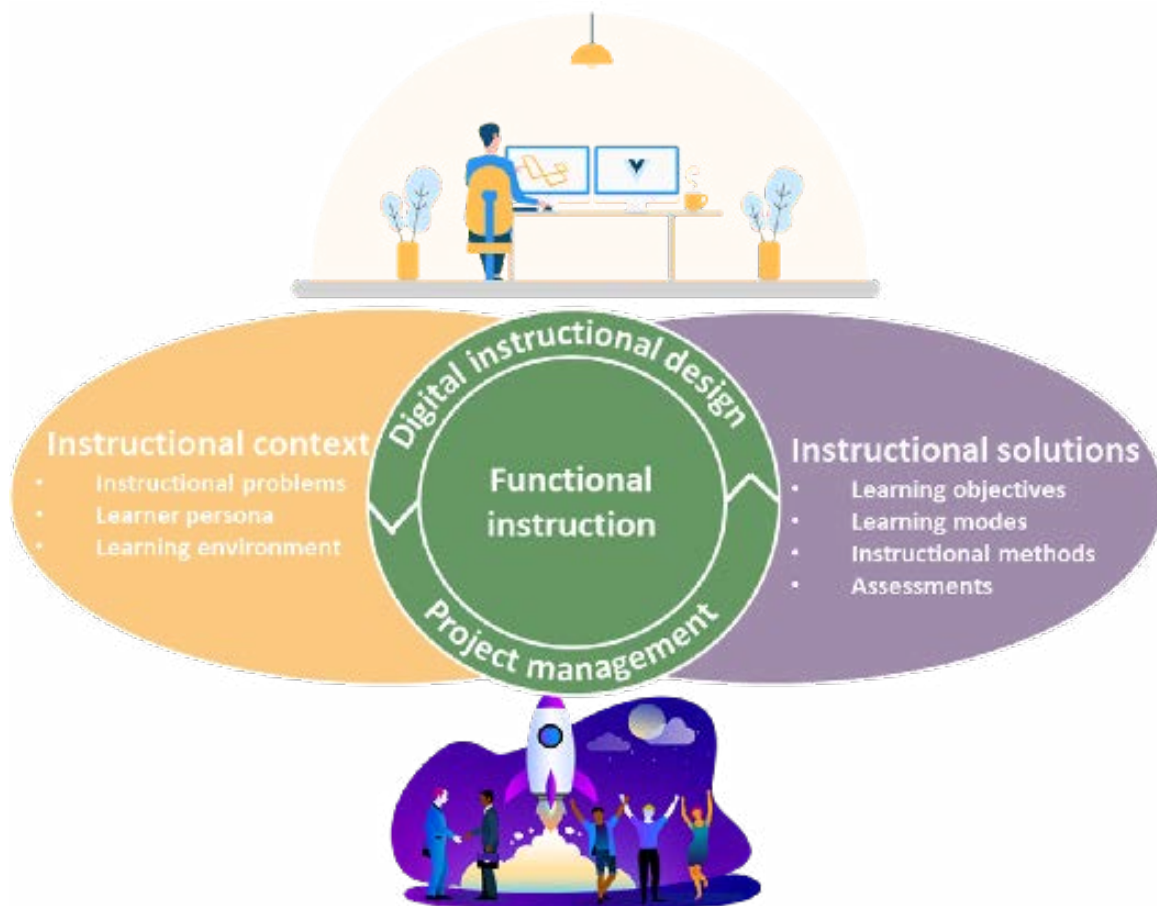
learning modes, instructional methods, and assessment methods) should align with learning objectives that together create a coherent and consistent instructional solution.

The alignment of instructional solutions and instructional contexts: A functional instructional solution must be localized and contextualized in an instructional context (i.e., **instructional problems and learning needs, learner personas, and learning environments.**). Instructional designers attempt to map out the existing instructional contexts, align instructional solutions with it, and based on it, develop a desired instructional context that could facilitate learning and development. Therefore, a feasible instructional solution should include (1) learning objectives that address the key issues of instructional problems and learning needs, (2) learning methodologies that could fit in the existing physical, cognitive, and psychological learning environment, and (3) assessments that meet the administrative requirements and assessing the target learning.

The two-layer alignments are the results of the rich interactions of “analysis” and “design” phases of the **instructional development process**. The analysis of instructional contexts in the “analyze” phases generates **analysis result reports** to inform the “design” phases in which instructional solutions are developed. Meanwhile, during the “design” phases, instructional designers might continue to analyze the instructional contexts if further information is needed. Therefore, the process of developing instructional solutions is an iterative process of design, communication, revisions, and confirmations.

The iterative design process of instructional solutions requires active and ongoing communication among multiple stakeholders (project sponsors, target/potential learners, peer instructional designers, subject matter experts etc.). **Project management (for more details see CU7)** plays an essential role in assisting in communicating with multiple stakeholders, making decisions with decision logs, coordinating different instructional design tasks, managing the scope and budgets of the instructional solutions, managing the time for developing the instruction solutions, and resolving possible conflicts and issues.

Instructional designers, nowadays, usually design instruction in a **digital design environment**. **Technologies are used to support instructional design practices, such as Teams, Zoom or Slack for communication, Microsoft office to record the instructional contexts and design the instructional solutions, or different authoring tools to visualize different concepts in instructional solutions.**



Instructional context sets up the design boundaries for instructional designers to consider how, when, where and why an **instructional solution** could work in the most cost-benefits manner. A **functional instruction** is developed based on the considerations of how the instructional solutions could fit with the pre-existing instructional context (see Figure 1 Instructional design system). Instructional designers use problem-, context-, and user-centered design approaches to develop such functional instruction.

Instructional designers develop the functional instructional solution into an **instructional design blueprint** with various **Design Considerations** (For more details see CU3), which enables instructional developers to develop instructional products based on it. CU2 focuses on the development of instructional solutions that could be further developed into instructional design blueprints.

The background of the slide is a warm, orange-toned photograph. It depicts a hand holding a pencil, poised to write on a spiral-bound notebook. The lighting is soft, creating a focused and studious atmosphere. On the right side of the image, there is a solid purple circle. The title text is overlaid on the image, with 'Instructional' on a purple rectangular background and 'situation' on a white rectangular background.

Instructional situation



➤ Instructional situation

When instructional designers receive an initiation request of an instructional design project, instructional designers firstly consider clients' requirement of the target instruction. The client's requirement usually states what kind of instructions are needed for what kind of learners (**Learner personas**) for what kind of purposes (**Instructional problems and learning needs**) in what kind of contexts (**Learning environments**).

The client's requirements usually indicate a rich instructional context that set up design boundaries for developing functional instructional solutions. However, not every client comes to instructional designers with clear goals and detailed requirements of target instruction. It is imperative for instructional designers to analyze the instructional context through communicating with clients and even conducting **needs assessments**.

Needs assessments

An ongoing systematic process of collecting data and insights about the needs of knowledge, skills, and ability that learners need to achieve.

Instructional problems and learning needs

Instructional problems and learning needs indicate why instruction is needed (Brown, 2002). Instructional problems indicate the needs to solve at-the-moment problems, such as learning collaborative working practices to improve a company's workflow. Learning needs could be **static needs** of learning specific knowledge, skills, and ability, such as the need to learn mathematics in primary school, or **proactive needs** of learning to face future changes, such as improving digital literacy for learners to face the drastic change of digital society.

Instructional problems and learning needs arise from different contexts. For example, the learning needs in K-12 education mainly come from the curriculum and support of students' development, while the learning needs in VET come from the job requirements of specific types of profession. In an organization, the learning needs more likely come from the current problems-at-hand and sometimes proactive professional development for the organization's aligning with organization's strategies in future. Instructional designers have the responsibility to ask for clarification and to analyze the **key issues that underlie the instructional problems** and the **key learning contents for addressing the learning needs**. In addition, instructional designers also collect **administrative requirements** of instruction to inform the development of instructional solutions (see Template 1 Instructional problems and learning needs).

Template 1 Instructional problems and learning needs

Instructional project's name	
Instructional problems/learning needs	
Key issues that cause the instructional problems/ Key performance and competence of learning needs	
Expected duration of the instruction	
Tentative instruction launch date	
Certification	
Technological requirements	
Available management supports	
others	

Learner personas

Learner personas are the characteristics of the target/potential learners (Fulgencio & Asino, 2021). Relying on user-centered approaches, instructional designers analyze learner persona and list out its implication on the requirement of instructional solutions that could provide personalized learning journeys for target learners.

Physical ability and mobility

Physical ability and mobility refer to learners' abilities to perform physical acts and participate in various learning activities. Students' physical ability could impact their physical access to learning, manipulation of equipment, access to technology, time and energy to participate in learning activities, reaction to the surrounding environments, etc. (Inclusive Teaching, n.d.).

Instructional designers should consider the possible **instructional materials** for different learners to receive instructional information and engage in learning activities, for example, by using VR simulation or videos as alternative options to field trips for students with mobility disabilities. Instructional designers should also consider **teaching strategies** that allow students to engage in learning at their own pace, for instance, by providing videos of

essential lectures. Instructional designers should provide assessments that allow all students to demonstrate their learning outcomes, for example, by including different types of assessment (e.g. oral, written, maker examination) and adapting the assessment based on learners' special needs with different types of technology.

Prior knowledge and skills

Prior knowledge and skills refer to a learner's multidimensional entity that is dynamic in nature and consists of different types of knowledge and skills. Instructional designers usually analyze at least the following types of prior knowledge and skills for instructional design.

- **Prior knowledge and skills related to the subject-matter content of the course** has a significant impact on a learner's knowledge acquisition and the capacity to apply higher-order cognitive problem-solving skills (Hailikari et al., 2008). Learners' prior knowledge and skills are diverse and dynamic. Instructional designers should be clear about what prior knowledge and skills are necessary for the target learning. It requires collaboration with subject-matter experts (SMEs) to conduct knowledge and task analysis and assess learners' prerequisite knowledge and skills for the target learning. The result of the analysis informs **the scope of learning content** (Hailikari et al., 2008), the **selection of learning methodologies** to facilitate learning (Kalyuga, 2021), and **the design of assessment** to provide feedback (Fyfe et al., 2012).
- **Learning experiences in different learning modes** has an impact on how learners will participate and regulate their learning in different learning modes (i.e., **face-to-face learning**, **eLearning**, and **blended learning**). Instructional designers should integrate "sufficient" instructional guidance (i.e., guidance for using learning materials and participating in learning activities) in the instruction regarding learners' past experiences (Fulgencio & Asino, 2021).
- **Technological knowledge and skills** inform the commonly used technology by learners and the support that learners need to use the educational technology that will be integrated into the instruction. Instructional designers could integrate the common-used digital tools in learning activities or design pre-training/support sections for learners to get familiar with the new digital tools.

Interest and motivation

Learner's interest refers to relatively enduring preferences for certain topics, subject areas, or activities (Schiefele, 1991). Motivation refers to learners' desire to learn a specific topic, which imitates, guides, and maintains goal-oriented learning behaviors (Schiefele, 1991). Learners' motivation and interest are related to learners' **self-regulated learning process** and how learners approach learning, which causes different learning experiences even with the same instruction (Efklides, 2011).

Learners' motivation and interest in the target learning vary in terms of their goals of participating in the course, whether the course is required or optional, their self-efficacy toward the target learning, the campus involvement of the instruction, etc. (Ainley, 2006). Instructional designers could identify the factors that affect learners' interest and motivation toward the target learning. Based on these factors, instructional designers could

utilize different strategies to activate and cultivate learners' interest and motivation, for example, by presenting **relevant learning content**, engaging learners in **generative learning activities**, assessing learning outcomes in diverse methods with positive feedback, and setting up an **inclusive learning environment**.

Learning style

Learning style refers to learners' preferred learning strategies (i.e., **surface learning strategies** and **deep learning strategies**) and preferred learning approaches (i.e., **microlearning**, **holistic learning**, **serialistic learning**, **concrete processing**, **modality preference**). In addition, learners also have preferences for **external regulation** and **self-regulation** (Tickle, 2001).

Surface Learning

Surface learning strategies refer to the strategies to learn through rehearsing and memorizing the learning materials.

Deep Learning Strategies

Deep learning strategies refer to the strategies to learn through constructing personal understanding of the materials, relating different ideas and arguments, and applying or transforming learned knowledge in novel contexts.

Microlearning

Microlearning refers to the strategies to decompose the learning content into small bites so that learners could easily process the small units of information.

Holistic Learning

Holistic learning refers to the approach learner utilized to focus on main ideas and attempt to construct an overall conception of the information before paying attention to details.

Serialistic Learning

Serialistic learning refers to the approach mainly focusing on linear tasks, procedural information and operational details in learning content.

Concrete Processing

Concrete processing refers to the approach mainly focusing on building connections of abstract knowledge with everyday life or concrete events.

Modality Preference

Modality preference refers to learners' preference for using different sensory channels to learn such as visual, auditory, and kinesthetic. However, learners usually rely on learning materials in different modality regarding to the types of learning content and learners' own physical ability.

External Regulation

Preference for external regulation means learners are more likely to rely on external instructional practices to assist them to achieve learning objectives

Self-regulation

Preference for self-regulation means that learners prefer to regulate their own learning by themselves and they also seek external regulation to proceed the self-regulated learning.

Understanding different learning styles allows instructional designers to conceptualize how different learners learn variously and design instruction that allows students to learn at their own pace. However, instructional designers should keep in mind that learners are very flexible in using these learning strategies and approaches when facing different learning and context. When facing different learning content, learners might utilize different learning strategies regarding their prior knowledge level, learning motivation and interest, etc. (Boekaerts, 1999). For example, learners with higher interest and motivation for the learning task are more likely to adopt the deep-learning approach. However, learners are always able to learn and adapt the needed learning strategies with sufficient support and scaffolding. Therefore, it is essential for instructional designers to consider what learning strategies are needed for achieving learning objectives.

Additionally, instructional designers should balance the tailored instructional styles and the necessity of exposing learners to diverse learning experiences that promote intellectual development and disposition formation. For instance, a myth is that learning materials should be designed to match learners' modality preferences (i.e., visual, auditory, and kinesthetic). In fact, learners are more likely to benefit from multimodal learning materials with thoughtful design regarding the theory of multimedia learning (Mayer, 2021). Learners should be presented with diverse and suitable learning materials regarding their physical abilities, personal preferences, cognitive information processing and the expected learning outcomes. Instructional designers focus on how instructional design practices assist learners in applying different learning strategies and learning approaches to achieve learning objectives.

Social-cultural background

Learners' social-cultural background indicates their culturally developed bodies of knowledge and skills essential for individual functioning, which encompass **shared social norms and values, religion and beliefs**, and **habits and behaviors presented in a social group** (Mavuru & Ramnarain, 2017). Additional information also includes learners' age, gender, primary language, employment status, socioeconomic status, geographic locations, and time zone

Shared Social Norms and Values

Social norms and values refer to the attitudes, behaviors, and values common to members of a particular group.

Religion and Beliefs

Religion and belief refer to the religious belief that learners hold as a community of believers.

Hhabits and Behaviors Presented in a Social Group

Habits and behaviors refer to learners' habitual behaviors for functioning in society.

The shared social norms and values could impact learners' engagement in learning tasks and performance. For example, Chinese learners would likely enact their home culture of respect when interacting with teachers and peers, which might restrain them from asking questions and engaging in critical discourse (Mavuru & Ramnarain, 2017). Social group habits and behaviors also might also impact learners' learning habits. For example, Generation Z and millennials commonly rely on social media, digital products and internet-enabled transactions for learning.

Information about learners' social-cultural backgrounds is essential to build up an inclusive learning environment where students feel safe to express their experiences and practices (Richards et al., 2007). Instructional designers could utilize **culturally responsive instructional methods** to form instructional solution (Gay, 2015).

Educational background

Learners' educational backgrounds refer to the formal education that learners have received. It indicates whether learners have **prerequisites** required for courses. It might also indicate specific **disciplinary thinking** learners have developed from the previous learning. Learners' disciplinary thinking might affect how learners perceive the target learning. For instance, a learner with a social science background might consider the important aspects of the target learning differently from learners with a natural science background. Instructional designers identify learners' educational backgrounds to increase the relevance of the target learning with learners. If learners have educational backgrounds from different disciplines, instructional designers could also utilize the multiple perspectives from learners to enrich the learning activities and cultivate learners' motivation and interest.

Template 2 Learner personas analysis

Learner personas analysis		
Learner persona	Learner details	Implication on instructional design (with example questions)
Physical ability		
Instructional problems/learning needs		What kind of learning materials are needed?
		What instructional practices could engage all learners in learning activities?
		What kind of learning materials are needed?
Prior knowledge and skill		
Prior knowledge and skills related to subject-matter knowledge		What prerequisite subject-matter learning content should be included?
		How does instruction connect the learning content with learners' prior knowledge and skills?
		What kind of learning support are needed?
Prior knowledge and skills related to subject-matter knowledge		What kind of learning modes should be used?
		What kind of guidance should be provided to support learning participation?
Prior knowledge and skills of using technology		What technology can be integrated?
		Is there a need for pre-training sections for using digital tools?
		How will the support section for using digital tools be provided in the instruction?
Interest and motivation		
Motivation and interest in the learning topics, learning activities, performance tasks, etc.		How is learning content relevant to learners' real-world experience?
		What activities can engage learners in active and constructive learning?
		What kind of assessment and feedback should be provided to support learning?
Learning style		
deep and surface learning strategies, and learning approaches		What learning strategies and approaches are beneficial to learn the target knowledge?
		What instructional practices can elicit desired learning strategies and approachapproaches?
Social-cultural background		
Social norms and values, religion and belief, habits and behaviors, geographic locations, time zones, etc.		What instructional practices can engage diverse learners in learning activities?
		What instructional practices can increase the inclusiveness and equality of the learning environment?
		What habits and behaviors could be integrated in instructional practices?

Educational background		
Prerequisites required for the course, disciplinary thinking modes, etc.		What practices can integrate the multiple perspectives from learners in learning?

The value of learner personas is that it assists instructional designers to work with a bigger picture that increases the ability of instruction to achieve the learners' mandate through the most appropriate learning design (Fulgencio & Asino, 2021). The six ng personas have different impacts on scoping learning content, selecting suitable learning methodologies for the target learning, setting up inclusive and culture-sensitive learning environments, and developing user-friendly instructional products. **Technology can be utilized to support the user/learner analysis, such as Webropol for questionnaires to assess learning needs and collecting information on learner persona, Team or Slack for project management and communication with multiple stakeholders.**

However, it is essential to keep in mind that the available information on learner personas could be limited in real-life practices. Even in the situation with no learner information, instructional designers should still make decisions based on the "audience perspectives" so that the course will not unintentionally exclude some learners. An example will be the design of MOOCs, if all the course are designed based on the same templates interfaces and same type of materials, it potentially excluded learners who need special equipment or learners with less self-regulated learning abilities (Reich, 2020).

Caution! Instructional designers should carefully consider ethical issues and data security needs when collecting information on learners' personas.

Instructional designers have the duty to create a safe instructional design environment, including physical and virtual space and digital space. Instructional designers should follow the data protection regulation law to protect the data generated from communication with multiple stakeholders and the surveys and assessments. All the data should be stored and used by following the local data protection regulation and instructional design purposes.

Learning environments

A learning environment refers to a learning setting consisting of the physical, cognitive and affective environment. A learning environment is formed when students and teachers utilize the course developed based on instructional solutions. However, there are pre-existing resources, settings and contexts that will be integrated into desired learning environments. Collecting the information on pre-existing learning environments allows the development of learning environments that could be localized in the most cost-benefits manner (Marc et al., 2018). Instructional designers utilize the following information:

- **Physical settings** refer to the pre-existing physical environment, including available educational technology (e.g., learning management system), furniture and equipment used for instruction. The pre-existing physical setting set up the design and delivery constraints of the final instructional products. Instructional designers typically re-utilize and improve the existing physical settings for instructional purposes.
- **Learning context** refers to the psychological environment covering the cognitive environment and psychological environment. Cognitive environments mean the place where knowledge and skills are to be learned. In the design phases, instructional designers mainly analyze the cognitive environment in relation to the performance context in which new skills and knowledge will be used by learners after the instruction is completed. The psychological environment arises from learners' interests, and motivation toward the course. Based on the pre-existing learning context, instructional designers use different instructional strategies to develop the desired learning contexts.

Template 3 Learner environment analysis

Learning environment analysis		
Categories	Characteristics	Implication(s) on instructional design
Physical settings		
Learning context		
Cognitive environment (physical and social aspect of performing contexts)		
Affective environment (motivation, interest and emotions)		



Instructional solutions



Instructional solutions

Based on the analysis of instructional context and its implication on instructional design, instructional designers set up learning objectives, select and combine learning methodologies (i.e., learning modes and instructional methods), and design **assessment tools** to form a functional instructional solution

Learning objectives (Intended learning outcomes)

Instructional designers translate instructional problems and learning needs into learning objectives to guide the development of instructional solution. Learning objectives are the statements of the **intended learning outcomes (ILOs)**, including what should be known, understood, and demonstrated to what levels after completing a course/training/programme (Biggs & Tang, 2011b).

Before setting up learning objectives, instructional designers need to work on documents review and communicate with SMEs to collect and organize the subject-matter learning content and topics. It includes the analysis of necessary **subject topic knowledge, skills and competence, performance tasks, applicable contexts**, and **solutions to the problems** (Marc et al., 2018). Instructional designers cross-reference the documented practices and information provided by SMEs to decide what should be included in the instruction. The included topics should be sufficient enough to address instructional problems and learning needs but also feasible to be learned within the pre-set duration of instruction.

Subject Topic Knowledge

Subject topic knowledge refers to domain-specific facts, concepts, and theories.

Skills and Competence

Skills and competencies refer to domain-specific skills and domain-transcending skills in cognition, communication, social-emotion, and psychomotor.

Performance Tasks

Performance tasks refer to the tasks and procedure that learners should perform by using subject-topic knowledge and skill.

Applicable Contexts

Applicable context refers to the contexts where the knowledge and skill could be applied, including the location, available resources, the culture of the workplace, etc.

Solutions to the Problems

Solutions to the problems refers to a pool of real-life problems within contexts and the solutions to the problems.

Instructional designers could utilize **Elaboration theory (For detailed information see CU1)** to organize the learning topics and develop learning paths, also known as course roadmap, to visualize the instruction. The learning topics can be organized based on prerequisites, order of importance, the familiarity learners have with topics, cause-and-effect relationships, etc. **Technological tools, such as concept map software and Microsoft office, could assist in visualizing the subject-matter learning content structure.** For the overall learning and different topics, Instructional designers could use the following frameworks to write down the intended learning outcomes (ILOs). These frameworks are developed based on the analysis of the nature of knowledge and learning processes.

Bloom's taxonomy of educational objectives

Bloom's taxonomy of educational objectives is a framework that takes cognitive perspectives to categorize the learning content into four knowledge types including : (1) **factual knowledge**, (2) **conceptual knowledge**, (3) **procedural knowledge**, and (4) **meta-cognitive knowledge** (Krathwohl, 2002). It also structures six hierarchical levels of cognitive learning behaviors in terms of the complexity of cognitive skills involves in the behaviors. Cognitive learning behaviors are structured in six hierarchical levels represented by different verbs: (1) **Remember** (recognizing and recalling) , (2) **Understand** (interpreting, exemplifying, classifying, summarizing, inferring, comparing and explaining), (3) **Apply** (executing and implementing) (4) **Analyze** (differentiating, organizing, and attributing), (5) **Evaluate** (checking and critiquing), and (6) **Create** (planning, generating and producing) (Krathwohl, 2002).

Instructional designers could write down the intended learning outcomes into the learning objective rubric (see table 4) in the form of “cognitive behavior verbs + learning content”, which give an overview of the learning objectives for the instruction.

Template 4 Setting learning objectives with Bloom's taxonomy of educational objectives

Learning objectives for the course/training/programme						
Cognitive process dimensions						
Knowledge dimension	1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual knowledge	ILO1:...					ILO3:...
B. Conceptual knowledge		ILO2:...			ILO4:...	ILO3:...
C. Procedural knowledge						
D. Metacognitive knowledge						

Remember

Remember refers to the process of retrieving relevant knowledge from long-term memory, such as recognizing and recalling knowledge

Understand

Understand refers to the process of determining the meaning of given information with oral, written and graphic communication, such as interpreting, exemplifying, classifying, summarizing, inferring, comparing and explaining the given information.

Apply

Apply refers to the process of carrying out or use a procedure in a given situation, such as executing and implementing a procedure.

Analyse

Analyse refers to the process of breaking information into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose, such as differentiating, organizing, and attributing the given materials.

Evaluate

Evaluate refers to the process of making judgement based on criteria and standards, such as checking and critiquing given information and cases.

Create

Create refers to the process of putting elements together to form a novel coherent whole or make an original product, such as planning, generating and producing new products.

Factual Knowledge

knowledge of basic elements that students must know to be acquainted with a discipline or solve problems in it (e.g., terminology or specific details and elements of a fact).

Conceptual Knowledge

knowledge of interrelationships among concepts and facts within a larger structure that enable them to function together (e.g., classifications and categories, principles and generalization, and theories, models, and structures)

Procedural Knowledge

knowledge about how to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods (e.g., subject-specific skills, algorithms, techniques, methods and criteria for when to use appropriate procedures).

Metacognitive Knowledge

knowledge of cognition in general as well as awareness and knowledge of one's own cognition (e.g., strategic knowledge, self-knowledge, contextual and conditional knowledge)procedures).

Bloom's taxonomy provides a ready-made structure and lists of verbs to assist in writing learning objectives in terms of external cognitive behaviors. The combination of different levels of cognitive verbs and different types of knowledge provides a valuable adjunct for suggesting a range of learning activities and assessments (Biggs, 2011; Murtonen et al., 2017). Such clear structure is beneficial for instructional designers to choose prescriptive instructional methods. For an example of using Bloom's taxonomy of education objectives see the link:

<https://www.youtube.com/watch?v=ayefSTAnCR8>

Bloom's taxonomy is developed from the time assuming if instruction asks for a specific level of cognitive behaviors, learners will perform the tasks and result in the same level of learning outcomes. But when performing higher-order thinking tasks, learners might still have misconceptions and insufficient understanding of the target knowledge, which result in different levels of learning outcomes (Biggs, 2011). If an instructional designer over relies on the verbs indicated in the learning outcomes to assume learners will reach the same level of achievement, the designed instruction returns to behaviorist practices assuming that creation of instructional activities regarding specific external cognitive behaviors could guarantee the desired learning outcomes. (Murtonen et al., 2017).

The Structure of Learning Outcome (SOLO)

The structure of learning outcome (SOLO) taxonomy focuses on the student's actual learning, i.e., the result of participating in different learning activities. SOLO categorizes learning content into two main types of knowledge: (1) **declarative knowledge** such as knowing the facts, concepts, and theories, and (2) **functional knowledge**, such as using theories to inform decision-making in professional contexts, for example, designing buildings, planning teaching, or performing surgery.

Regarding learners' actual learning outcomes, SOLO structures learners' level of understanding based on learner's performance that grows in complexity when mastering academic tasks (Biggs & Tang, 2011a; Vera et al., 2019). Each level of understanding is described as cognitive behavior verbs that could provide guideline for instructional designers to design learning activities and assessment tools.

Declarative Knowledge

Declarative knowledge, also known as propositional knowledge or content knowledge, refers to the knowledge about things expressed in symbol systems that is verifiable, replicable, and logically consistent

Functional Knowledge

Functional knowledge refers to the knowledge that informs action, where the performance is underpinned by understanding.



Pre-structural

Learners haven't understood the points.



Uni-structural

Learners know one aspect of the knowledge.

Verbs: define, identify, do simple procedure



Multi-structural

Learners know several aspects of the knowledge task but treat them separately.

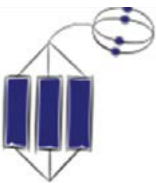
Verbs: Define, describe, compute, list, combine, do algorithms.



Relational

Learners relate several aspects of knowledge and integrate them into a coherent whole.

Verbs: Compare/contrast, explain causes, sequence, classify, analyze-part/whole, relate, analogy, apply



Extended abstract

Learners are reflective on learning, reconceptualizing the knowledge entity at a higher level of abstraction and generalizing it to a new topic.

Verbs: Evaluate, theorize, generalize, predict, create, imagine, hypothesize, reflect, solve problems.

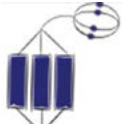
Instructional designers write Intended learning outcomes with SOLO with statement in the form of “verb + content + context” (Biggs, 2011):

- The verb at the appropriate level of understanding or performance intended
- The topic content the verb is meant to address (i.e., the object of the verb).
- The context of the content discipline in which the verb is to be deployed

The written ILOs could be organized in a rubric to get an overview of the course (see Template 5 Setting intended learning outcomes with SOLO). For an example of using SOLO for teaching see

<https://www.youtube.com/watch?v=nBxOfC7O-mA>

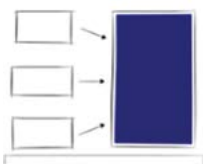
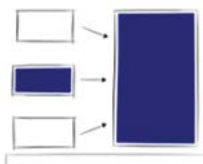
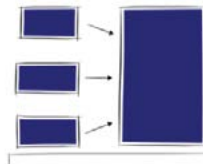
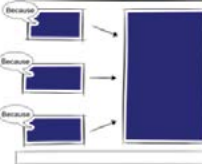
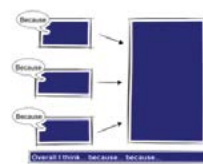
Template 5 Setting intended learning outcomes with SOLO taxonomy

Learning objectives for the course/training/programme					
SOLO intended learning outcomes (verb) (content) (context)	 Pre-Structural	 Uni-Structural	 Multi-Structural	 Relational	 Extended Abstract
ILO1			X		
ILO2				X	
...					
Implication on instruction					

Template from [HookED downloadable resources](#)

Different from Bloom's taxonomy, SOLO assumes that one level of cognitive behaviors does not necessarily result in the same level of learning outcomes. For example, when students engage in a learning activity, explaining the causes of an event. The learning activity elicits cognitive behaviors at the relational level in ILOs. However, learners could have different levels of understanding when explaining the causes (see Table 1 Explain causes rubric). Therefore, instructional designers can also utilize SOLO to set up the criteria for assessing the results and differentiate the learning outcomes of any learning activities, including self-assessment and teacher assessment.

Table 1 Explain causes rubric

Pre-structural	Uni-structural	Multi-structural	Relational	Extended abstract
Learners identify the event but need help to identify the cause for the events.	Learners identify the event and one relevant cause for the events.	Learners identify the event and several relevant causes for the events.	Learners explain how the causes relate to the event.	Learners reflect on the overall event and think in new ways.
				

Although SOLO and Bloom's taxonomy looks like they have a hierarchical process of learning, different learning outcomes could appear simultaneously during the learning process. For example, in SOLO taxonomy, learning functioning knowledge requires a solid foundation of declarative knowledge. However, the order of acquisition can be interwoven during the learning process. Instructional designers should be cautious of interpreting the taxonomy or the hierarchical structure of learning objectives as the linear learning process.

SMART principles

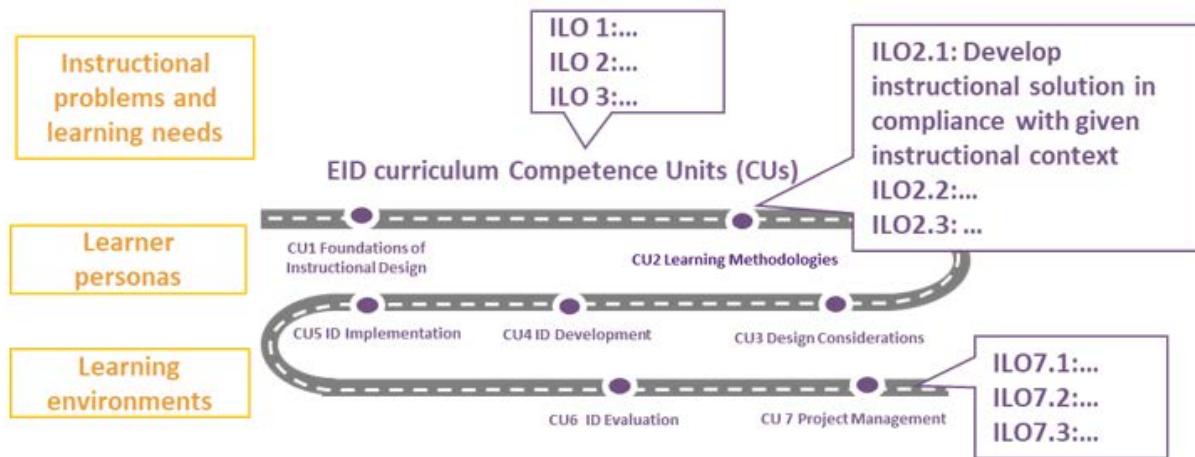
The analysis of learning content and learning process is the process of translating the instructional problems and learning needs into learning objectives, based on learning theories and instructional design theories. Instructional designers work closely with SMEs to develop the roadmap of the instruction and to set up learning objectives (see Figure 2 An example of course roadmap and learning objectives for instructional solutions).

- **Specific** principle indicates that ILOs should include the expected learning content, the level of understanding, and the involved performance contexts.
- **Measurable** principle indicates that ILOs should quantify the change in learner behaviors or the quality of the products produced by the learners.
- **Achievable** principle indicates that ILOs should be achievable for the target/potential learners within a specific period in a given context. Relevant principle indicates that ILOs should be related to learners' learning needs and aligned with the instructional methods and assessment.
- **Time-bound** principle indicates that ILOs should be set within a time constraint which appears as the duration of the instruction.

Course roadmap and learning objectives

The analysis of learning content and learning process is the process of translating the instructional problems and learning needs into learning objectives, based on learning theories and instructional design theories. Instructional designers work closely with SMEs to develop the roadmap of the instruction and to set up learning objectives (see Figure 2 An example of course roadmap and learning objectives for instructional solutions).

Figure 2 An example of course roadmap and learning objectives for instructional solutions



Instructional designers continue to develop the instructional solution by selecting suitable learning modes, integrating the instructional methods that could engage learners in intended learning activities, and deciding the assessment methods that could measure the performance against the criteria indicated in ILOs. All instructional design decisions are made based on scientific learning and instruction principles while acknowledge the instructional context.

Learning modes

Regarding the course roadmap and **learning objectives**, instructional designers consider the **pre-existing instructional context** to select suitable learning modes. Learning modes refer to methods of creating physical or virtual learning environments for learners to access the learning materials, engage in learning activities, and demonstrate learning outcomes. Learning modes include face-to-face learning, electronic learning (eLearning) and blended learning (bLearning).), providing different kinds of **synchronous and asynchronous learning activities**.

Face-to-face learning

Face-to-Face learning refers to traditional in-person learning where learners participate in learning activities at the same time and location, including different on-site lectures, group works, discussion forums, etc. Face-to-face learning is commonly used when these elements are needed:

- **Accessible learning artifacts**, especially the artifacts that are not available for learners for example, VR equipment and workplace machines.
- **Synchronous hands-on learning activities** that involve higher-order thinking allow learners to be immersed in generative and collaborative learning, especially in complex and ill-structured domains. Learners benefit from real-time interactions to get just-in-time support, guidance, and feedback from peers and more knowledgeable others.

- **Synchronous dialogues and discussions** allow learners to share diverse perspectives, generate instant reactions, and engage in discussion and meaning making in connection to the target knowledge.
- **Social connections within a learning community** are developed when learners participate in in-person activities. This process involves rich informal conversation that facilitates the social transmission of information and develops learners' sense of belonging in the learning community.

Face-to-face learning is essential for learning that involves hands-on practices, complex project works, and complex skill practices. However, setting up face-to-face learning has time and location constraints. In addition, the synchronous learning activities have less space for learners to process learning at their own pace if they miss out or don't understand given information.

eLearning

eLearning refers to a wide set of learning in which learners utilize different electronic devices, such as tablets, laptops, and mobile phones, to access and consume the learning materials, nowadays usually via Internet, intranet/extranet (LAN/WAN), and wireless networks (Derouin et al., 2005).

One typical eLearning is web-based learning, such as Massive Online Open Courses (MOOCs), and Open Courses from different universities like **MIT Open Courseware**. Mobile learning (mLearning) is another form of eLearning that learners access learning via their mobile phones (Motiwalla, 2007). mLearning reaches an extensive population of learners due to its small-bite-unit information and ability to allow learning anywhere and anytime.

eLearning materials include various forms, using and combining audio, lecture video, digital text, etc. eLearning activities are also in diverse formats, such as online discussion forums, digital games, online collaborative project work, simulation-based experiments, and so on. eLearning is commonly used since the eLearning materials and eLearning activities have the following characteristics:

- **Access to and reviewing learning content without time and location limits** allows learners to learn at their own pace. Learners could rewind the audio and lecture video to understand the knowledge, repeat specific knowledge for memory, drill specific skills, and retake the quiz and assessment when it is necessary. Learners could adjust their learning schedule more flexibly based on their needs.
- **Well-managed learning materials with learning management systems** organize the learning modules and lessons in a standard way. It is easy to upload to different information systems for learners to access the learning materials. It also allows the organization of learning paths in a flexible way in which learners can choose which modules they would like to take based on their own learning needs.
- **Online social interaction and learning communities** via the Internet allow learners to have discussions via text or online forums with a wide range of peers worldwide and to build up social connections with others who have the same interest.

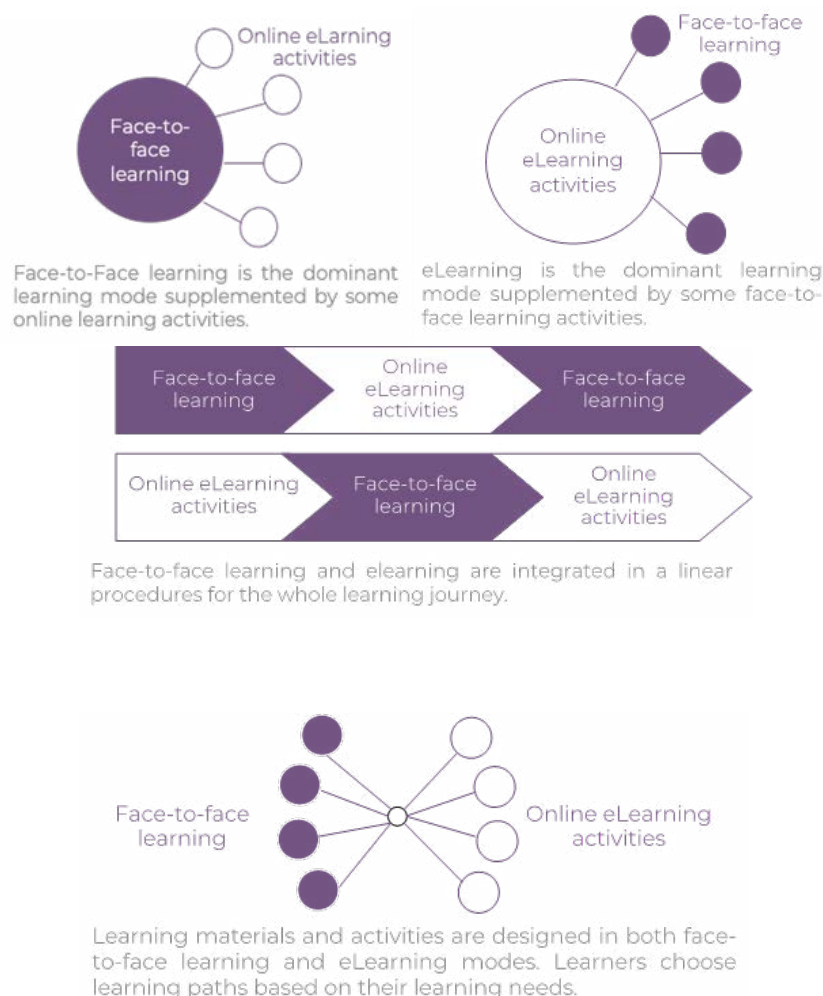
- **Online face-to-face learning** allows learners to participate in virtual classrooms and video conferences for a set time. Different software and platforms, such as Google classroom, Team, Zoom, etc., allow learners to have real-time social interaction and conduct collaborative work with digital tools.

eLearning allows instructional designers to consider how to engage learners in different learning activities. The flexible learning environment enables learners to learn at their own pace. However, eLearning requires learners to have relatively high digital literacy, digital skills, and self-regulated learning skills and strategies. The provision of eLearning might explicitly exclude some learners from learning. In addition, although face-to-face interaction can be provided in a virtual classroom, there are elements such as non-verbal language and emotional connection, missing in online face-to-face interaction. Research evidence also shows that learners interact with learning materials differently in online learning setting (Gellisch et al., 2022)

bLearning

bLearning is about the well-planned integration of face-to-face learning and eLearning in a manner that utilizes the advantages of face-to-face learning and eLearning for learners to achieve learning objectives (Oliver & Trigwell, 2005). bLearning have different models:

Figure 3 Different models of blended learning



The use of bLearning is for the following purposes (Hannon & Macken, 2014):

- (1) the learning content is presented in an appropriate and convenient way for learners to consume
- (2) learning activities are designed to engage learners in different learning experiences for knowledge construction and disposition formations
- (3) technology is suitably integrated to facilitate learning and satisfy learners' needs.

With the integration of instructional technology in education, bLearning is getting more and more common in contemporary instructional settings. The distinction between bLearning, face-to-face learning, and eLearning is getting blurred. No matter which learning modes are selected, combined and adapted, instructional designers should thoroughly consider how the learning mode can match with (1) **the physical, cognitive, and psychological learning environment**, (2) **learner personas and requirements**, and (3) **learning objectives and instructional methods**.

Caution! Nowadays, technology is typically used as instructional tools in all learning modes. Instructional designers should also raise the awareness of data security needs of protecting learners' learning data and create awareness of cyber-malice and ensure security interventions against unethical learning practices, academic dishonesty, identity theft and bullying.

The effectiveness of the learning mode comes not only from the design of learning content but also from the instructional methods. Instructional designers develop functional instruction that could fit with the chosen learning modes but also adapt different learning modes based on learning objectives and instructional methods.

Physical

If all learners have equal access to technology, equipment, and place

Cognitive

Whether the learning required a specific cognitive learning environment, such as handcraft needs diverse of tools and machines for skills development

Psychological

Whether the social networking and social interaction are necessary for learning performance

Learner Personas and Requirements

prior knowledge and skills of different learning modes, available time, energy, and resources to participate in learning

Instructional methods

Instructional methods, also known as pedagogical approaches, refer to diverse ways to design the presentation of learning content and learning activities for learners to achieve the learning objectives. Instructional methods have different focuses on different types of learning, resulting in different emphasis on learning content presentation, skill practices, engagement, authentic contexts, experiential exploration, problem-solving, and collaboration. Different instructional methods can elicit diverse learning activities that determine if learners will perform the intended cognitive behaviors which might also affect how learners engage in the learning activities. ICAP framework identifies 4 modes of engagement when learners participate in different learning activities (Chi & Wylie, 2014):

- **Passive mode of engagement:** Learners are focusing on receiving information from the learning materials such as listening to a lecture and watching a video.
- **Active mode of engagement:** Learners engage in overt motoric action or physical manipulation, for example, taking notes, highlighting important points, and manipulating the video by pausing and rewinding.
- **Constructive mode of engagement:** Learners engage in generative behaviors that produce new ideas that go beyond the information given, such as self-explaining, drawing analogies, asking questions, reflecting and monitoring their own understanding, etc.
- **Interactive mode of engagement:** Learners engage in interpersonal activities where two or more parties are doing generative behaviors and mutually exchanging ideas with dialogue and discussion, such as criticizing each other by requesting justification, explaining to each other, defending and arguing a position, etc.

Instructional designers utilize different instructional methods to design learning activities for students to have constructive and interactive modes of cognitive engagement. Instructional designers should identify the difference between participating in learning activities and cognitive engagement in learning activities. Even though learners might have a passive mode of participation, they could also process the materials deeply and constructively. Regarding the available resources (e.g., technologies, human resources, time, and so on) and the selected learning modes, instructional designers adapt the instructional methods to create instruction and learning environment with an appropriate combination of challenge and guidance, empowerment and support, self-directed learning and structured instruction for learner.

Lecture and demonstration

A lecture is where the subject matter expert tells the learners about the major topics that make up the discipline or professional area, and what the latest thinking is on a topic or discipline. A lecture presents the knowledge structure and system, elaborates the topic-specific content, removes learners' misconceptions, demonstrates the specific examples of knowledge application, and compares different interpretations (Biggs, n.d.).

Whether a lecture is informative depends on the involved learning topics and the presentation of topics. Regarding the presentation of topics, if there are multiple topics involved in the lecture, instructional designers could utilize the **elaboration theory** to organize the learning content and consider the optimal sequence and order to present the topics. **Nowadays, instructional designers utilize digital presentation tools (e.g. Powerpoint, Prezi, or Google Slides) to develop lecture slides to visualize the learning content with multimedia.**

Although the lecture is commonly connected with passive learning engagement, with the assistance of instructional technology, many learning activities for active engagement could be included in the lectures. **For example, interactive tools, e.g., Flinga and Mural, can be integrated into the lecture to engage learners in short-time discussions and share their perspectives regarding the lecture topics. Gagne's nine events of instruction** can be used as a framework to design lectures with some interactive learning activities. A well- designed lecture will elicit the learning activities such as listening, identifying, categorizing, naming, summarizing, inferring, explaining, exemplifying, etc. Whether learners could have active learning engagement is up to learners.

Microlearning & Drill and practice

Microlearning and Drill and practice are two commonly used instructional methods that break the to-be-learned knowledge or skills into small-bite units for learners to understand specific concepts, examples, and practice problems. Microlearning consists of the small learning units (5-10 minutes) that learners can access **"just-in-time" learning** at any condition when it is needed (Dolasinski & Reynolds, 2020), for example, learning 10 new words when waiting for boarding at the airport or check out a quick cooking recipe for lunch in YouTube. Drill and practice emphasizes the **systematic repetition, rehearsal, and practice** of the small learning unit to assist learners to become proficient with **"just-in-time feedback"** (Lim et al., 2012), for instance, recognizing or recalling the 10 vocabularies learned at the airport the next day. It provides activities for active learning engagement. For a detailed design description see **the 10 drill design principles.**

Microlearning and drill and practice are integrated for teaching in different instructional settings. The design is based on the **cognitive load theory** and **forgetting curve**, utilizing small learning units, **spaced repetition**, and **a variety of formats and contexts for the same concepts** or element to facilitate learners' remembering, understanding, and applying the target knowledge and skills (Redondo et al., 2021). Microlearning and drill and practice, nowadays, are more commonly situated in mobile learning with different apps, for example, **Duolingo** for language learning. Digital tool, such as learning apps

and learning management system, can track and visualize learners' progress, which allows learners to master the learning materials at their own pace (Lim, Tang & Kor, 2012).

However, completing all micro-lessons or being proficient in specific skills does not automatically lead to mastery of complex concepts and skills. When complex and ill-structured learning is involved, microlearning and drill and practice are commonly used as a supplemented tool to macrolearning to provide practices, feedback, reinforcement, and support (Redondo et al., 2021). For example, **4C/ID ten steps to complex learning** utilize drill and practice as part-task practices to automate the rules that reduce the cognitive load of complex project work. It also utilizes microlearning for just-in-time information to demonstrate how to conduct a specific task. **Software or app, such as Quizlet, YouTube, TED, and Kahn Academy, can be used for microlearning design.**

Game-based learning

Game-based learning refers to instructional methods that utilize **gamified exercises and simulations** for teaching specific knowledge and skills (Pan et al., 2022). Learning games can afford rich opportunities for drills and practices, communication, problem-solving, hypothesis generation, identity development, collaboration, and reflective thinking (Ge & Ifenthaler, 2018). Therefore, game-based learning can be integrated with any other instructional methods listed in this document to improve students' **cognitive learning outcomes**, increase **learning engagement and motivation**, bring up **positive emotions** toward learning, and enhance **social interaction** in learning.

Instructional designers balance the fun, challenges, and engagement of game playing experience and apply it to develop learning experiences. The ABC-model of game design indicates that learning games should involve the following component (Ge & Ifenthaler, 2018):

- **affective components** including satisfaction, relatedness, choice, and curiosity
- **behavior components** including specific cognitive behaviors with real-time feedback
- **cognitive components** including the declarative, procedural, strategic, and metacognitive knowledge required for playing the game

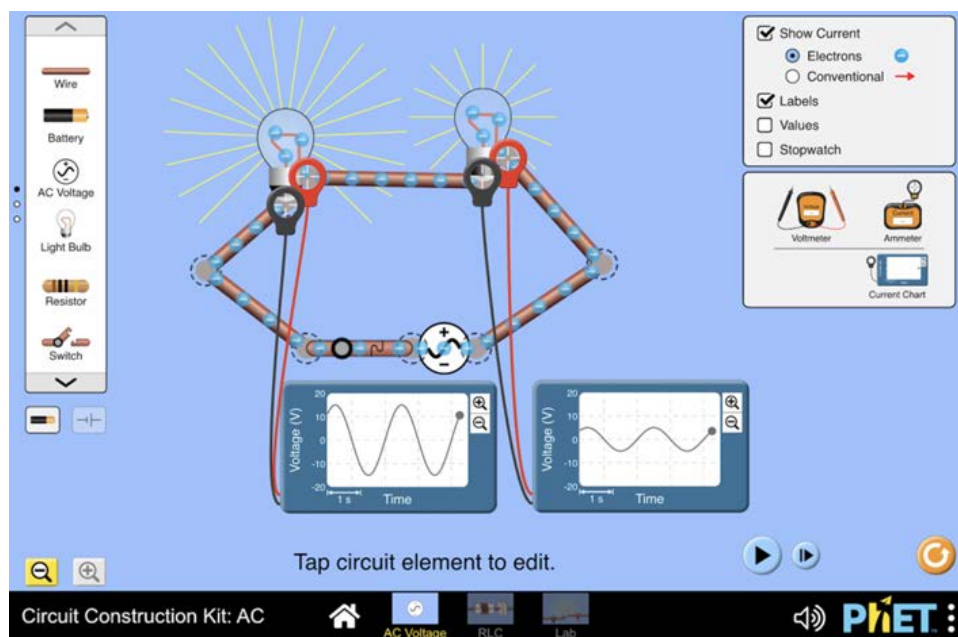
These three components interact with each other to shape learners' game-playing and learning experiences. In order to create learning games that involve learners in constructive and interactive learning engagement, instructional designers should be aware that cognitive components are the key components to designing game mechanics. Affective components have the role of supporting learners' behavior and cognitive engagement, which is an auxiliary naturally resulting from the game design. In other words, designing a gamified learning experience is a process to align the cognitive components and behavior components with the statement of intended learning outcomes (ILOs), to develop relevant learning content and appropriate level of challenges for learners based on learner personas.

Learning games can be relatively big, such as massive multiple player online games (MMOG) or relatively small, such as group competition with **Kahoot!**. Instructional designers should consider the available technology, human resources, and budget to decide how learning will be immersed in the game context. For detailed design principles of game-based learning see **Beyond Fun: Pintrich, Motivation to learn, and Game for learning.**

Simulation-based learning and inquiry-based learning

Simulation-based learning emphasizes the impact of **authentic real-world contexts and experiences** for learners to immerse in contexts where the knowledge and skills are applied (see Figure 4 An example of simulation-based learning: Circuit Construction Kit) (Wieman et al., 2008). Simulation offers the context to replace and amplify real-life experience or augment the invisible knowledge component in real world, (e.g., the electron in the picture). With well-designed simulation, the irrelevant elements in the real-world case can be weakened and the relevant information of target knowledge can be amplified, which could facilitate learners' conceptual understanding. Students in simulations based learning can take over certain roles and act in a hands-on way in simulated context (Chernikova et al., 2020). For examples of simulations-based learning design and experience of interaction with learning representations see **Phet.**

Figure 4 An example of simulation-based learning: Circuit Construction Kit



Simulation-based learning allows learners to practice and interact with learning materials to mimic real-life problem-solving with systematic guidance. Scaffolding plays an important role in supporting learners to attain the target learning. Learners with **different levels of prior knowledge and skills** would benefit from different types of scaffolding. For example, for learners with a relatively low level of knowledge and skills, instruction can provide a higher degree of support and simplification compared to real-life cases or practice situations. In contrast, for more advanced professionals and complex learning, it is more suitable to provide a simulation that represents the realistic approximations of novel and rare practice situations (Bauer et al., 2022).

Instructional designers should carefully consider the design of learning representation in simulation to represent the target knowledge, the instructive information for learners to engage in **inquiry and exploration**, and the relevancy of learning contexts with learners' daily experiences.

Simulation-based learning is a useful tool for students to engage in inquiry-based learning. **Inquiry-based learning** guides learners to follow methods and practices similar to those of professional scientists to discover knowledge that is new to the learner. It involved the following activities: (1) **identifying, clarifying, and** problem-at-hand or phenomenon. (2) **Interpreting and explaining** concepts belonging to the stated problem (3) **executing** investigation to answer the stated research questions or hypotheses, (4) **Analyzing, organizing and inferring** data, and **generating** the basic conclusions of the investigation, and (5) **discussing, communicating and presenting** their findings and conclusions to others, as well as **reflecting** on anything in the mind during learning process (Pedaste et al., 2015).

With effective simulation, students could investigate real-life experiences and conduct simulated experiments to collect data for knowledge discovery in a safe place. It provides learning activities that engage learners in active and constructive learning.

Problem-based learning (PBL)

Problem-based learning (PBL) is an instructional method to engage learners in project work for experiencing and explaining phenomena or solving authentic, real-world problems as they take part in various practices (Krajcik & Shin, 2022). In this process, learners achieve their goals through active meaning construction based on experiences, social interaction, the sharing of knowledge and understanding, and utilization of cognitive tools (e.g., computer software) (Krajcik & Shin, 2022).

Driving Questions

Driving questions refer to questions that students find meaningful and that creates wonder to sustain engagement and drive learning

Learning Goals

Learning goals refer to the learning objectives that requires students to demonstrate mastery of key ideas and practices

Practices for Participating

Practices for participation refer to the activities student engage in the problem-solving processes that are central to expert performance in the discipline.

Collaboration

Collaboration refers to the collaborative learning activities that lead process of deep learning, building shared knowledge, and finding solutions.

Learning Technology

Learning technology refer to the cognitive tools for learners to participate in activities normally beyond their ability.

Tangible Learning Products

Tangible learning products refer to the shared artifacts and external representations of group learning.

PBL is suitable for long-term learning, especially for complex and ill-structured learning and expert performance. PBL environments have six key features: (1) **driving questions**, (2) **learning goals**, (3) **practices for participating**, (4) **collaboration**, (5) **learning technology**, (6) **tangible learning products** (Krajcik & Shin, 2022). Inquiry-based learning and problem-based learning are two commonly used instructional methods for students to engaged in active knowledge construction

PBL focuses on authentic problems in realistic environments that engage in planning and conducting real-world research and design for solving the problems with available resources and within a period. Learning activities involve: (1) **asking** for clarification for the questions, (2) **collecting and analyzing** ideas, (3) **researching and analyzing** available resources, and (4) **drawing** inferences and **producing** learning products. In this process, learners collaborate with their peers, teachers and other experts

PBL takes constructivist and sociocultural assumptions about learning. It is suitable for designing higher-order thinking and problem-solving skills. It also engages learners in a self-initiative learning community where they form a social network and problem-solving practices that could sustain even after the completion of instruction. Learners take the responsibility for their self-regulated learning with appropriate modeling and scaffolding. It is an approach to create learning activities that engage learners in constructive and interactive learning. **Instructional technology can be used as presentation tools for the authentic problem with multimedia materials or simulation, collaboration and communication tools for learners to share ideas and discussing solutions, and authoring tools to generate instructional products.** **4C/ID ten step to complex learning** is one of the instructional design theories that integrate the drill and practice and PBL for complex skill learning. **Cognitive apprenticeship** also utilizes PBL to construct learning environments.

Collaborative learning

Collaborative learning is an instructional method to engage learners in collaborative activities to work for the same learning goals. It takes the social-constructivism and sociocultural learning perspectives, emphasizing the social activities in the learning process to extend students' learning outcomes and facilitate continuous learning after the completion of the instruction (Marc et al., 2018).

Collaborative learning is not an independent instructional method. Instead, it is commonly used to create a learning environment with interactive learning that supports higher-order thinking and complex problem-solving. Students usually engage in **discussing** problems and solutions, **describing** perspectives, **explaining** the phenomenon, **evaluating** the alternatives to problem-solving, creating shared external representations of target knowledge, and so on. It is commonly integrated with other instructional methods, see example

Acquiring the History of the City with Collaborative Game Based Learning

However, Learners do not naturally engage in collaborative work when they are assigned to a group. Instructional designers consider how instructional information gives guidance for collaborative work and whether the learning activities provide opportunities for every learner to have their voices heard (Schnaubert & Bodemer, 2019). A variety of technologies may be used to support the interaction, discourse, and participation of collaborative learning. **Computer-supported collaborative learning (CSCL)** identifies how technology can facilitate the sharing and creation of knowledge and expertise through peer interaction and group learning processes.

An instructional functioning, motivational and culturally sensitive instruction

As indicated in different instructional methods, different learning activities with diverse cognitive behaviors are elicited when using a specific instructional method. An instructional functioning instructional solution relies on **the alignment of instructional methods with learning objectives**. As a simple example, drill and practice usually elicit the strategic practice of applying knowledge or skills. If the learning objectives aim to create a novel product, only choosing the drill and practice will fail to elicit the learning activities that support the higher-order thinking, such as evaluating the alternative solutions.

To align the instructional methods and learning objectives, instructional designers (Biggs, n.d.):

- describe the intended learning outcome in the form of a verb (learning activity), its object (the content) and specify the context and a standard the students are to attain
- create a learning environment using teaching/learning activities that address that verb and therefore are likely to bring about the intended outcome

Instructional designers select, adapt and integrate different instructional methods based on its effectiveness in engaging learners in the target learning process. Instructional designers should also pay attention to the overall learning objective (i.e., course objectives) leverages from all the intended learning outcomes.

Assessment

Assessment is one of the essential components of an instructional solution. A well- designed assessment allows learners to demonstrate what they have learned and provide informative feedback for learners to regulate their learning process. Instructional designers consider the following functions of assessment to design the assessment that serve the instructional and administrative purpose.

- **Assessment of learning** assesses learners' learning outcomes against preset learning objectives and criteria. It usually occurs at defined key points during the instruction or at the end of the unit, term, or semester. It provides informative feedback to plan future learning goals for learners' life-long learning and pathways and transparent interpretation across all audiences which can be used for administrative purposes (e.g. issuing the credits). **Summative assessment** is the type of assessment commonly used for such purpose (Broadfoot & Black, 2004).
- **Assessment for learning** assesses students' knowledge, understanding and skills to provide information for students to regulate their learning and for teachers to adjust their teaching. It involves formal and informal assessment activities as part of learning activities. **Formative assessment** is the type of assessment for such purpose (Broadfoot & Black, 2004).
- **Assessment as learning** describes the situation in which learners' perception of assessment affects their learning process. While instructional designers consider learning objectives as the starting point for the learning journey, learners might take the assessment criteria, especially criteria of summative assessment, as the starting point and set up their own learning objectives based on it (Torrance, 2007). This means that if the assessment is aligned with learning objectives, assessment will work as part of learning activities and guide learners to the learning goal. Other way around, if the design of assessment fails to align with learning objectives, it misguides learners away from the targeted learning path.

Regarding the impact of assessment on learning, the instructional designer seeks to develop solutions that integrate assessment into instruction so that it can together form coherent instruction for learners to achieve the learning objectives. Instructional designers should consider two layers of alignment when designing an assessment.

- **Aligning assessments with learning objectives** requires instructional designers to design assessment based on the list of cognitive verbs and target learning content stated in the learning objectives. The alignment ensures that the assessment tools (1) allow students to demonstrate the target performance, (2) provide informative feedback for regulating the learning process, and (3) provide assessment results to determine the issuing of certification or credits.
- **Aligning assessments with instructional methods** requires instructional designers to design assessment activities that support knowledge construction and set up assessment criteria for learners' self-assessment or teacher formative assessment. It provides informative feedback to

regulate learners' learning progress. For example, in inquiry learning, the activity of drawing conclusions based on the investigation can be set as a formative assessment. The assessment criteria should be developed to evaluate the quality of conclusions and provide information on the level of understanding learners currently have. Such alignment enables teachers to understand what kind of support is needed and learners could use it as self-assessment to regulate their own learning.

Template 6 Assessment design blueprint

Assessment design blueprint							
Intended learning outcomes (ILOs)	Instructional methods	Assessment					
		Purposes	Timing	Types	Items	Criteria	Technology
General objective							
ILO 1							
ILO 1.1							
ILO 1.2							
ILO 2							

Nowadays, technology is commonly used in designing assessment tools. When students use digital resources and systems, learning data are generated to inform the learning progress and enable teachers to make timely interventions.(Lodge et al., 2020). Therefore, instructional designers could integrate the technology in the assessment to collect learning data and utilize

Caution! instructional designers should also raise the awareness of data security needs of protecting learners' personal data generated from different types of assessment.

Based on the two-layer alignment, instructional designers identify the assessment purpose, the type of assessment (formative and summative assessment) to be used, and the assessing timing. Regarding these elements, instructional designers developed assessment items for the assessing purpose as indicated in an assessment design blueprint (see Figure 6 Assessment design blueprint). The assessment items can be categorized into at least the following kinds:

- **Norm-base vs. Criterion-based assessment:** Norm-based assessment assesses the learning achievement compared to the overall performance of a group of peers. Norm-based assessment is good for comparing individuals' learning outcomes and comparing to other groups. But norm-based assessments fall short of measuring the learning progress. Criterion-based assessment evaluates the learning outcomes against a set of

pre-set criteria without reference to the achievement of others. However, instructional designers should state the criteria precisely and measurably in a way that reduces the possibility of misinterpretation of the criteria.

- **Holistic vs. Analytic assessment:** The holistic assessment provides the performance tasks for learners to apply what they learned to address target learning as a whole. It is typically design with ill-defined assessing criteria. In contrast, the analytics assessment provides performance tasks corresponding to each preset sub-topics of the target learning and requires learners to master subtopics of the whole task at different levels regarding its importance in the whole picture. Rubric is commonly used for analytics assessment, which provides a well-defined assessing criteria.
- **Contextualized vs. Decontextualized assessment:** Contextualized assessment integrates authentic activities to provoke and engage the learner to reflect on the application of learned knowledge in real-life performance tasks. Decontextualized assessment focuses on the abstract knowledge representation assessing learners' understanding of the knowledge at the abstract and conventional level, such as declarative knowledge or procedural knowledge detached from real-world context.

Instructional designers usually integrate different assessments to create coherent assessment tools which can capture a comprehensive picture of learners' learning outcomes. For example, if instructional designers only use contextualized assessments, it would be difficult to know if learners could apply the knowledge in other contexts. If only decontextualized assessments are used, it is also difficult to know if learners could apply the target knowledge in concrete contexts. Instructional designers should keep in mind the learning objectives and learning process to consider how to integrate different assessment tool

Open-task assessment can be used to capture unintended outcomes. Any rich teaching context is likely to produce learning that is productive and relevant, but unanticipated. The value of many formal activities lies precisely in the surprises they generate, such as field trips, practice or lab sessions, while informal activities bring about unanticipated learning in infinite ways. Assessment practices should allow for such rich learning experiences, with the reflective journals, critical incidents, and portfolio, as formative assessment (Biggs, n.d.).

Instructional solution canvas and constructive alignment

An instructional solution consists of multiple components and component interactivities to address instructional problems and satisfy clients' requirements and learning needs. Instructional designers could utilize instructional solution canvas as a tool to organize all these instructional components (See Template 6 Assessment design blueprint).

Instructional designers should deliberately develop the constructive alignment of the instructional solutions. **Constructive alignment** is an instructional design principle where learning objectives, learning and teaching activities elicited by the instructional methods, and assessment should align to bring

a coherent course for learners. The design process requires sufficient financial resources, time available for developing constructive alignment, available teaching equipment, and adopting educational technology. Active communication with clients, subject-matter experts, and design team members is necessary to develop constructive alignment. Project management is an essential tool for designing instructional solutions with constructive alignments and developing instructional materials and learning objects based on the instructional solution.

Template 7 Instructional design Canvas

The Instructional Solution Canvas

Project name:

 Instructional problem/ learning needs	 Learning objectives	 Instructional methods	 Assessment plan
 Learner persona	 Learning modes		 Assessment criteria
 Learning environment	 Technology integration	 Communication plan	
Delivery date:		Budget:	

In addition, instructional methods should create learning activities that could **cultivate learners' learning motivation**. ARCS (Attention, Relevance, Confidence, and Satisfaction) model is an example aiming to guide the design of instruction that considers learning motivation. The model indicates that instruction should (1) **catch and sustain students' attention by presenting relevant learning content** (connecting with learners' prior knowledge and skills); (2) **state why the students need to learn the content** (connecting learners' learning activities with learning objectives); (3) **make students believe that they are about to succeed if they exert effort** (including scaffolding in instruction for learners to develop in ZDPs with support); and (4) **help students feel a sense of reward and pride** (including constructive and positive feedbacks in the instruction) (Keller, 1987; Li & Keller, 2018).

Finally, instructional designers should also create **a culturally sensitive learning environment** for learners based on analysis of learner personas. Instructional designers (1) recognize and respect students' culture and language in instruction, and respects the students' personal and community identities, (2) use textbooks, design bulletin boards, and implement classroom activities culturally supportive for learners, and (3) create community-based learning environment allowing learners to interact with people from various backgrounds (Richards et al., 2007).



Instructional solutions in instructional design projects



► Instructional solution in instructional design process

The alignment of instructional solution and instructional context provide a guideline for developing inclusive and culture-sensitive instruction solution that can be easily localized to the instructional context. The instructional solution in this phase has been developed to cover the general idea regarding the learning objectives, learning mode, instructional methods, and assessments. As the design process continues, the instructional solution will be developed into an instruction blueprint with more detailed descriptions of the instructional materials and learning objects with design consideration (see CU3 design consideration). Learning objects are learning materials, learning activities affordance, and assessment tools that serve learning objectives. Instructional designers coordinate the diverse instructional design tasks to design instructional materials and learning objectives with storyboards (for a detailed description of the storyboard see CU 3 – Design consideration)

Ideally, the instructional solution follows the Universal Design for Learning to provide the guidance for develop instructional blueprint of instructional materials and learning object (Navarro et al., 2016):

- **Representation:** Instructional materials and learning objects should be accessible to learners with diverse needs. Instructional designers consider how to present the learning materials in a variety of modalities and methods. **Technology could assist in presenting learning content, such as videos, websites, pictures, etc.**
- **Action and expression:** Learners are providing alternative methods of communication to express their needs before, during, and after learning. Learning activities provide learners a channel to demonstrate what they have learned. **Technology could assist in providing social communication channels, activities to capitalize on learners' abilities, such as creating multimedia learning products, and the development of comprehensive assessments, such as simulation-based problem solving.**
- **Engagement:** Learners are involved in the learning activities. Instruction utilizes different strategies to empower learners and draw them into learning. **Technology can support the essential functions of learning activities, such as supporting collaboration with prompts, supporting practices with video games or quizzes, etc.**

The background of the slide is a warm, orange-toned photograph. It depicts a hand holding a pencil, poised to write on a spiral-bound notepad. The lighting is soft, creating a professional and creative atmosphere. The text is overlaid on this image in three horizontal purple bars.

Instructional designer competencies



➤ Instructional designer competencies

In this iterative design process, instructional designers develop their competences of taking multiple perspectives to understand the instructional problems, utilizing scientific-based evidence to develop functional instructions, solving problems regarding specific instructional contexts, and collaborating with others for reaching shared goals. To develop effective instructional solution, instructional designers should develop their competences in:

- **Solving problems reflectively and creatively:** Instructional designers continuously learn empirical knowledge of human learning and learning methodology and use it to design functional instruction. More importantly, instructional designers actively reflect on experience and at-the-moment instruction design work to understand the complexity, dynamism, and interaction of the instructional situation and solution.
- **Designing culture-sensitive instruction:** Instructional designers understand the impact of cultural variables, such as everyday habits, values, beliefs, and behaviors, on learning and integrating the cultural variables in developing instructional solutions. Instructional designers are also culturally sensitive when communicating with multiple stakeholders to reach a consensus on the instructional solution.
- **Collaborating actively:** Instructional designers initiate, maintain, and actively collaborate with other experts to generate an appropriate instructional solution with the involvement of multiple stakeholders. Therefore, instructional designers actively communicate with stakeholders and experts from various fields to define the problems, identify the needs, approach the instructional solutions, and seek alternatives if necessary.
- **Using technology effectively:** Instructional designers develop the ability to utilize technology for multiple purposes, such as supporting instruction, creating diverse learning opportunities for learners. Instructional designer also utilize technology to facilitate problem-solving process, such as visualizing the contexts, problems, and design ideas for instructional solution

The background image shows a hand holding a pencil, poised to write on a spiral-bound notebook. The entire scene is overlaid with a semi-transparent orange filter. A solid blue horizontal bar is positioned across the middle of the image, containing the word 'Conclusion' in white, bold, sans-serif font. A small portion of a purple circular shape is visible on the right edge, and a light blue triangular shape is in the bottom right corner.

Conclusion



➤ Conclusion

Developing an instructional solution is a process where instructional designers utilize the instructional context information to develop coherent, functional, culturally sensitive, and inclusive instruction based on learning theories, instructional design theories, and design thinking. Instructional designers utilize technology as a tool for creating rich learning experiences as stated in instructional solutions. In the design process, instructional designers engage in diverse activities including instructional context analysis, communication with multiple stakeholders, and developing instructional solutions. Instructional designers also utilize technology to assist the instructional design process to facilitate collaboration and problem-solving.



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