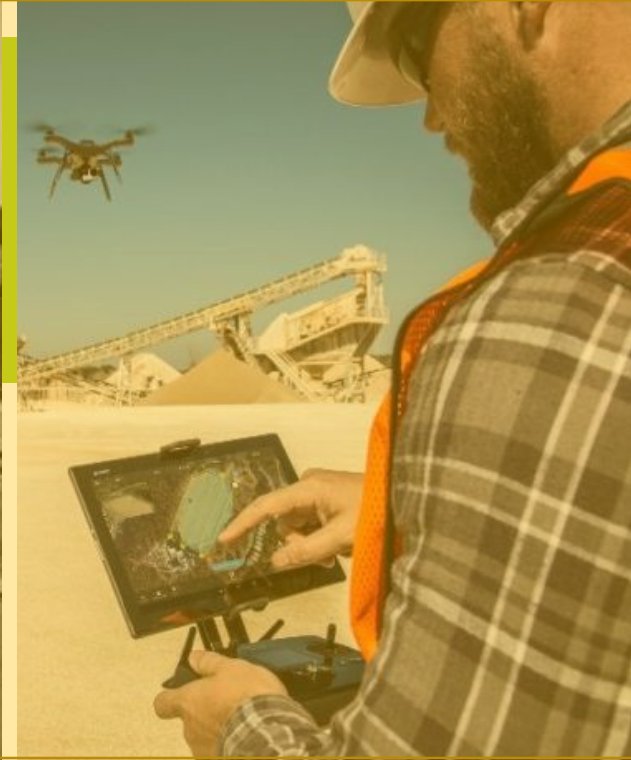


CBL4UAV

Challenge Based Learning for UAV Photogrammetry
2022

Farzaneh Dadrass Javan

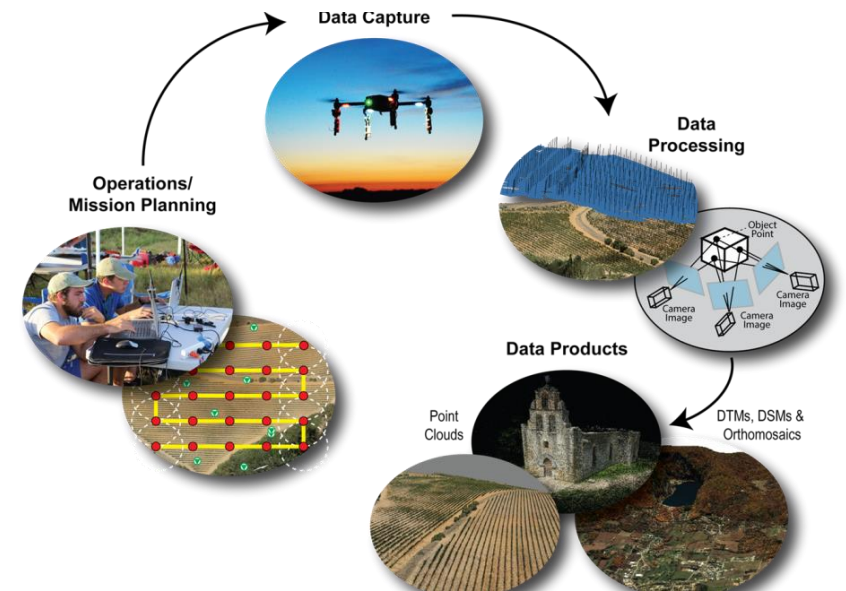


Photogrammetry is in constant state of change

Toni Schenk, 2005

WHY UAV + PHOTOGRAMMETRY

- Photogrammetry is an engineering discipline and as such heavily influenced by developments in computer science and electronics. The ever increasing use of computers has had and will continue to have a great impact on photogrammetry. The discipline is, as many others, in a **constant state of change**.
- After more than 100 years, pigeons have been replaced by unmanned aerial vehicles that represent a valid alternative to airborne and terrestrial acquisitions in many applications.
- Their flexibility and (relatively) reduced cost have made UAV a valid instrument for unexpected uses, contributing to increase the interest for geospatial technologies among the broad audience.
- The introduction of more automated and intuitive open-source and commercial software for photogrammetric processing has enabled many (often unexperienced) practitioners to adopt UAVs in their everyday surveying activities.
- Many universities offer courses on the use UAV for different mapping purposes in several faculties, often without delivering any knowledge on the principles of photogrammetry but only giving end-users' perspectives.
- This often generates false expectations on the functioning of this technique.



WHY CHALLENGE BASED

- Challenge-Based Learning aims at delivering education and knowledge by tackling and solving real-world challenges: teacher/mentor, stakeholders and students are all involved in this process.
- In the general CBL framework, stakeholders from the public, private and non-profit sector bring the real-world challenge (i.e., use-case), while students develop the technical solution thanks to the support of the mentors.
- In this setting, students develop important practical skills and learn how to implement academic knowledge in practical situations which are not often covered in traditional academic education.
- This makes CBL particularly suitable for students from other domains that want to gain knowledge on photogrammetry to solve challenges in their domains.
- By using educational scaffolding techniques, the students and stakeholders will be helped on their way and will have an increasing amount of freedom to work on their challenges.
- The teacher ensures the academic and content quality while delivers knowledge relevant for the perspectives of the students and stakeholders involved.

Challenge Based Learning



DP

<https://microcredentials.digitalpromise.org/explore/challenge-based-learning-mini-challenge>

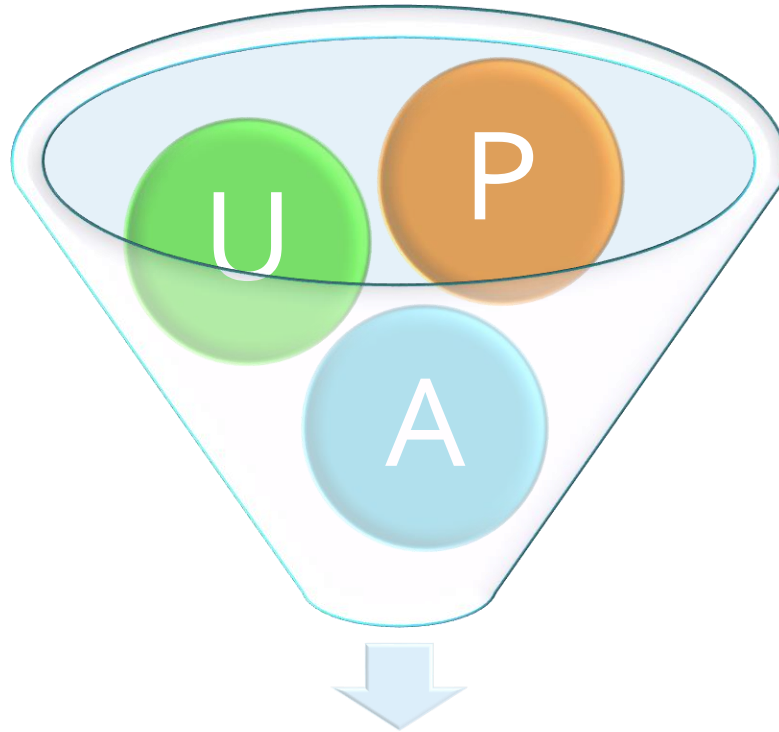
WHY CBL₄UAV PHOTOGRAMMETRY

- UAV photogrammetry is normally taught using a traditional approach, giving relatively extensive explanations on the algorithmic background.
- This still represents the best way to train geomatics (or engineering students), but it is often far from the interest and the expectations of students with limited mathematical background or technological attitude.
- This still represent a large percentage of the students approaching UAV mapping in the broad sense.
- In this regard, CBL represents a valid alternative to present photogrammetry in a different perspective embedding it in a challenge closer to their studies.
- As an example, problems faced in agriculture, food security, mining, cadastral, geology, cultural heritage can be reformulated in this framework, facilitating the understanding of the students and the development of innovative solutions through education and playing a bridging role from the academic environment to the end-users' demands.



CBL₄UAV PHOTOGRAMMETRY

- **P**hotogrammetry
- **U**AV
- **A**griculture



- System design
- Technology
- Data processing
- Training and education

- UAV + photogrammetry as an emerging technology can provide lots of Geospatial information as an "instrument" helping for real life problem solving in other disciplines.
- Exploring new and more practical solution to existing problem, or industry based and application driven education is debated and demanded more and more.
- In recent years, new innovative educational methods have been explored to tackle different needs, leveraging on new technologies and pedagogical frameworks, and driving better academic performance among students.

CBL₄UAV PHOTOGRAMMETRY

- Problem based learning, cooperative learning, thinking-based learning, and most recently challenge-based learning are just the most known examples of new educational approaches.
- Compared to traditional techniques, the advantage of these frameworks mainly lies in their higher adaptability, stimulating the enthusiastic involvement of students with different background and interests.

Photogrammetry is in constant state of change

+

UAV as an emerging technology

+

Agriculture as an immense area of application

Challenges

- **Which sensor**
 - Active / passive
 - Visible / thermal / Multi spectral / hyperspectral / fusion
- **Which platform, which design**
 - UAV model
 - Mission parameters
- **What accuracy**
- **Which types of products**
 - Ortho / point cloud / digital models /
- **Which level of information**
 - 2D / 3D



CHALLENGE BASED LEARNING

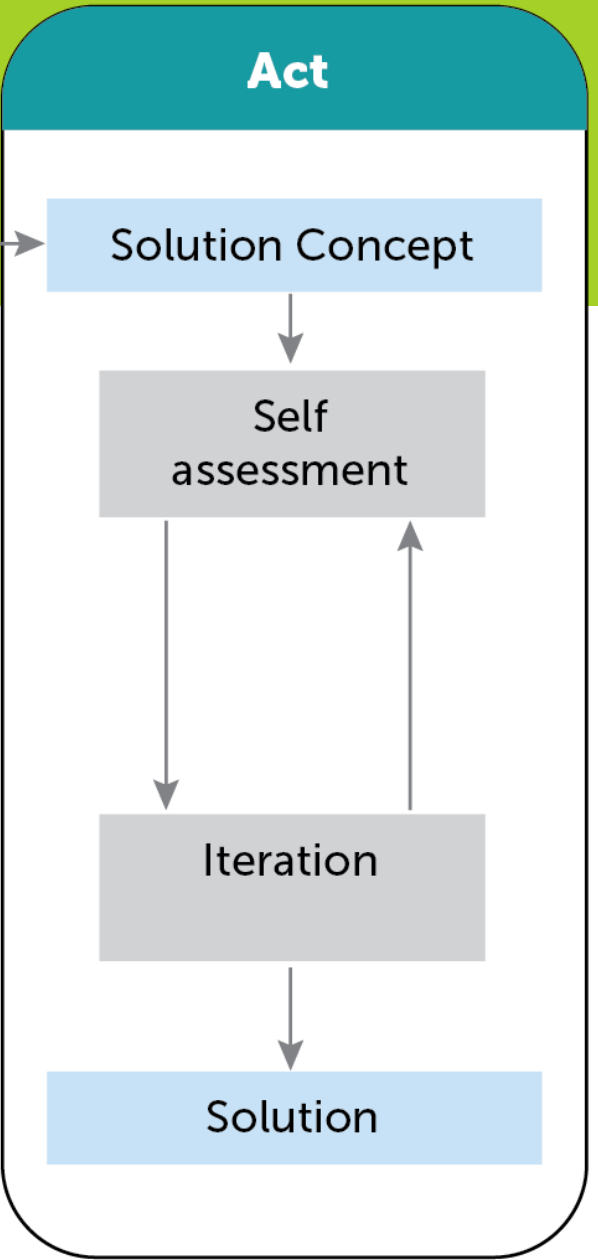
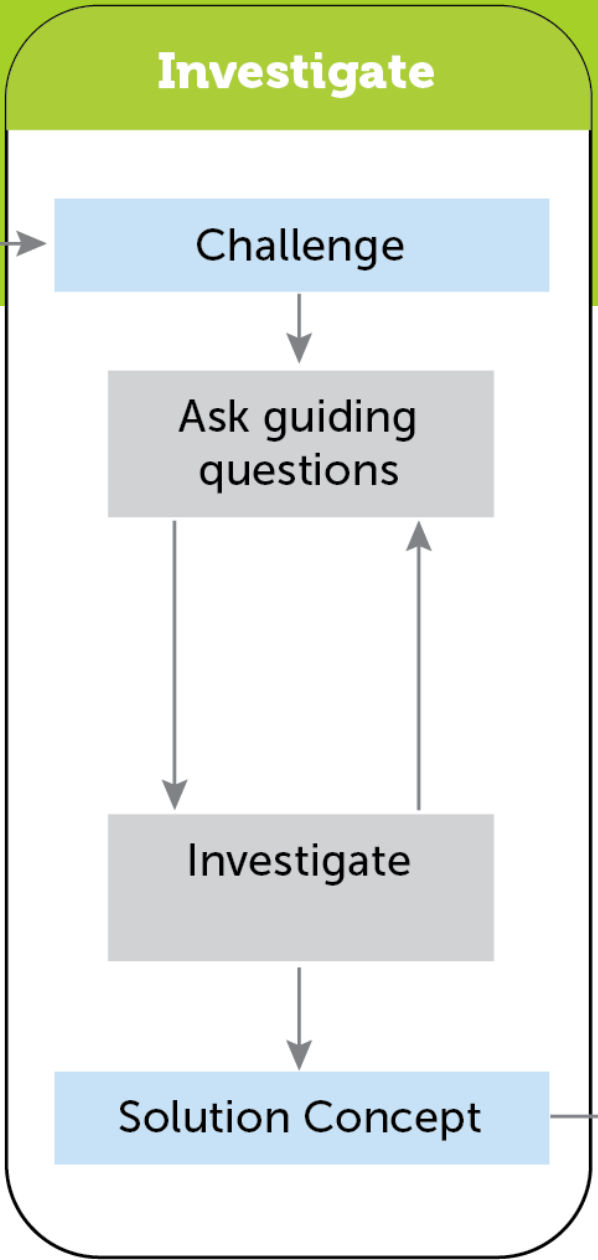
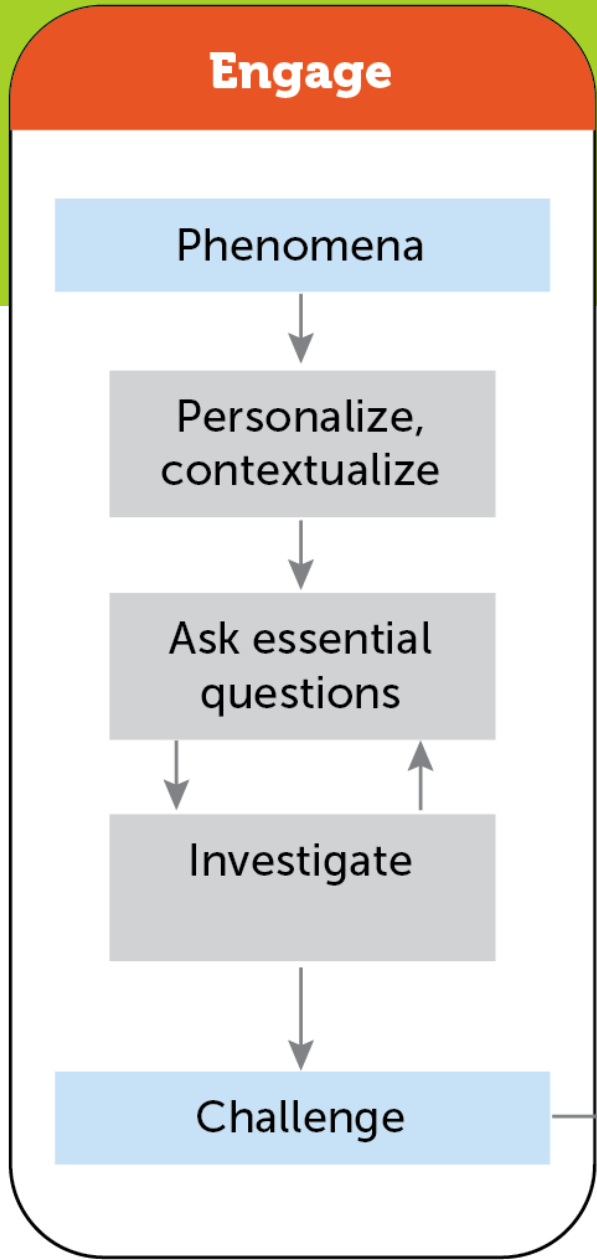
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CBL MAIN PHASES

1. **Engage:** getting connected to a challenge
2. **Investigate:** finding new relevant information, analyse
3. **Act:** design, implement and evaluate a solution





ENGAGE PHASE

- The goal of the engage phase is to connect yourself to the topic.
- Therefore, you are only given the Big Idea and a bit of information on how to get from Big Idea to Essential Questions.
- During the Engage Phase, we move from an abstract Big Idea to a concrete and actionable Challenge using the Essential Questioning process.
- The purpose of the Engage phase is to define your own challenges for the course and combine these in a challenge proposal.

ENGAGE PHASE

▪ Essential question

McThighe and Wiggings (2013) provide the following conditions for developing an essential question, an essential question is:

- Open-ended, meaning that there will not be one single correct answer
- Intellectually engaging (thought-provoking), can easily spark a discussion or debate
- Calls for Higher-order thinking, cannot be answered by only recalling knowledge
- Will lead to important transferable ideas within and across disciplines
- Raises additional questions
- Requires justification, not just an answer
- Recurs over time, answers can be different at any given moment



CBL as educational model

PHASE 1 ENGAGE

Big idea

Teacher Quality

Essential questions

What is the added value of the UTQ for different stakeholders?

What do the experts say about quality education?

What does a successful teacher do?

How does good teaching reflect society?

How can teaching be used as a tool for learning and not as an end itself?

Challenge

Redesign Module X so that it is tailored to Lifelong Learning

PHASE 2 INVESTIGATE

Guiding questions (content and skills)

What is lifelong learning?

Which knowledge do I need?

Who are the stakeholders involved?

How is supervising 'lifelong learning' students different from regular students?

Guiding activities and resources

How can I gain this knowledge best?

How can I find data?

Where can I find data?

Textbook, lecture, micro lecture, expert interview, practicum, discussion, debate, fieldwork

Analysis

Analysing the results

PHASE 3 ACT

Solution/answer/assessment

The challenge is performed

Implementing/evaluation/reflecting

Test is in the real world.

What could be the impact?

How did you do?

Could you have done better?

Why should you change something?

Why didn't you change something?

Publishing

Share results and findings

ENGAGE PHASE

Challenge (problem)

- With all the information you gathered by answering the essential questions, you can now start defining the problem
 - An existing problem that you are seeking to solve
 - Situations that you want to improve
 - Areas where some conceptual clarity is needed
- Ask yourself the following (non-essential) questions:
 - What is the key issue you are trying to address about and why is it important?
 - Is there any evidence that this is worth the investment?
 - Are all stakeholders perspectives taken into account?
 - What institutional/programme/social factors shape this problem?

CHALLENGE (ASSIGNMENT 1-1)

1- Develop some essential question as a group.

The first step is identifying the stakeholders (relevant groups, organisations, people, and individuals) who might be effected based on the concept of food security.

You can find an example by following this link: [Stakeholder Analysis \(Links to an external site.\)](#). But you may also come up with another way.

Next, you will explore the question, each from different perspectives, choose one of the key stakeholders you identified to determine their perspective.

Plan a meeting with your team and the coach to discuss the results.

Outcome

A list of stakeholders, distinguish between external and internal stakeholders and between direct and indirect influence.

A brief overview of the perspectives of the stakeholders that were spoken with.

ESSENTIAL QUESTIONS



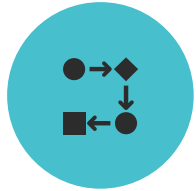
IS IT OPEN-ENDED (DO NOT HAVE A SINGLE, FINAL, AND CORRECT ANSWER)?



IS IT THOUGHT-PROVOKING AND INTELLECTUALLY ENGAGING (OFTEN SPARKING DISCUSSION OR DEBATE)?



DOES IT CALL FOR HIGHER-ORDER THINKING (ANALYSIS, EVALUATION, PREDICTION)?



IS IT POINTING TOWARD IMPORTANT, TRANSFERRABLE IDEAS WITHIN (AND SOMETIMES) ACROSS DISCIPLINES?



DOES IT RAISE ADDITIONAL QUESTIONS AND SPARKS FURTHER INQUIRY?



DOES IT REQUIRE SUPPORT AND JUSTIFICATION, NOT JUST AN ANSWER?

Essential Questions: 4-Phase Implementation

Phase	What to do	Goal
1	Introduce a question designed to cause inquiry.	Ensure that the Essential Question is thought-provoking relevant to both students and the content of the current unit or course, and explorable via text, a research project, a lab, a problem, and issue, or a simulation in which the question comes to life.
2	Elicit varied responses and question those responses.	Use questioning techniques and protocols as necessary to elicit the widest possible array of different plausible, yet imperfect answers to the question. Also probe the original question in light of the different takes on it that are implied in the varied student answers and due to inherent ambiguity in the words of the question.
3	Introduce and explore new perspectives.	Bring new text, data, or phenomena to the inquiry, designed to deliberately extend inquiry or call into question tentative conclusions reached thus far. Elicit and compare new answers to previous answers looking for possible connections and inconsistencies to probe.
4	Reach tentative closure.	Ask students to generalize their findings, new insights, and remaining (or newly raised) questions into provisional understandings about both content

CHALLENGE (ASSIGNMENT 1-2)

2. Develop/choose individually at least five more essential questions

- Please, share the questions on the discussion board for feedback
- Address the essential questions in a few sentences based on your own perspective
- Gather as many different perspectives (use the stakeholder analysis from the previous assignment) as possible in the time you have, for each question.
- **Outcome**
 - At least one essential question
 - A list of resources (people, books, etc.)
 - Reflect on whether certain perspectives have changed your own perspective.
- **Format**
 - Max 2 A4.

CHALLENGE (ASSIGNMENT 1)

Process

- Get to know each other,
- working process

Content

- Describe Big Idea
- Find (minimal 3) essential questions
- Formulate a Challenge

Document; Reflect; Share



Assignment 1

- Challenge proposal submission

Due date

- week 2

ENGAGE PHASE

CBL as educational model

PHASE 1 ENGAGE

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Publishing

Share results and findings

INVESTIGATE PHASE

- **GUIDING QUESTIONS**
- **GUIDING ACTIVITIES**
- **GUIDING RESOURCES**
- **ANALYSIS**

INVESTIGATE PHASE



- Once you have defined the essential questions you can start writing guiding questions based on the essential questions.
- Guiding questions are smaller pieces of the essential question that should be researched to increase the understanding of the big idea and to brainstorm solutions to the challenge, and finally choosing one to plan and implement
- They will keep you from getting lost or off-track when looking for information.
- You will try to find the answers to these questions when you do your research.

INVESTIGATE PHASE

- **CREATING GUIDING QUESTIONS**

- Make two lists of questions.
 - one for “factual” questions
 - one for “interpretative” questions
- The answers to factual questions will give you the basic background information you need to understand your topic.
- The answers to interpretive questions show your creative thinking in your trajectory

INVESTIGATE PHASE

Factual

- Who?
- What?
- When?
- Where?

Interpretative

- **Hypothetical:** How would things be different today if something in the past had been different?
- **Prediction:** How will something look or be in the future, based on the way it is now?
- **Comparison or Analogy:** Find the similarities and differences between your main subject and a similar subject, or with another subject in the same time period or place
- **Judgment:** Based on the information you find, what can you say as your informed opinion about the subject?

INVESTIGATE PHASE

Guiding Activities/Resources



Any resource or activity that helps answer the guiding questions can be used.



Examples of Guiding Resources include:

Study:

Online content , (Online) courses,
Papers, Textbooks , Stake holders



Examples of Guiding Activities include:

Experiments:

Conduct a Research, attend a
workshop, make an interview

INVESTIGATE PHASE



Analysis/Synthesis

- Once all the Guiding Questions have been addressed and the results of the Guiding Activities recorded, you analyze the accumulated data
- The Investigation phase concludes with a presentation that demonstrate that you have successfully addressed all the Guiding Questions and developed clear conclusions that will set the foundation for the result/solution.

INVESTIGATE PHASE

FACTUAL QUESTIONS

- Example
 - How do you construct an exam?
 - How is an open book exam different from a closed book exam?
 - When is an exam reliable?
 - What does research say about effective open book exams?
 - Does CELT/TELT offer support for constructing an open book exam?
 - Who are the experts in open book exam expert within the UT?
 - What is the learning effect of an open book exam?

INVESTIGATE PHASE

INTERPRETATIVE QUESTION

- To avoid moving too quickly towards a conclusion based on the factual questions, it is advisable to also formulate interpretative questions.
- Some types of interpretative questions
 - **Hypothetical:** How would things be different today if something in the past had been different?
 - **Prediction:** How will something look or be in the future, based on the way it is now?
 - **Comparison or Analogy:** Find the similarities and differences between your main subject and a similar subject, or with another subject in the same time period or place
 - **Judgment:** Based on the information you find, what can you say as your informed opinion about the subject?

Assignment 2

- Guiding question / guiding activity document

Due date

- week 2

INVESTIGATE
PHASE

ENGAGE PHASE

Big Idea

UAV photogrammetry for food security in Iran



ACT PHASE

- SOLUTION CONCEPT
- SOLUTION DEVELOPMENT
- IMPLEMENTATION AND EVALUATION

- **Solution concept:** The investigation phase is accomplished by the definition of a concrete foundation for the solution. In the current step, the students will design their plan to follow the solution. As a result of this step, the solution concept is finalized.
- **Solution development:** while the solution concept is approved in the previous step, the students will start with development. Based on the situation, they need to implement a code, set an experiment, conduct a questionnaire, or make a prototype. Experiences during this step might force the students to the previous phases for revision.
- **Implementation and evaluation:** While the solution is developed, the students will continue with implementation. In this step, they need also to evaluate their solution, measure the outcomes, reflect on the results, discuss the findings, and report the failure or success process.

Reflect, documenting, and share

is also the main elements in CBL. Not only after the completion of implementation but also throughout the whole process, should have had students document their experience. They also need to reflect on their findings and even on other groups available in the course (if available) and also they need to share their findings. When the implementation is complete and results and findings are finalized, students will share their works publicly.



To see how CBL works for teaching UAV photogrammetry



To practice the course design



To explore how to do assessment in this new methodology



To define a framework for our future educational programs

PROSPECTS

WITH SPECIAL THANKS TO

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