BLOCKCHAIN FOR AGRI FOOD EDU

Blockchain teaching in higher education in the agri-food sector

Research-based guide for blockchain education in the agri-food sector with recommendations for pedagogical strategies for blockchain education in the agri-food sector

https://blockchainforagrifood.eu/

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Co-funded by the European Union

Status: March 2024

The work is funded by the European Commission and was created as part of the Erasmus+ project Blochckain for agrifood education.

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Introduction

Project: Blockchain for Agri-Food Educators
Project Website: [Home | Blockchain for Agri Food Edu]

The Project *Blockchain teaching in higher education in the agri-food sector* is funded by Erasmus+ and explores opportunities and limitations of current blockchain teaching in agri-food disciplines in our countries' HE systems. Part of the project is a Guide to Blockchain Education in the Agrifood Sector and further disciplines with recommended approaches to blockchain teaching (Blockchain for Agri Food Edu, 2024).

Therefore, the following document aims in serving as a guide for teaching persons as well as faculties in Agricultural Sciences and presents various methods for teaching and learning with a special focus on the concept of Blockchain. In order to be able to create the guide, we conducted a research and created a document, concluding the findings and identifying helpful practices and methods for the teaching and learning of Blockchain.

Blockchain technology has the potential to assist the agricultural and food sectors in managing foreseeable risks and maintaining affordability across the ecosystem (Blockchain for Agri Food Edu, 2024).

The different methods in this document are presented through a What?-How?-Why?-Scheme where the method will first be explained, then a graph will be shown to illustrate the method and how it works and lastly, a few key advantages on why it can be helpful to adapt these methods into the curriculum are shown.

The goal of the guide is to provide the reader with knowledge on effective pedagogical strategies, offering invaluable guidance on course design considerations.

1 LEARNING METHODS

In the following section, we will dive into various teaching methodologies that have been developed to facilitate the comprehension of blockchain technology among students of agricultural sciences. From traditional didactic approaches to interactive sessions and practical demonstrations, we will explore how educating persons can adapt their strategies and teaching methods to suit the diverse needs of the students for them to be able to understand the concept of Blockchain.

1

1.1 Backwards Design

What?

For most of the methods that are being presented in this guide should start by defining your learning objectives and then select an active learning approach aligned with those goals. Students generally respond favorably to active learning activities when they are meaningful, appropriately challenging, and closely linked to both learning objectives and assessments. Lastly, seek assistance and feedback from colleagues in your department and the Center for Teaching during the design and implementation of active learning approaches (Brame, 2016).

How?

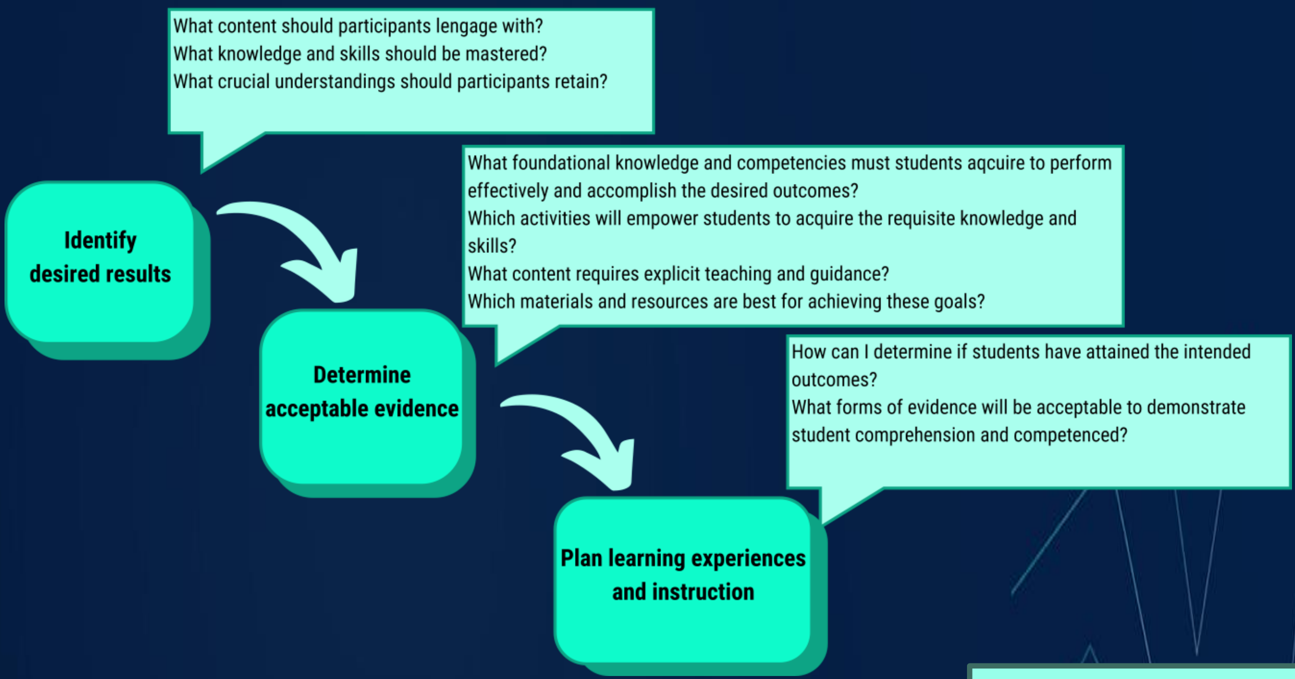

Fig. 1: Backwards Design Process, own illustration, based on Bowen (2017)

A link to a blank backwards design template is provided here and it is referred to as UbD Unit Template 2.0.

Why?

Backwards Design ensures intentional decision-making throughout the design process of a lecture. It establishes a purpose behind incorporating elements into the curriculum. Once learning goals or desired results are identified, instructors find it easier to develop assessments and shape instruction aligned with grounded learning outcomes and get a clear vision of the intended outcomes for student learning activities. It also eliminates possibility of engaging in activities or tasks solely for the sake of doing them, ensuring that each task and piece of instruction serves a purpose aligned with the overarching goals of the course (Brame, 2016).

Bowen (2017).
Brame (2016).

1.2 TYPES OF LECTURES

1.2.1 Assignment in 4 Parts

What?

In today's dynamic technology and business environment, it's crucial for students to cultivate the ability to recognize and utilize emerging technologies effectively to generate innovative business value. The following assignment is a method that can be used for the teaching of an emerging technology like Blockchain as part of a lecture. Students are tasked with researching blockchain technology and examining its potential application in light of a recent event. The assignment is divided into four parts (Milovich et al., 2016).

How?

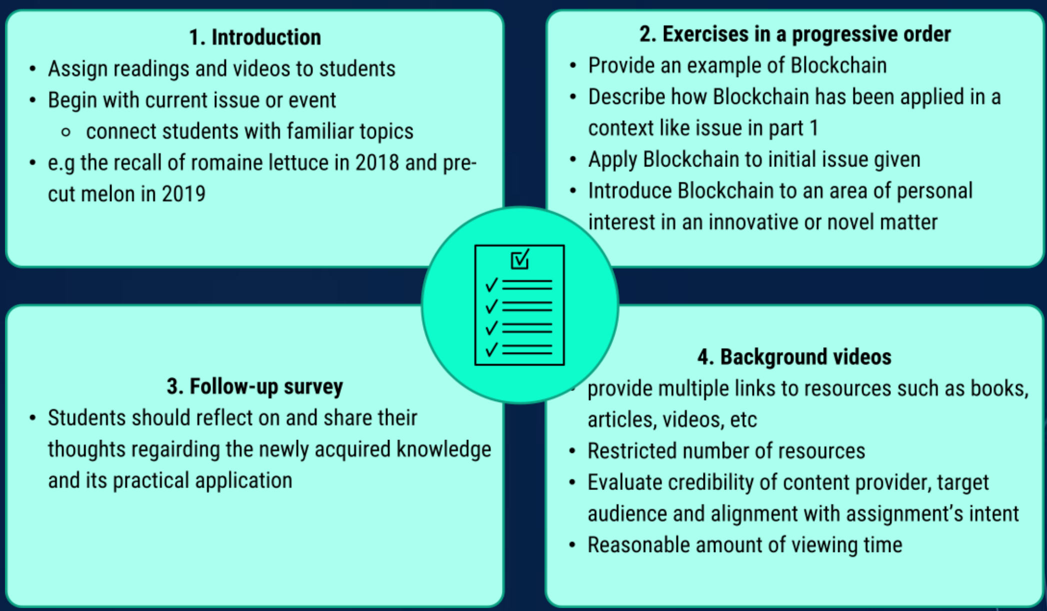

Fig. 2: Assignment in 4 parts, own illustration, based on Milovich et al. (2020)

Why?

The Assignment can help to enhance students' ability to apply newfound knowledge in emerging technologies to address business challenges innovatively. It helps promote the students' exploration of emerging technologies and their potential effect on society and organizations since applying new technology to a current event deepens understanding Utilizing various media types, such as articles and videos helps maintaining content freshness and provides information from diverse sources. To further enrich the learning experience, it is suggested that students bring their completed assignments to class for open discussions (Milovich et al. 2020). This approach, especially valuable for Question 4, which explores innovative applications of blockchain technology, contributes to an active learning environment (Brame, 2016).

Milovich et al. (2020)
Brame (2016)

1.2 TYPES OF LECTURES

1.2.2 Blended Courses

What?

Blended learning is gaining popularity in higher education due to its flexibility in scheduling and its capacity to accommodate a larger student population(Ho, Lu, & Thurmaier, 2006). Blended Courses are courses that consist of 30-70% online content (King & Arnold, 2012). The blended model consists of face-to-face and asynchronous instruction (Holenko & Hoić-Božić, 2008; Precel, Eshet-Alkalai, & Alberton, 2009; Slevin, 2008)

How?

There are 2 types of communication in blended courses that can enhance cooperation:

Communication encompasses professor-student interactions through news postings, email, and troubleshooting help.

Discussion boards facilitate student interaction. What to consider when implementing a blended course system:

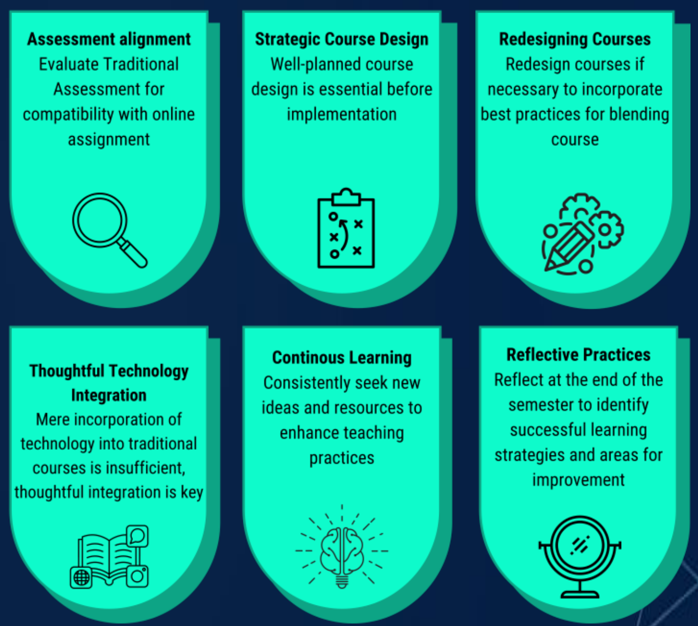

Fig. 3: Important Elements of Blended Courses, own Illustration, based on King & Arnold (2012)

Why?

Blended courses can enhance students' time flexibility by giving them the opportunity to work through the online contents independently. Furthermore, they address diverse learning needs and learning styles through the flexible course approach, which can also lead to lower dropout rates in comparison to fully online or fully in person courses (King & Arnold, 2012).

King & Arnold (2012)
Ho, Lu, & Thurmaier (2006), cited in King & Arnold (2012)
Holenko & Hoić-Božić (2008;), Precel, Eshet-Alkalai, & Alberton, (2009), Slevin (2008); cited in King & Arnold (2012)

1

1.3 LECTURE METHODS FOR ACTIVE LEARNING

1.3.1 Whimbey-Lochhead-Pair Method

What?

You Divide the class into pairs and provide the problem solver in each pair with a short written problem statement. Give a few problems that are carefully worded to be ambiguous so students can practice interpretation. Require students to find or estimate some of the physical constants they need. Give them real cases where a clearly defined problem is not laid out in front of them. These can include troubleshooting, debugging, or debottlenecking problems.

How?

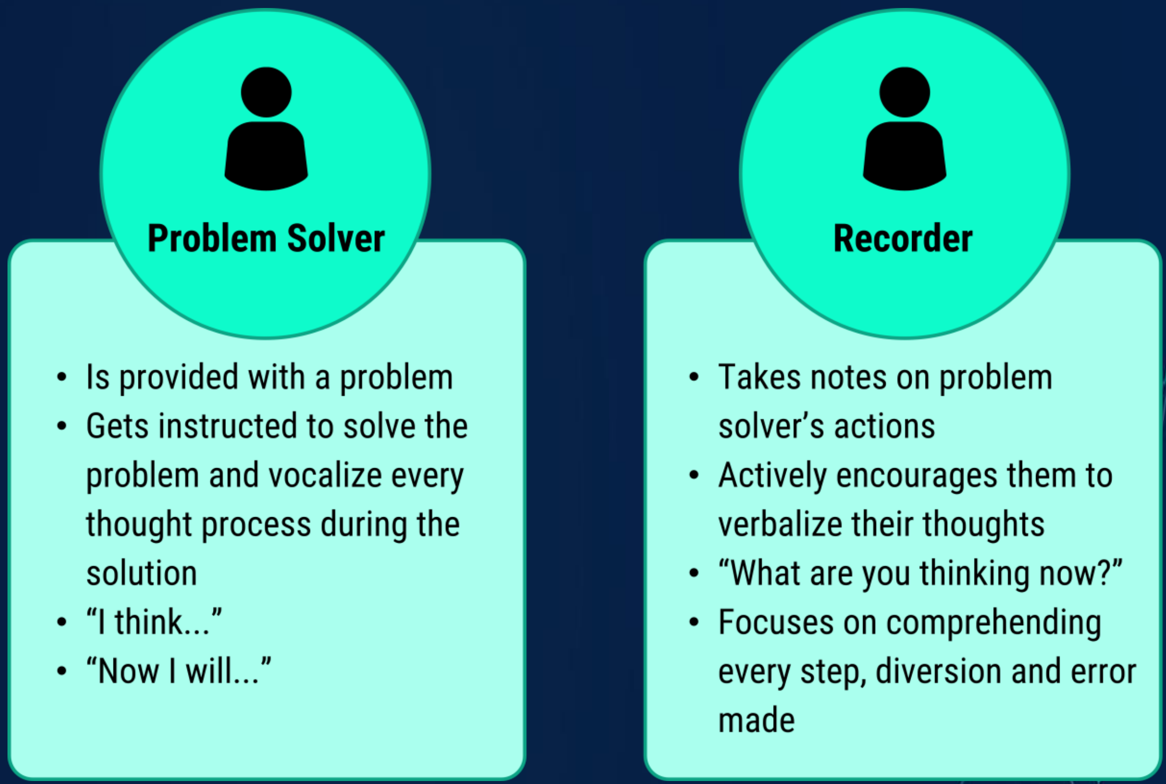

Fig. 4: Roles in the Whimbey-Lochhead-Pair Method, own Illustration, based on Lochhead and Whimbey, as cited in Wankat & Oreovicz (2015)

Why?

The Whimbey-Lochhead-Pair method can help to understand how individuals approach problem-solving, not solely to arrive at the correct solution and verbalizing problem-solving steps helps students become more conscious of their procedures when tackling problems. For optimal effectiveness, repeat the procedure multiple times throughout the semester.

Lochhead and Whimbey (1987), cited in Wankat & Oreovicz (2015)

1.3 LECTURE METHODS FOR ACTIVE LEARNING

1.3.2 Feedback Lecture

What?

The feedback lecture originated from Oregon State University during a period when concerns about the evolving demographics of students pursuing higher education clashed with available faculty and resources (Ogden, 2003). Students receive feedback from peers during group discussions and from the professor both during and after submission of response sheets. Peer-to-peer teaching frequently takes place within these group discussions, which are guided by thought-provoking questions selected to engage students' interest (Osterman et. al., 1985).

How?

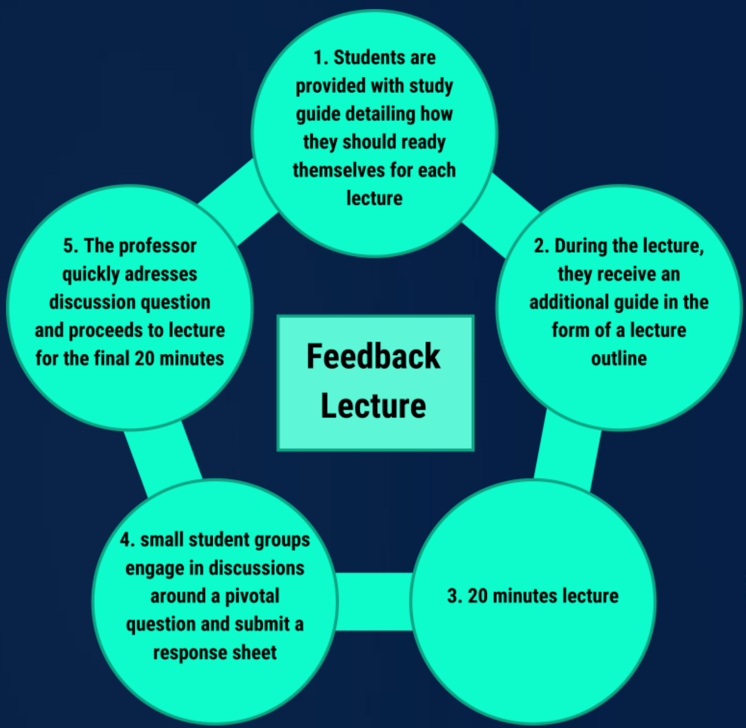

Fig. 5: Parts of the Feedback Lecture, own Illustration, based on Osterman et al. as cited in Wankat (2015)

Why?

Explicit objectives in the study guide ensure that learning is meticulously directed. Lecture outlines serve as organizational aids for the presented material while the mid-lecture group activity necessitates student engagement, fostering a more cooperative class environment. Thought-provoking discussion questions (Step 5) captivate student interest. Overall, the Feedback Lecture instills motivation in students to prepare for each class, as they are aware of active participation requirements, mitigating the likelihood of procrastination (Osterman et al., 1985).

Osterman et al. (1985), cited in Wankat & Oreovicz (2015)
Ogden (2003)

1.3 LECTURE METHODS FOR ACTIVE LEARNING

1.3.4 Strip Sequence

What?

Distribute the steps of a blockchain process to students on strips of paper, deliberately jumbled and then ask them to collaboratively reconstruct the proper sequence. The activity can be done in pairs or in groups (Brame, 2016).

How?

Organize the following events that occur during respiration in the correct order. Specify on your final sequence the names of the major steps to which these events correspond. If an event does not occur during respiration, eliminate it.
After the bid is validated through smart contracts, the crops undergo processing and companies store information captured at every step of the process on the blockchain.
The crops can be transported to the refineries via IoT-enabled vehicles, capturing temperature conditions under which they are kept and delivered.
Distribution of grown crops to the food processing companies
wholesalers and retailers can bid for the products they want through the bidding platform
IoT sensors generating data or Farmers storing data
The data captured either by using IoT sensors or manually by farmers is saved in the distributed storage platform
consumers can explore everything by backtracing the supply chain

Fig. 6: Strip Sequence, own Illustration, based on Takyar, n.d and Aarhus University, as cited in Brame (2016)

Why?

The Strip Sequence can enhance students' logical thinking processes by challenging them to arrange different parts of a process into the correct orderand helps students apply what they have learned through reading or didactic teaching. Furthermore, it can strengthen students' logical thinking processes and test their mental model of a process (Brame, 2016).

Takyar (n.d). Aarhus University, cited in Brame (2016)
Brame (2016)
Michigan State University

1.3 LECTURE METHODS FOR ACTIVE LEARNING

1.3.5 Concept Map

What?

Concept maps help illustrate the relationships between various concepts.
Concepts are typically represented in nodes, often depicted as circles, with labeled arrows connecting them to indicate relationships.
To engage students in creating a concept map, begin by identifying key concepts either in small groups or as a whole class.
Instruct students to establish the general relationships between the concepts, arranging them in pairs. They should draw arrows connecting related concepts and label these connections with short phrases describing the relationships (Brame, 2016).

How?

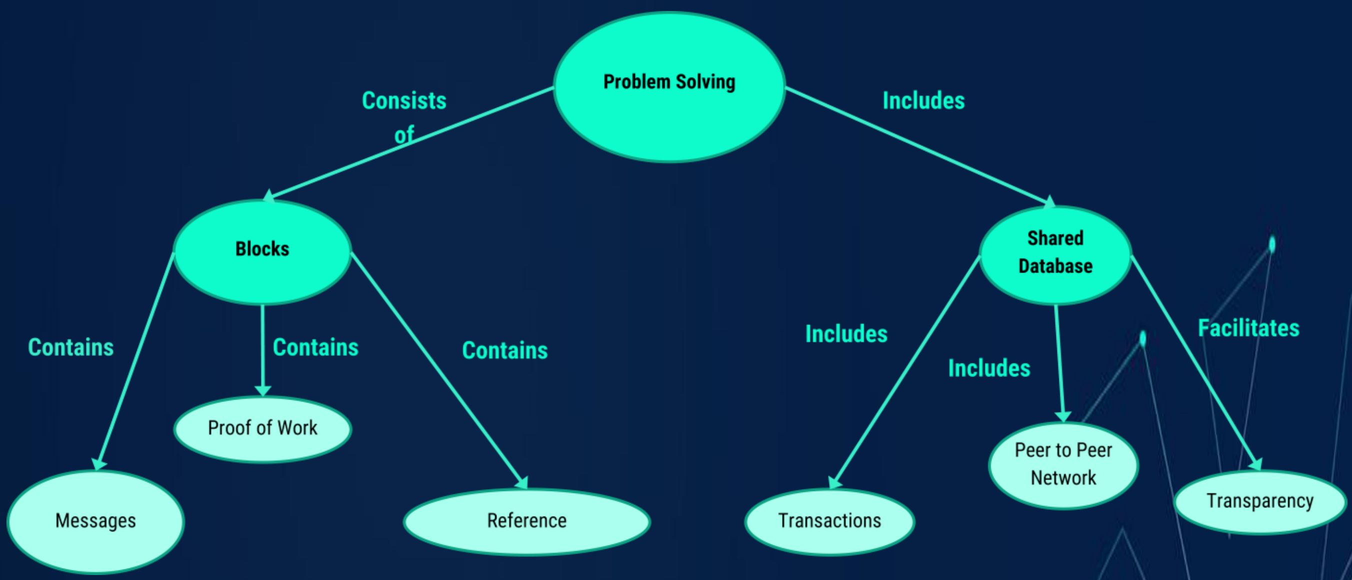

Fig. 7: Example of a Concept Map, own Illustration, based on Novak & Canas, as cited in Brame (2016); Islam et al. (2020) and Wankat & Oreovicz (2015)

Why?

By tasking students with constructing an external representation of their mental model of a process, this method facilitates the examination and enhancement of the organization within the model. Additionally, it highlights the potential for multiple "correct" answers. Due to its visual nature, a concept map is often particularly accessible for visual learners, aiding in better retention (Brame, 2016).

Novak and Canas (2008), cited in Brame (2016)
Islam et al. (2020)
Wankat & Oreovicz (2015)

1.3 LECTURE METHODS FOR ACTIVE LEARNING

1.3.6 Bloom's Taxonomy

What?

You can distribute to students the learning goals for a specific unit along with a figure encapsulating Bloom's taxonomy, featuring representative verbs for each category. In order to do this, teachers can task groups of students with the challenge of creating test questions aligned with your learning goals and levels of the taxonomy. Optionally, encourage each group to share their most favored test question with the entire class, or alternatively, distribute all student-generated questions to the class as a comprehensive study guide.

How?

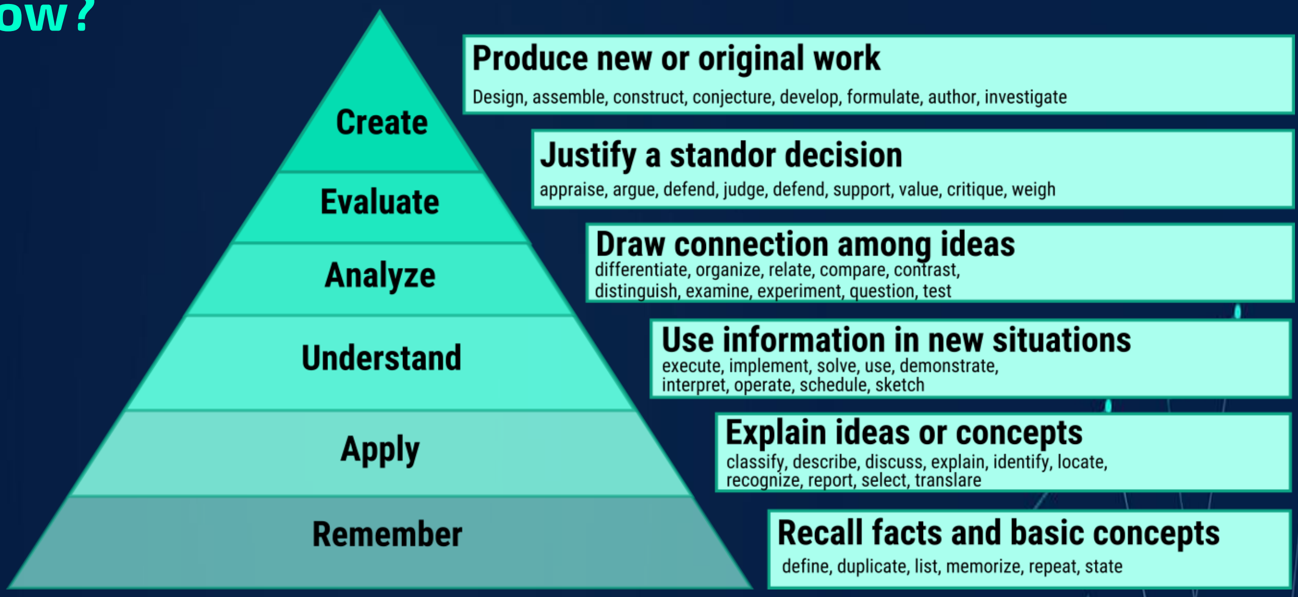

Fig. 8: Bloom's Taxonomy, own illustration, based on Bloom, as cited in Brame (2016) and Armstrong (2010)

Why?

By making use of Bloom's Taxonomy, students reflect on their existing knowledge and also contemplate the implications of the instructor's stated learning goals, ensuring that both teachers and students comprehend the purpose of that exchange. It provides clarity for instructors in defining their goals and for students in understanding the intended outcomes, which are:

- "to plan and deliver appropriate instruction";
- "to design valid assessment tasks and strategies";and
- "to ensure that instruction and assessment are aligned with the objectives."

Bloom (n.d), cited in Brame (2016)
Armstrong (2010)

1.3 LECTURE METHODS FOR ACTIVE LEARNING

1.3.7 Decision-Making Activities

What?

Decision-making activities are a teaching technique, where students are prompted to imagine themselves as policy-makers faced with difficult decisions. The practical aspect of the problems can motivate students to dig deeper and explore them (Handelsman et al., 2007).

How?

This teaching technique involves providing students with a brief description of a challenging problem, organizing them into groups to deliberate and come up with a decision, and facilitating a discussion where groups present their decisions and reasoning.

Example for blockchain

You are the administrator of a prominent blockchain network, and there's a global shortage of verified transactions. You are presented with a batch of transactions that may contain potentially harmful data, which hasn't been thoroughly analyzed yet. Will you permit these transactions to be added to the blockchain? What factors will influence your decision, and what additional information would you require before reaching a conclusion?

Fig. 9: Example of a Blockchain problem for Decision-Making Activities , own Illustration, based on Handelsman et al., as cited in Brame (2016)

Why?

The goal of employing this technique is to promote critical thinking skills and encourage students to actively engage with complex problems. By simulating real-world decision-making scenarios, students are motivated to delve deeply into the issues at hand. This approach also fosters collaborative learning and enables students to practice justifying their decisions, skills which are valuable in both academic and professional contexts.

Handelsman, Miller, and Pfund (2007), cited in Brame (2016)

1.3 LECTURE METHODS FOR ACTIVE LEARNING

1.3.8 Case-Based Learning

What?

Case-based learning is similar to the decision-making activities with the only difference that students are presented with real-world situations and tasked with applying their knowledge to analyze and make decisions about open-ended scenarios (Brame, 2016).

How?

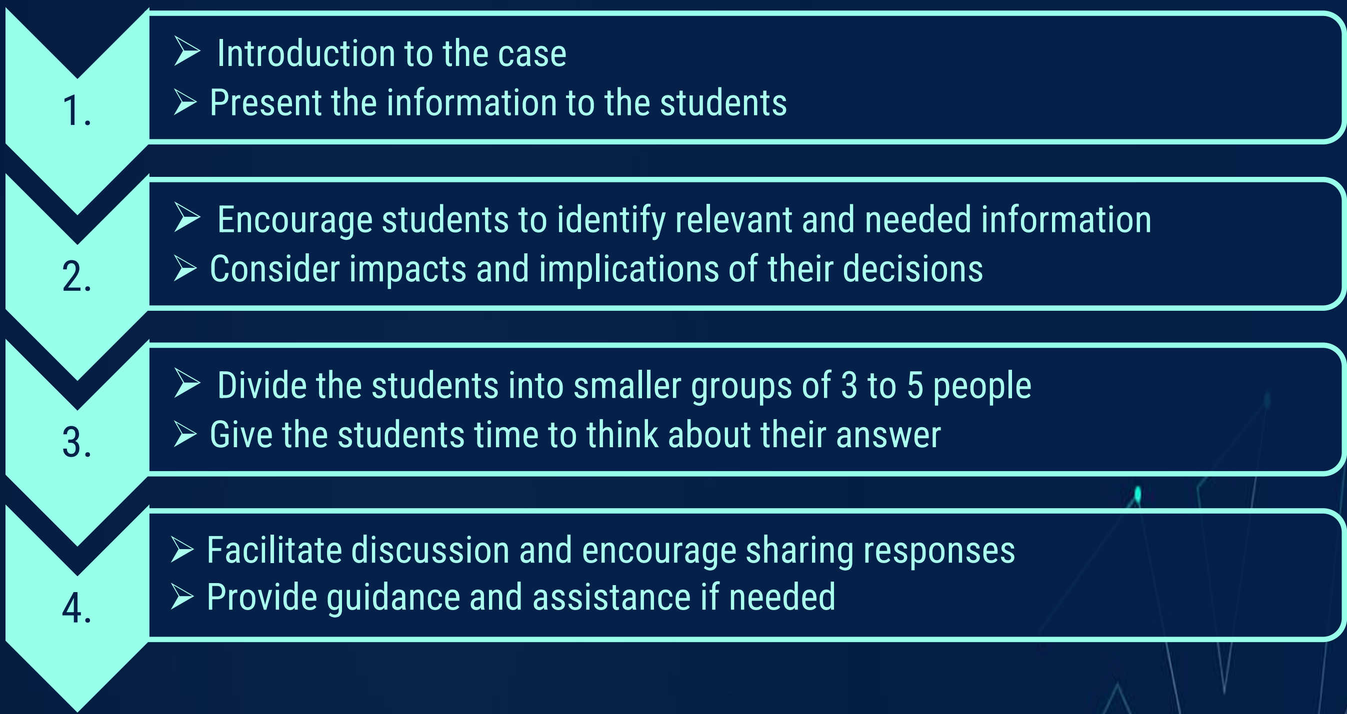

Fig. 10: The case-based learning process, own Illustration, based on Brame (2016)

Why?

The purpose of using case-based learning is to engage students in applying their knowledge to real-world situations, promoting critical thinking and problem-solving skills. By presenting authentic scenarios, students are motivated to explore and understand the complexities of the subject matter. Working in groups allows for peer interaction and discussion, enhancing comprehension and learning outcomes. Additionally, the variety of answers generated fosters a deeper understanding of the subject matter and encourages students to consider different perspectives.

National Center for Case Study Teaching in Science and World History Sources, cited in Brame (2016)

1.4 SUPPLEMENTS FOR LECTURES

The Pause Procedure, Retrieval Practice, and Demonstrations

	What?	How?	Why?
Pause Procedure	Take breaks lasting two minutes every 12 to 18 minutes, prompting students to engage in discussions and revise their notes in pairs (Bonwell and Eison, 1991; Rowe, 1980; 1986; Ruhl, Hughes, & Schloss, 1980).	To implement the procedure, plan the timing, explain the purpose, provide clear instructions and encourage engagement.	This method fosters students' reflection on their comprehension of the lecture material, including its structure. It allows for questioning, clarification, and interaction, leading to an improvement in learning compared to lectures conducted without such pauses.
Retrieval Practice	Pause for two to three minutes every 15 minutes, instructing students to write down everything they can recall from the preceding segment of the class (Brame and Biel, 2015).	Start by introducing the practice, set a timer, monitor and assist the students. Encourage them to ask questions during this time.	This practice encourages students to recall information from memory, leading to enhancements in long-term retention, their capacity to grasp subsequent material, and their aptitude for applying knowledge to unfamiliar contexts.
Demonstrations	Ask students to predict the outcome of a demonstration. Students can briefly discuss with a neighbor.	To use this technique, ask students to predict the outcome of a demonstration, allowing a brief discussion of their predictions with a neighbor, promoting peer interaction and collaboration. Conduct the demonstration, facilitate a discussion and provide an instructor explanation to clarify the concepts and any misconceptions.	This approach aims to engage students in active learning by prompting them to test their understanding of a system. Comparing predictions to observed outcomes helps students identify and correct misconceptions in their understanding of the topic (Brame, 2016).

Bonwell and Eison, (1991); Rowe (1980; 1986); Ruhl, Hughes, & Schloss (1980), Brame and Biel (2015), cited in Brame (2016)

1.4 SUPPLEMENTS FOR LECTURES

Think-Pair-Share and Minute Papers

	What?	How?	Why?
Think-Pair-Share	Ask the students a question requiring higher order thinking skills such as application or evaluation levels within Bloom's taxonomy.	Firstly, present a question to the class that demands a higher-order thinking skills. Give students one minute to individually think about or write down their responses. The groups then share their responses with the class. The final step is the receival of instructor explanation, addressing key points or common misconceptions.	This technique promotes thinking skills, which are essential for deeper learning as well as for comprehension. By engaging in individual reflection and peer discussion, students have the opportunity to articulate their thoughts and consider alternative viewpoints, leading to the formation of new mental connections (Brame, 2016).
Minute Papers	This technique involves asking students a question that prompts them to reflect on their learning or engage in critical thinking. Similar to the think-pair-share approach, the minute papers technique encourages students to articulate and examine newly formed connections between concepts (Handelsman et al., 2007).	Pose a thought-provoking question to the class that requires reflection or critical thinking. Give students one minute to individually write down their responses, allowing them to express their thoughts and insights. The students then share their responses in a discussion, or the instructor collects them to inform future class sessions (Angelo and Cross, 1993).	This technique promotes reflective thinking and critical analysis, which are essential for deepening understanding and fostering meaningful learning. Writing down individual responses allows students to organize their thoughts and clarify their understanding of the topic. Collecting responses to inform future class sessions helps instructors identify areas where students may need additional support or instruction, allowing for more targeted and effective teaching strategies.

Table 1: Types of supplements for lectures, adapted from Brame (2016); Angelo and Cross (1993); Handelsman, Miller, and Pfund (2007)

Brame (2016), Angelo and Cross (1993), Handelsman, Miller, and Pfund (2007), cited in Brame (2016)

2 TEACHING METHODS

In the next segment, we will examine various learning methods that can help students to understand the concepts of blockchain and offer multiple approaches for different kinds of learning styles and preferences. By addressing these learning methods, the students can be empowered to improve their understanding of blockchain within their field of study.

2.1 THE SCIENTIFIC LEARNING CYCLE

What?

The technique described is the "scientific learning cycle," which is a methodological approach to teaching science subjects. It consists of three distinct phases: Exploration, Term Introduction, and Concept Application (Wankat, 2015).

How?

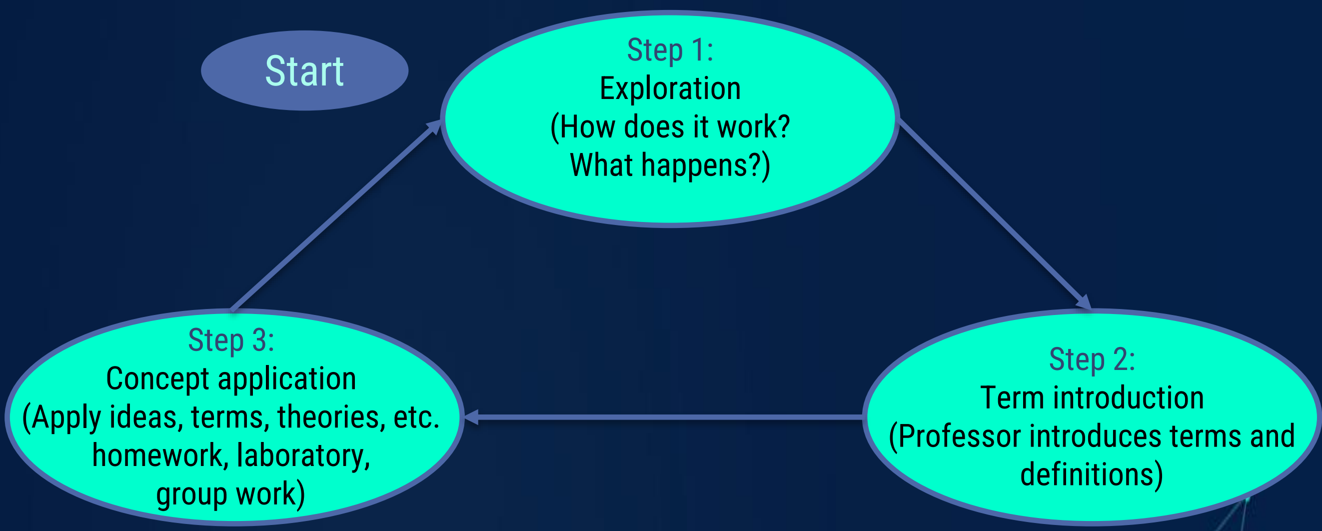

Fig. 11: The scientific learning cycle steps, own Illustration, based on Wankat (2015)

The Exploration phase involves students autonomously exploring new phenomena with minimal guidance. The Term Introduction phase includes the professor introducing terminology and providing additional information to complete the scientific picture. The Concept Application phase requires students to apply the newly acquired knowledge to different contexts or examples. Throughout the process, various instructional methods can be employed, such as lectures, readings, homework assignments, group discussions, or laboratory experiments.

Why?

The scientific learning cycle aims to foster independent discovery and understanding among students. By engaging in the Exploration phase, students can uncover patterns on their own, promoting deeper understanding and retention. The Term Introduction phase helps students acquire relevant terminology and definitions, aiding in the comprehensive description of identified patterns. The Concept Application phase allows students to apply their newfound knowledge to different examples, reinforcing understanding and facilitating knowledge transfer.

Wankat (2015)

2.2 VARK LEARNING STYLES

What?

The VARK learning styles stands for Visual, Aural, Reading/ Writing, and Kinaesthetic learning styles. VARK categorizes individuals into different learning preferences based on how they prefer to receive and process information (Fleming, 1995). Each learning style is associated with specific modes of learning:

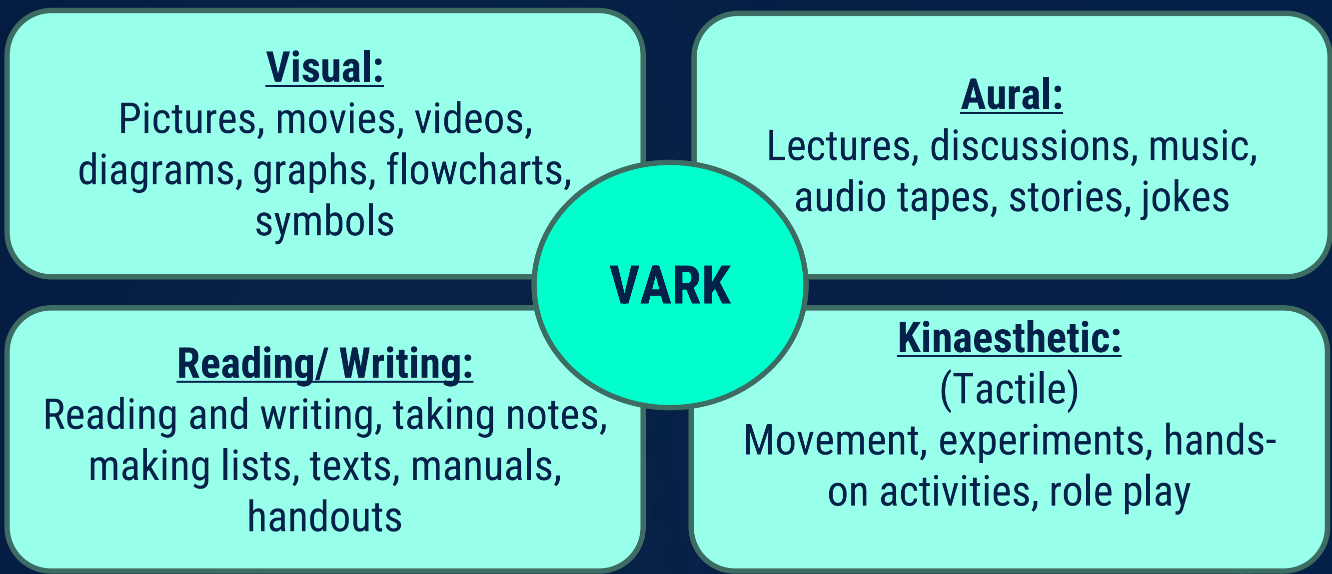

Fig. 12: VARK models of learning, own Illustration, based on Wankat (2015)

How?

Determining different learning styles involves answering typical questions. Each question is designed to assess a specific learning preference. For example, visual learners are identified by their preference for seeing information to remember it, while aural learners prefer listening to class lectures over reading from the textbook. Once individuals identify their learning style, they can adapt their learning strategies to align with their preferences. For example, visual learners may benefit from using diagrams or videos, while kinesthetic learners may prefer hands-on activities (Fleming and Mills, 1992).

Why?

The VARK learning styles framework helps individuals understand their preferred way of learning and tailor their study strategies accordingly. Recognizing and accommodating different learning styles can enhance learning outcomes by optimizing the way information is presented and processed (Wankat, 2015).

Wankat (2015); Fleming and Mills (1992) and Fleming (1995), cited in Wankat (2015)

2.3 KOLB'S LEARNING CYCLE

What?

Kolb's learning cycle outlines the essential steps for comprehensive learning, serving as a framework to understand how individuals learn and design effective educational programs (Kolb, 1984; 1985). It identifies four learning steps derived from two dichotomies: active experimentation (AE) versus reflective observation (RO), and abstract conceptualization (AC) versus concrete experience (CE).

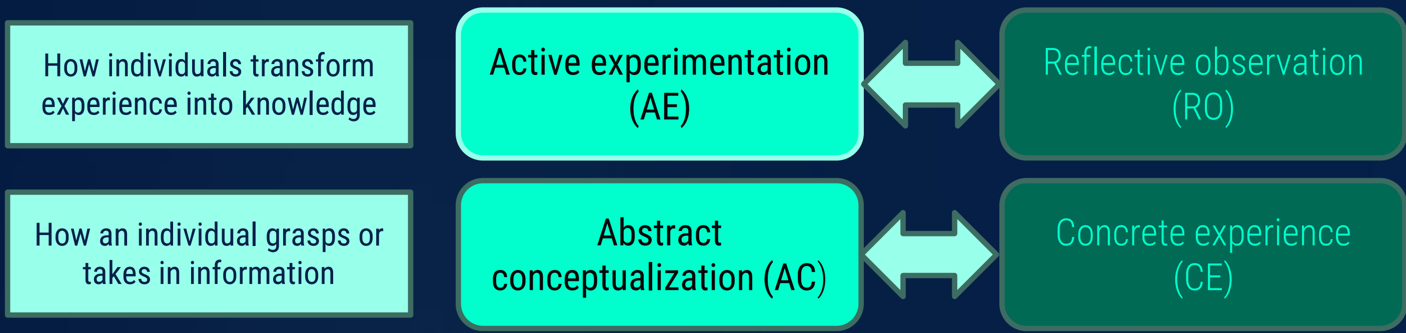

Fig. 13: Kolb's learning cycle, own Illustration, based on Kolb (1984; 1985)

How?

The first dichotomy pertains to how individuals convert experience into knowledge. Active experimentation involves doing things and observing results, while reflective observation involves examining ideas from various angles and delaying action. The second dimension in Kolb's theory is the dichotomy, distinguishing how an individual absorbs information. In abstract conceptualization, individuals use logical analysis, abstract thinking, and systematic planning, while in concrete experience, they learn from specific experiences and personal involvement, often in a non-systematic manner (Wankat, 2015).

Why?

Kolb views each of these four steps as integral to a complete learning cycle. For instance, a lecture (RO) can be followed by activities like thinking about the ideas (AC), doing homework (AE), and participating in demonstrations or laboratory experiments (CE). Incorporating a conversation about the material can enhance the effectiveness of the RO by encouraging students to reflect from multiple viewpoints (Kolb, 1985). Abdulwahed and Nagy (2009) applied a model based on Kolb's cycle in a process control laboratory, resulting in better student learning

Wankat (2015), Kolb (1984; 1985), Abdulwahed and Nagy (2009), cited in Wankat (2015)

2.4 KOLB'S LEARNING STYLES

What?

Kolb's theory of learning styles categorizes learners into four types: imaginative (divergers), analytic (assimilators), common sense (convergers), and dynamic (accommodators). Each of the different categories prefers a different approach to learning based on their inclination towards the different learning steps from Kolb's learning cycle (CE, RO, AC, AE) (Kolb, 1985).

How?

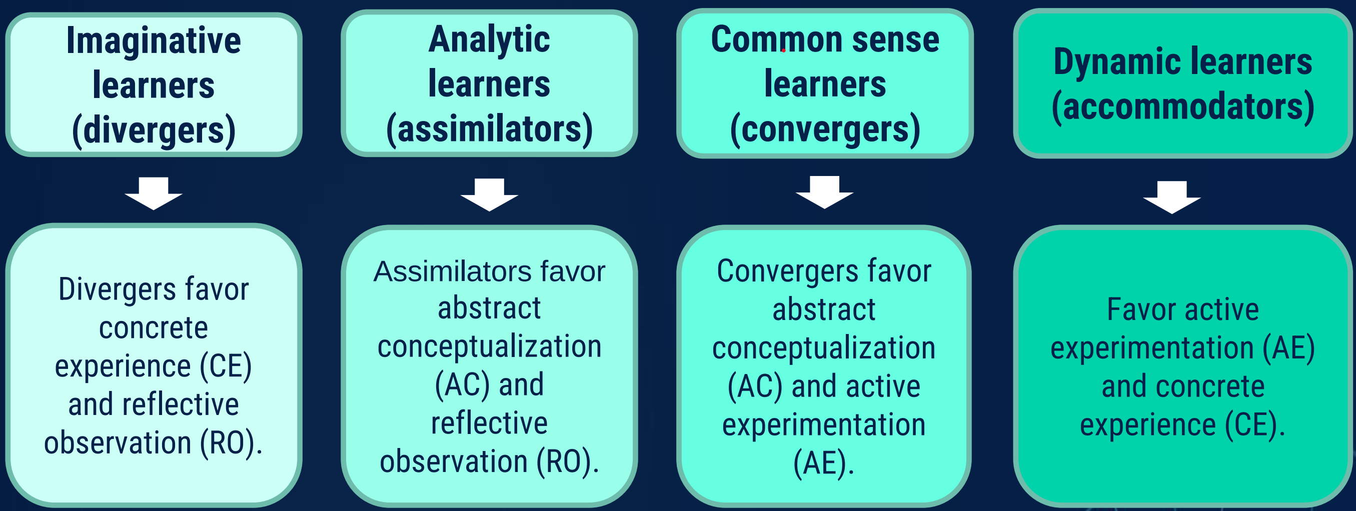

Fig. 14 Kolb's learning styles, own Illustration, based on Kolb (1984; 1985) and Wankat (2015)

Why?

While individuals may have preferred learning styles, everyone can develop all four steps in Kolb's learning cycle. The purpose of Kolb's learning style theory is to highlight the diversity of learning styles and the importance of accommodating these differences in educational settings to optimize learning outcomes and cater to individual strengths and preferences.

Mismatches between teacher and student styles can lead to difficulties, emphasizing the importance of incorporating activities catering to each learning style to foster skill development and understanding (Wankat, 2015).

Wankat (2015), Kolb (1984; 1985), cited in Wankat (2015)

2.5 ACTIVE LEARNING METHODS

2.5.1 Team-Based Learning

What?

Team-based learning originated as a method to enhance learning outcomes by promoting discussion among students and teams. Over time, it has developed into a methodology widely employed in reputable universities, corporations, and government agencies to enhance student engagement, retain knowledge, and improve the application of concepts beyond the classroom (Brame, 2016).

How?

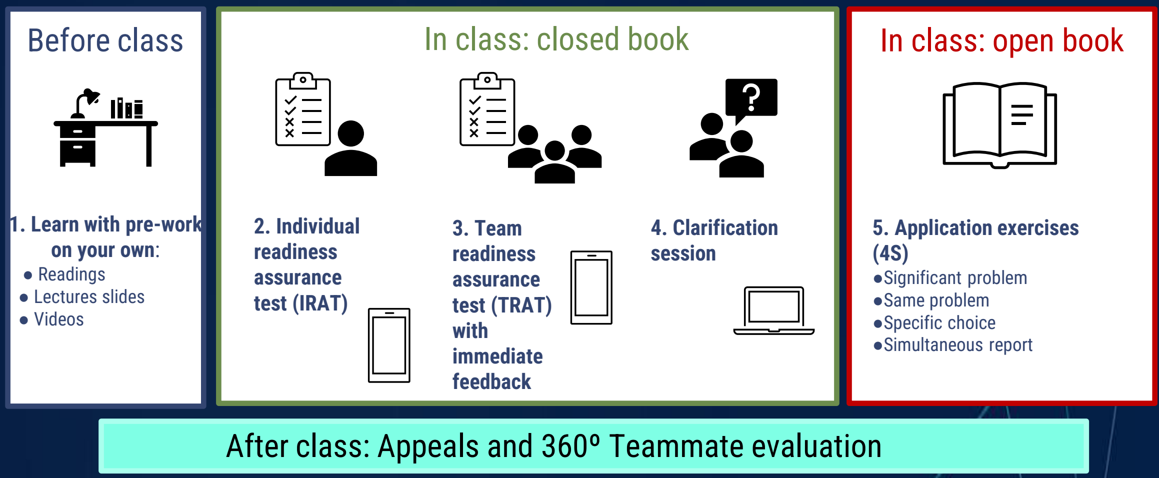

Fig. 15: The team-based learning process, own Illustration, based on InteDashboard (2020)

First, Students are provided with material to review before the class. Then they individually complete a multiple-choice test to assess their understanding. In the following, The same test is completed by students in teams, allowing for discussion. After this, the instructor addresses any issues or questions raised. Then, Students apply their recently acquired knowledge to solve real-world problems in teams.
Finally, the students assess each other's performance (with an InteDashboard).

Why?

Team-based learning encourages engaging and interactive classes, it also prepares students for the workforce. Another benefit it that it fosters the development of high-performing teams, as well as enhances learning retention. Finally, this method adopts the 'flipped classroom' approach, emphasizing quality learning through group activities and discussions.

Brame (2016)
InteDashboard (2020), cited in Brame (2016)

2.5 ACTIVE LEARNING METHODS

2.5.2 Peer-Led Team Learning

What?

Peer-Led Team Learning (PLTL) is an active learning approach involving small group interactions (Snyder et al., 2016).

How?

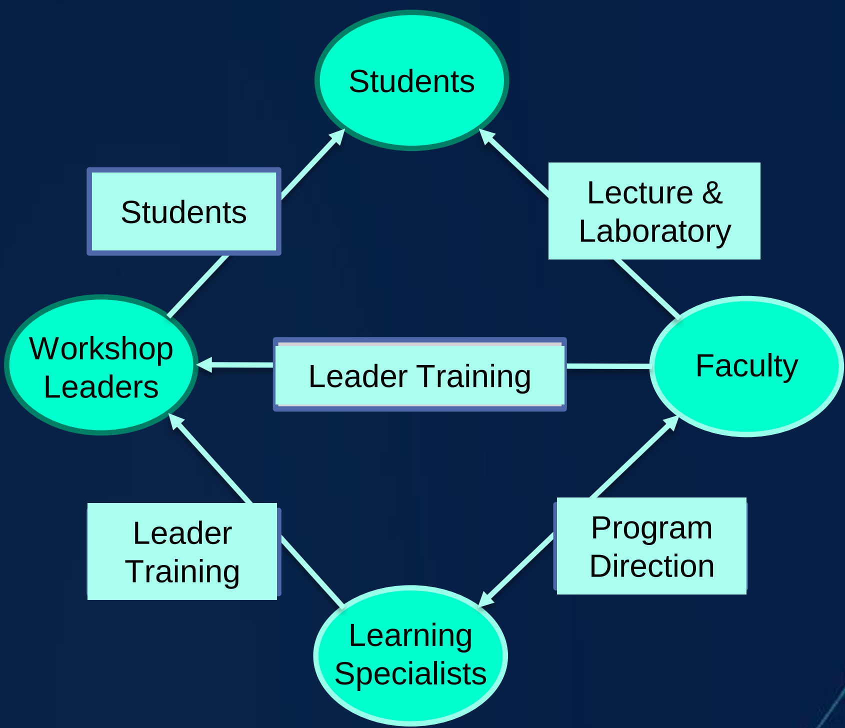

Fig. 16: Example of peer-led team learning, own Illustration, based on Snyder et al. (2016)

Students collaborate in small groups, guided by an undergraduate peer leader who has successfully completed the same course. Peer leaders work alongside an education specialist and the course instructor to facilitate small group problem-solving. They act as role models and are not positioned as teachers, tutors, or content experts. (Snyder et al., 2016).

Why?

Viewing the peer leader as relatable and considering them as a role model is both linked to higher student assessments of learning gains from PLTL sessions. This is significant for institutions aiming to reduce attrition rates, as students who perceive themselves as learning and successful are more likely to remain in a course and persist in the discipline until graduation. (Winterton, Dunk, and Wiles, 2020).

Snyder et al. (2016)
Winterton, Dunk, Wiles (2020)

2.5 ACTIVE LEARNING METHODS

2.5.3 Problem-Based Learning

What?

Problem-based learning (PBL) fosters collaborative problem-solving through real-life case-based scenarios in small groups of 4-6 students, aiming to cultivate self-directed learners capable of applying theoretical knowledge to practical contexts (Fukuzawa, 2019).

How?

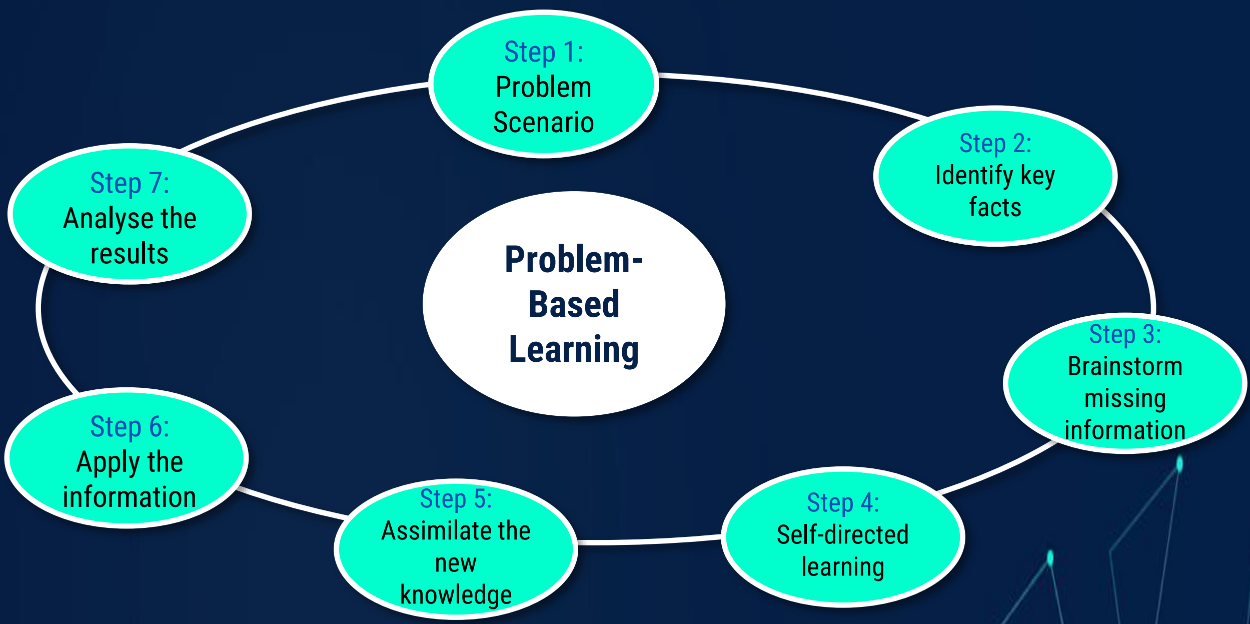

Fig. 17: Problem-based learning stages, own Illustration, based on Fukuzawa/ Teaching Anthropology (2019)

students receive a problem rooted in course material. They brainstorm hypotheses, create learning outcomes, identify necessary information, assign individual tasks for information gathering, reconvene to discuss findings, test hypotheses using shared information, and repeat the process if needed. The final step involves producing a collaborative PBL report (Bate, Hommes, Duvivier, & Taylor, 2014; Schmidt, 1983; Wood, 2003).

Why?

Instructors serve as facilitators, meeting with each group to guide discussions and oversee the investigative process. PBL investigations are open-ended, and assessment is focused on the investigative process rather than solely on the solution. PBL methods have been associated with increased student satisfaction, improved problem-solving skills, and enhanced self-directed independent learning (Fukuzawa, 2019).

Fukuzawa (2019), Bate, Hommes, Duvivier, & Taylor (2014); Schmidt (1983); Wood (2003), cited in Fukuzawa (2019)

3 PRACTICAL EXAMPLE

In the following part, a practical example of a game that can be used to teach blockchain will be presented. It can help students in agricultural sciences to explain blockchain better and easier by applicating it during the lecture.

3. PRACTICAL EXAMPLE OF A GAME TO TEACH BLOCKCHAIN

1 Determine learning goals

Example: Understanding the principles of blockchain.

2 Select game materials

Utilize a card game format where cards are placed face down, and players claim opponents' cards upon correct guesses.

3 Design game structures

In blockchain, every user stores their transaction data, requiring modification of at least 51% of users' records to alter transactions. Design a game structure where guessing multiple cards in one try is harder than guessing and claiming a single card.

4 Design game materials

To play the game, designers must provide a manual explaining the rules and a deck of cards. Figure 1 shows a sample card from the game.

5 Write game rules

Rules of the Game:

- Each card has one of three colors on its back.
- Turn over six red cards during the game.
- During a player's turn, announce the presumed amount of money on an opponent's card and flip it over. If correct, claim the card; if wrong, return it face down.
- Once all six blue cards are revealed, flip over a gold card.
- Correctly guessing the money amount on an opponent's card allows claiming it, with different conditions based on the card color:
- For red cards, claim immediately upon correct guess.
- For blue cards, claim if two cards with the same amount are flipped.
- For gold cards, claim after revealing three cards with the same amount

6 Test and revise

Test the designed game, detect any issues encountered during the trial, and implement the required adjustments to refine the game into a more coherent model.

Fig. 18 : Blockchain game rules, own illustration, based on Choi et al. (2021)

Choi et al. (2021)

3. PRACTICAL EXAMPLE OF A GAME TO TEACH BLOCKCHAIN

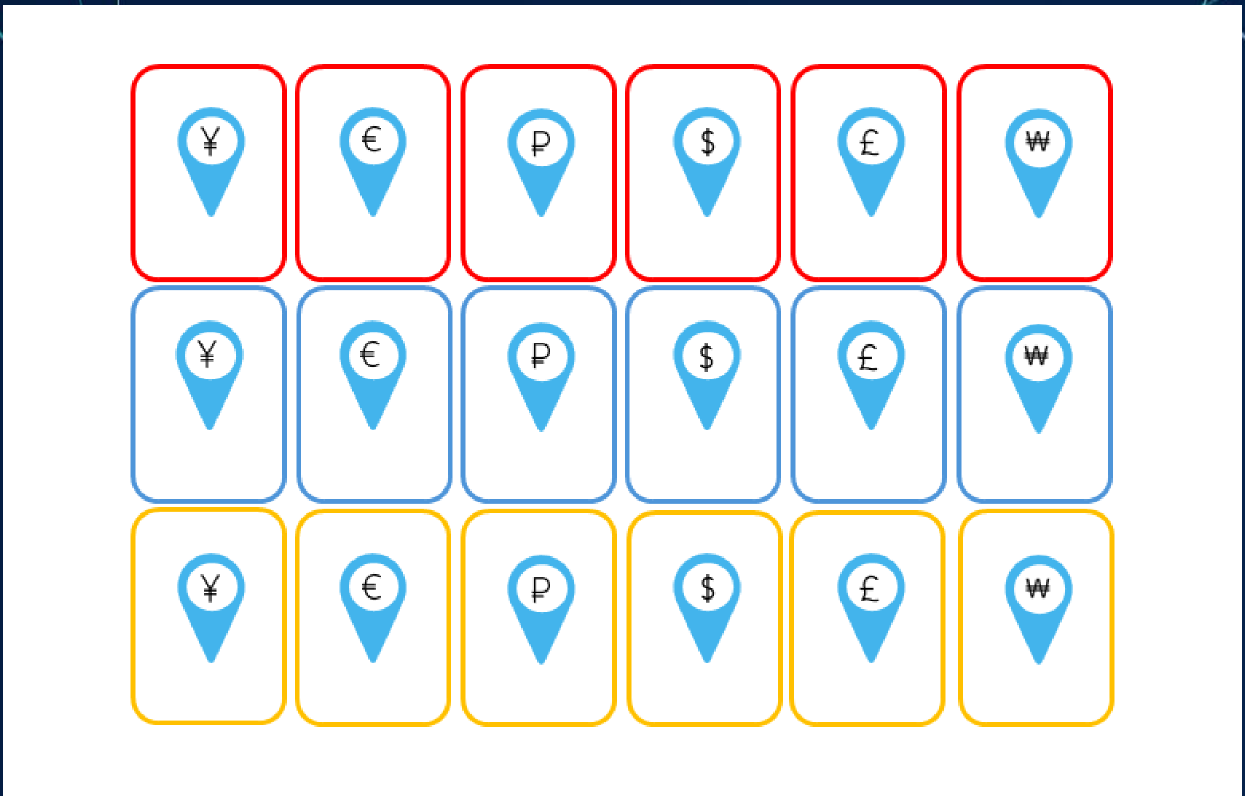

Fig. 19 : Game cards, own illustration, based on Choi et al. (2021)

Choi et al. (2021)

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List of Abbreviations

AC	Abstract Conceptualization
AE	Active Experimentation
CE	Concrete Experience
IRAT	Individual Readiness Assurance Test
PBL	Problem-Based Learning
PLTL	Peer-Led Team Learning
RO	Reflective Observation
TRAT	Team Readiness Assurance Test
VARK	Visual, Aural, Reading/ Writing, and Kinaesthetic

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Blockchain teaching in higher education in the agri-food sector

Research-based guide for blockchain education in the agri-food sector with recommendations for pedagogical strategies for blockchain education in the agri-food sector

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Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Co-funded by the European Union