Workshop: How to Design Gamified Learning Environments

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What is Gamification?

Ludus

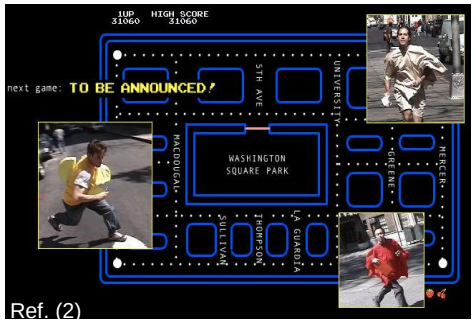
Applies to the whole

Specific to Element

Paidia

Game Sérios

Gamification



Play

Playful design

1. Photo (https://goo.gl/R4fAwA) by Serious-Game.fr/CC 2.0
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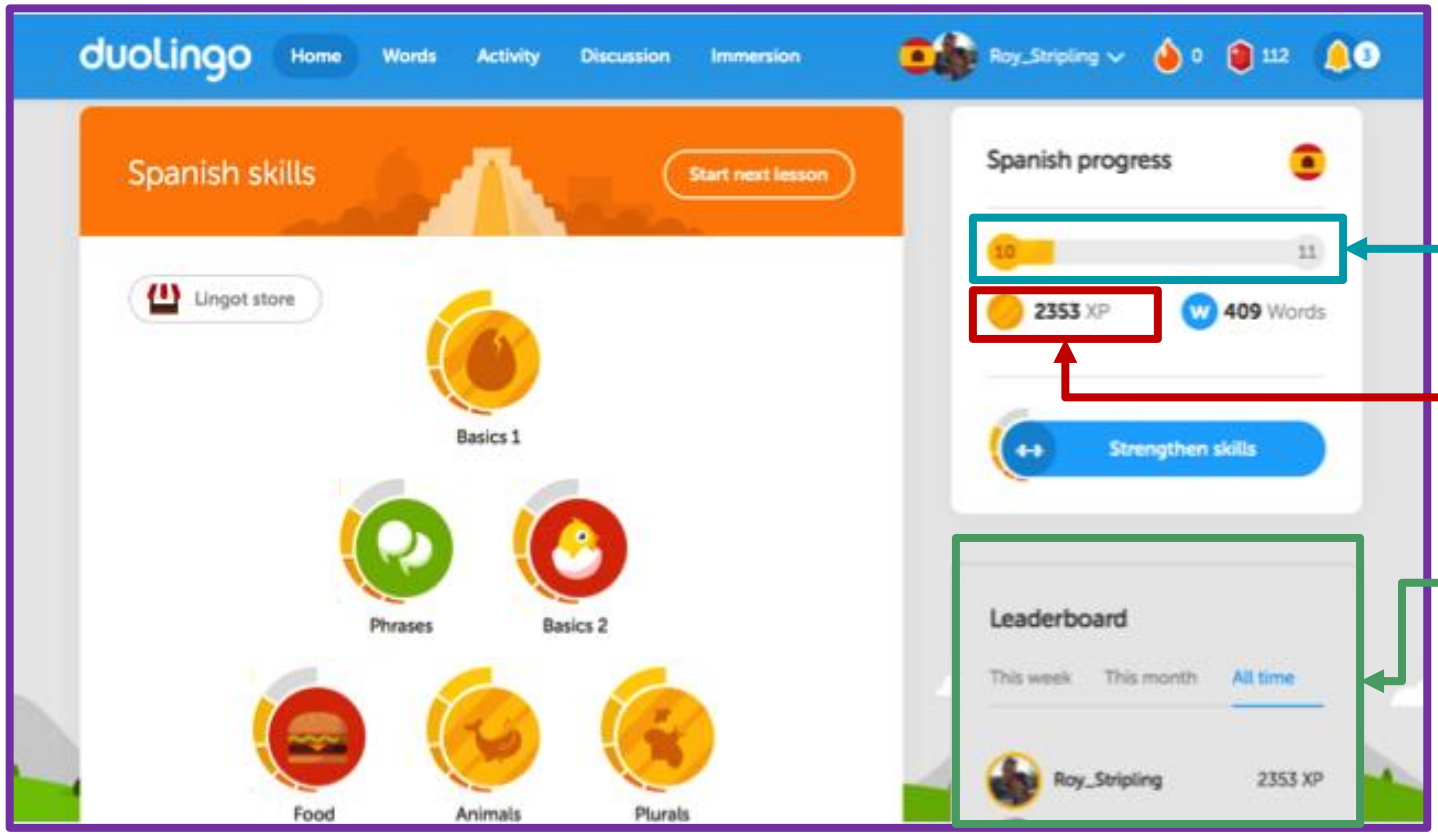
What is Gamification?

*"the use of **game design elements** in nongame contexts"*
(Deterding, Dixon, Khaled, & Nacke, 2011)

"Gamification is not itself a product; one [a teacher] does not create a gamification as one creates a game. Instead, one [a teacher] adds game elements to change a process that already exists to change how that process influences people"[1]

[1] Gamification Science, Its History and Future: Definitions and a Research Agenda
Richard N. Landers, Elena M. Auer, Andrew B. Collmus, and Michael B. Armstrong

What is Game Design Elements?

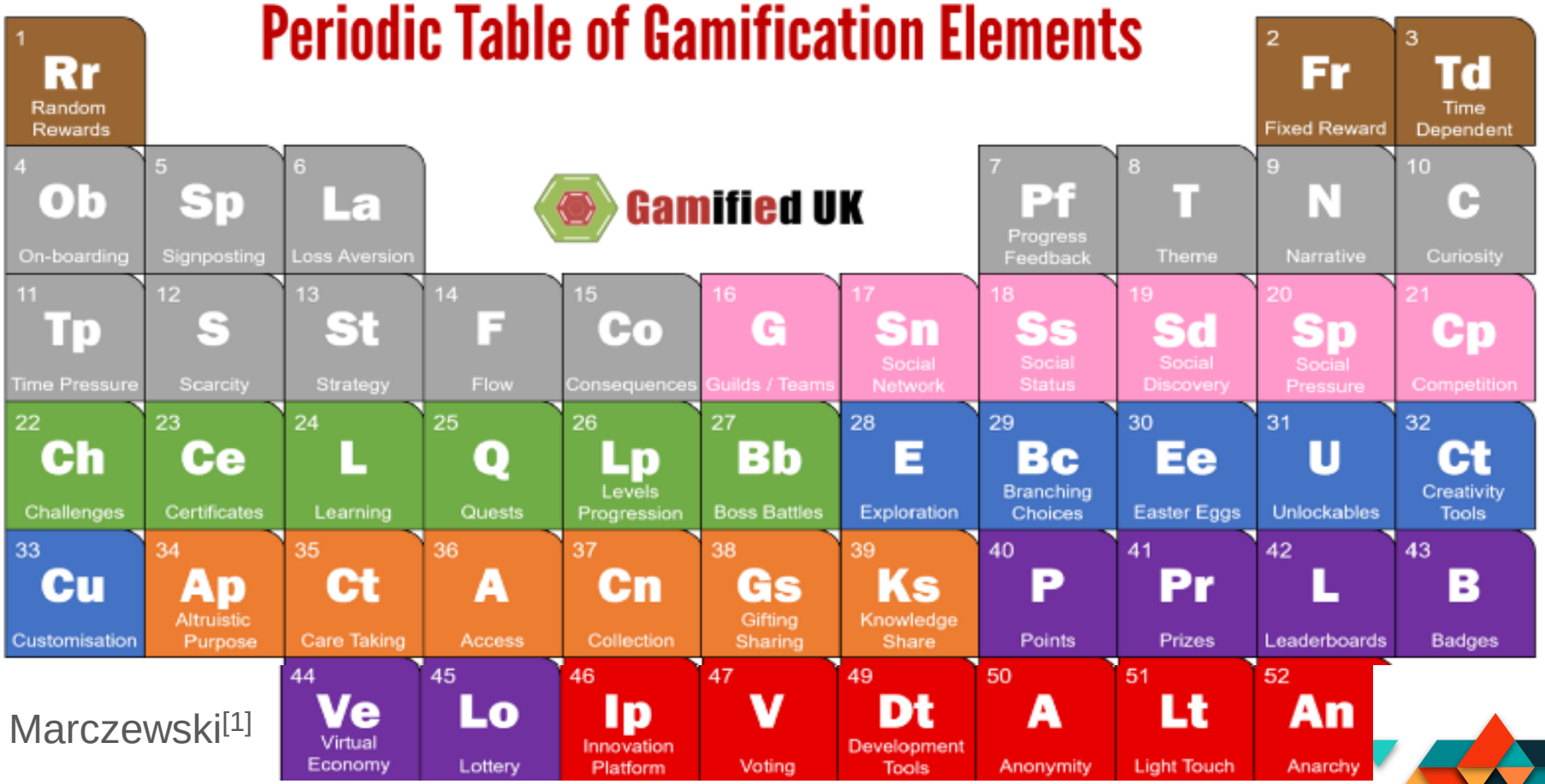


Progress Bar

Points

Leaderboard

What is Game Design Elements?



Marczewski[1]

MDA & MDC Framework to classify game design elements

A game developer perspective

Mechanics, Dynamics and Aesthetics (MDA) framework

- **M**echanics: the basic rules or components of the game
- **D**ynamics: the behavior of the player with the mechanics
- **A**esthetics: the emotional responses of the player

MDA: *Hunicke, LeBlanc, & Zubek (2004)*

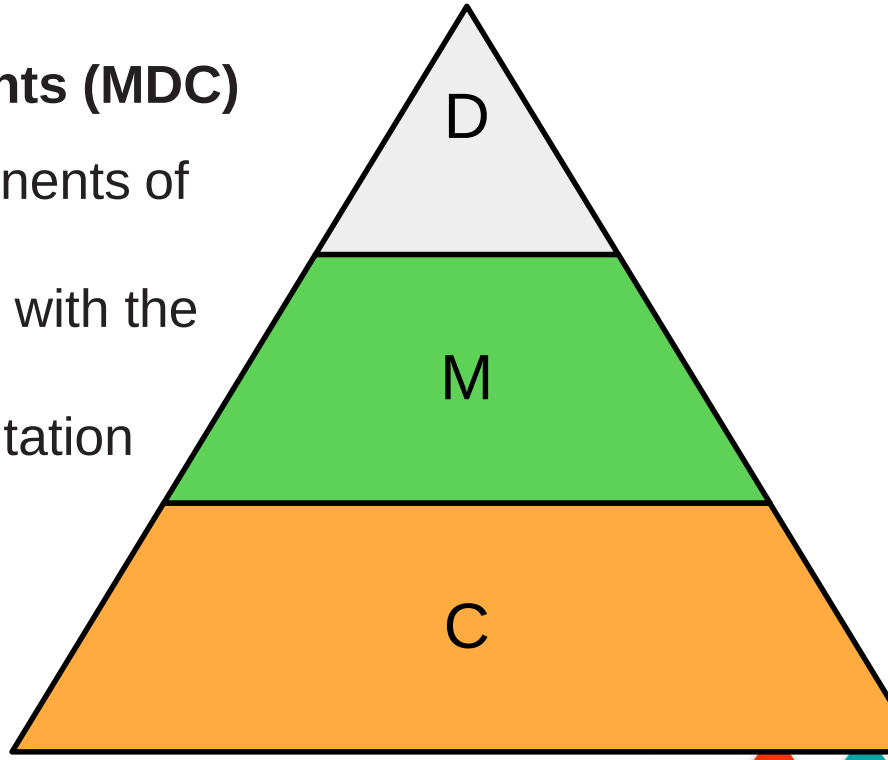
MDA & MDC Framework to classify game design elements

A game developer perspective

Mechanics, Dynamics and Components (MDC)

- **M**echanics: the basic rules or components of the game
- **D**ynamics: the behavior of the player with the mechanics
- **C**omponents: the M and D implementation

Extends MDA framework

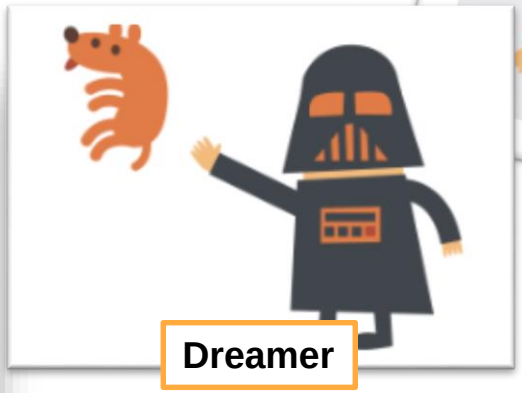


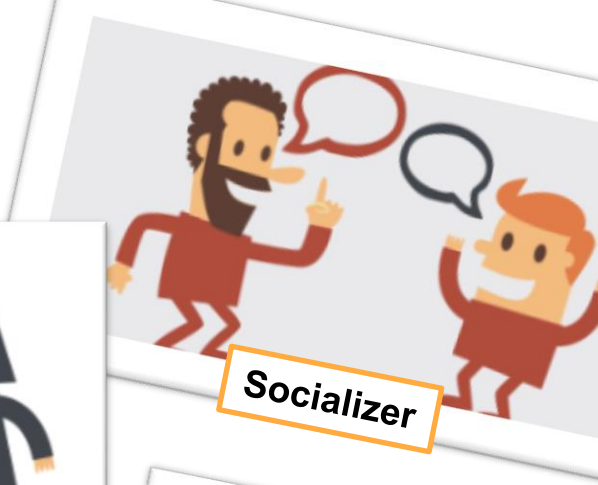
Kevin Werbach (2012)

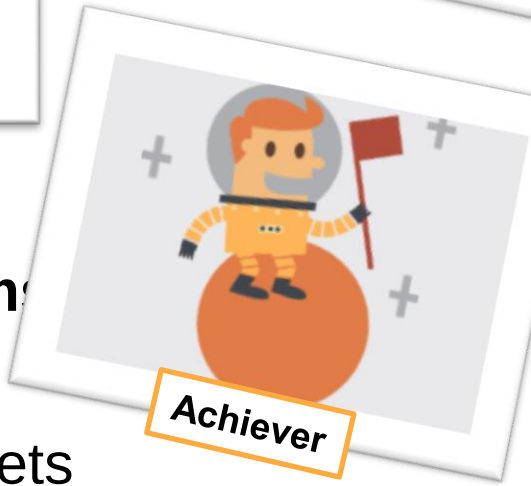
Player Profiles & Player Models

Yee (2016) **Player Types**

Achievements: *Advancement, Mechanics, Competition.*
Social: *Socializing, Relationship, Teamwork.*
Immersion: *Discovery, Role Playing, Customization, Escapism.*





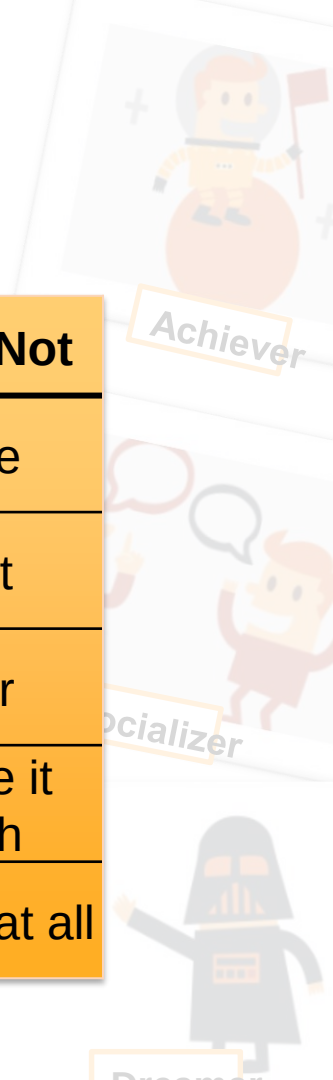


Player Types Questionnaire to Gamified System
(Andrade, Marques, Bittencourt & Isotani, 2016)

- Variation of Yee Player Types → no subcomponets
- Aimed at the general public

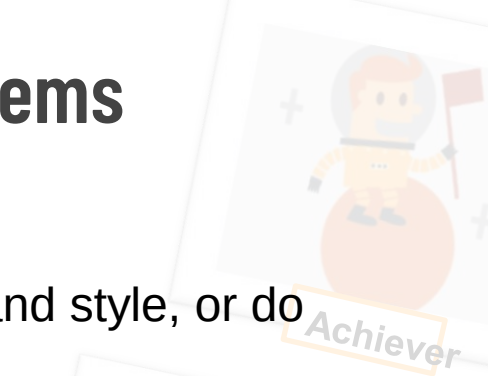
Player Types Questionnaire to Gamified Systems

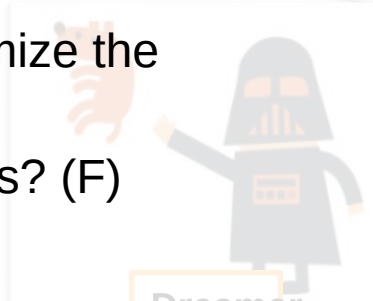
Score	HI - How Important	F - Frequency	L - Like or Not
2	Really important	Always	Really like
1	Important	Often	I like a bit
0	Whatever	I do not know for sure	Whatever
-1	Little importance	Rarely	I do not like it very much
-2	No important	Never	I don't like it at all



Player Types Questionnaire to Gamified Systems

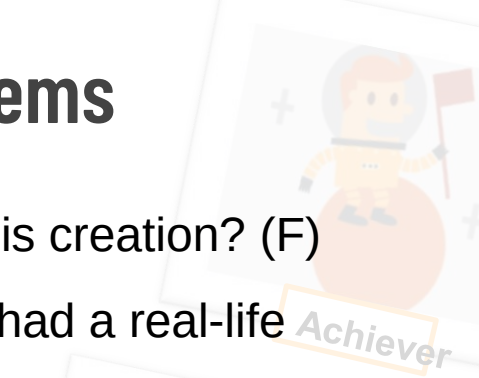
1. Be in advantage in relation to the other players? (HI)
2. About your character's armor or clothing matching in color and style, or do the pieces of the game look interesting? (HI)
3. Observe your own performance in relation to other players (HI)
4. About the appearance of your character, be different from the appearance of other characters? (HI)
5. To you, compete with other players is.. (HI)
6. You become very good at a game is.. (HI)
7. Defeat other players? (F)
8. Do you think of items or features that could be changed to customize the appearance of your character or the game itself? (F)
9. Chat with other players (online) about your personal issues/issues? (F)
10. Try to provoke or irritate on purpose other players? (F)

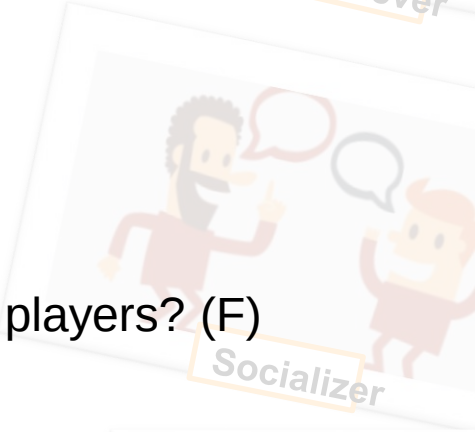




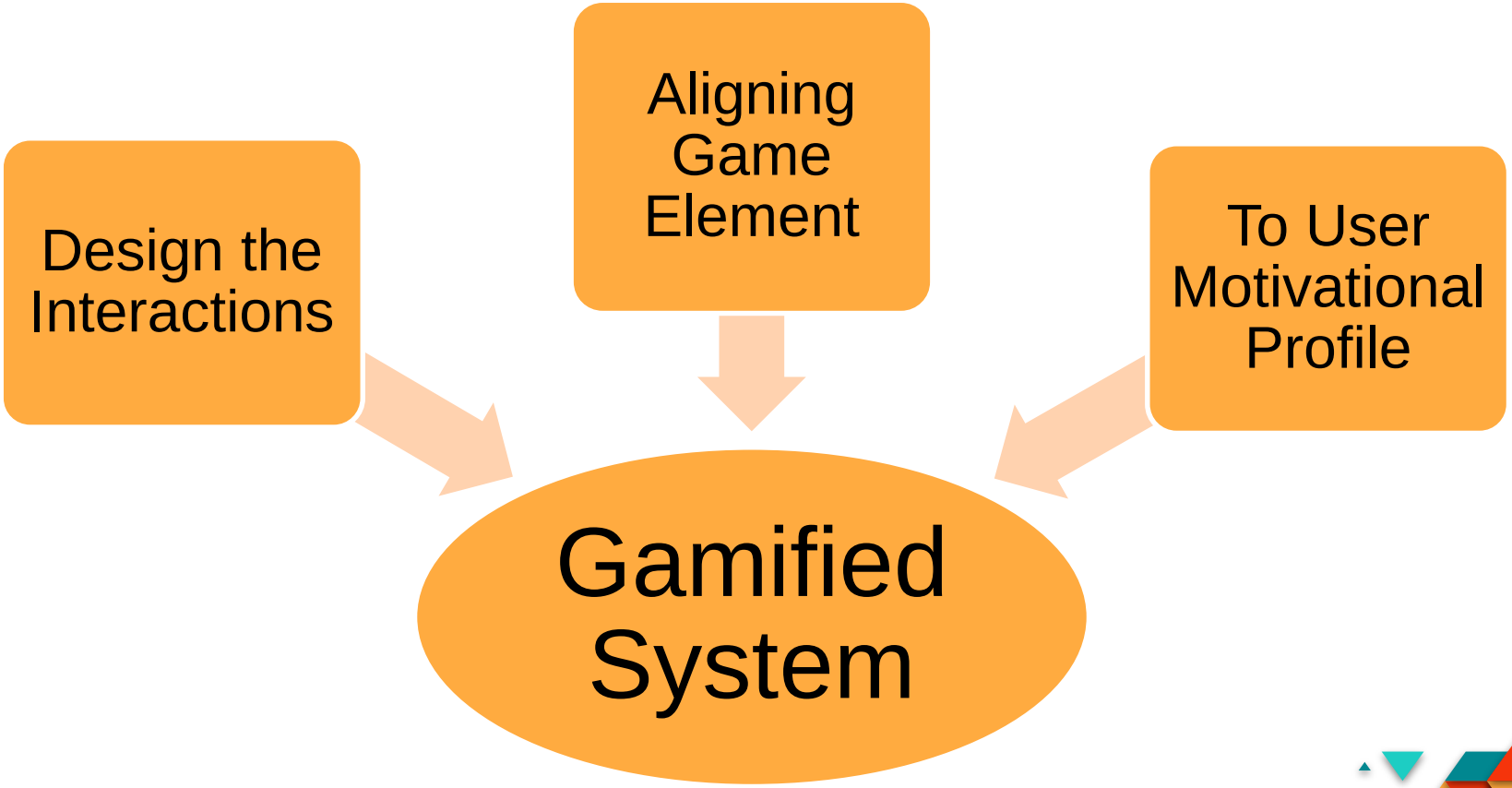
Player Types Questionnaire to Gamified Systems

11. How long do you spend customizing your character during his creation? (F)
12. How often other players (online) offered you help when you had a real-life problem? (F)
13. Do you like being immersed in a fantasy world? (F)
14. Looking to be part of a group at games? (F)
15. How often do you have meaningful conversations with other players? (F)
16. Do you like helping other players? (L)
17. Do you like to do actions/things that irritate other players? (L)
18. Do you like meeting other players? (L)
19. Do you like chatting with other players? (L)

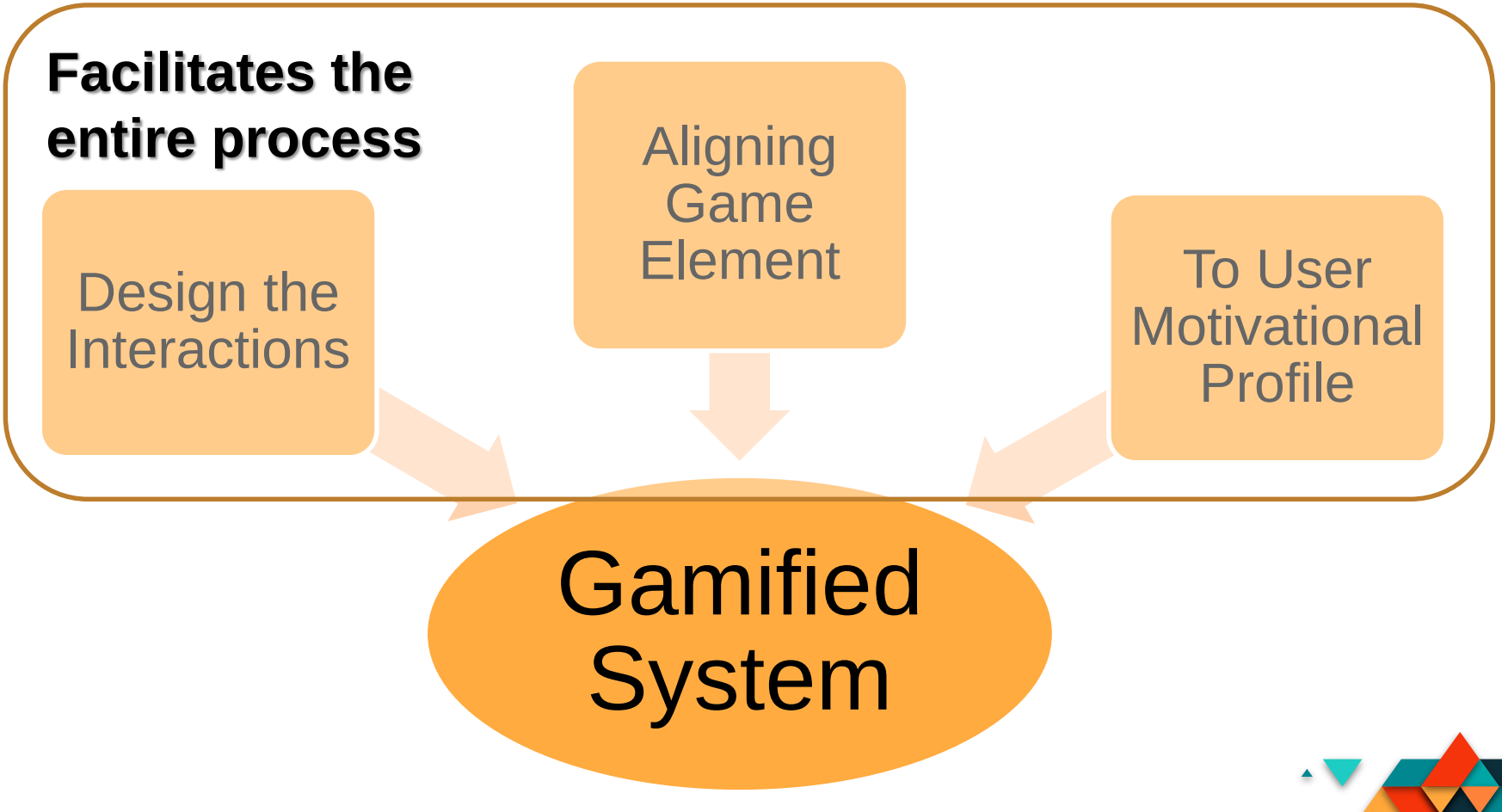




Gamification frameworks

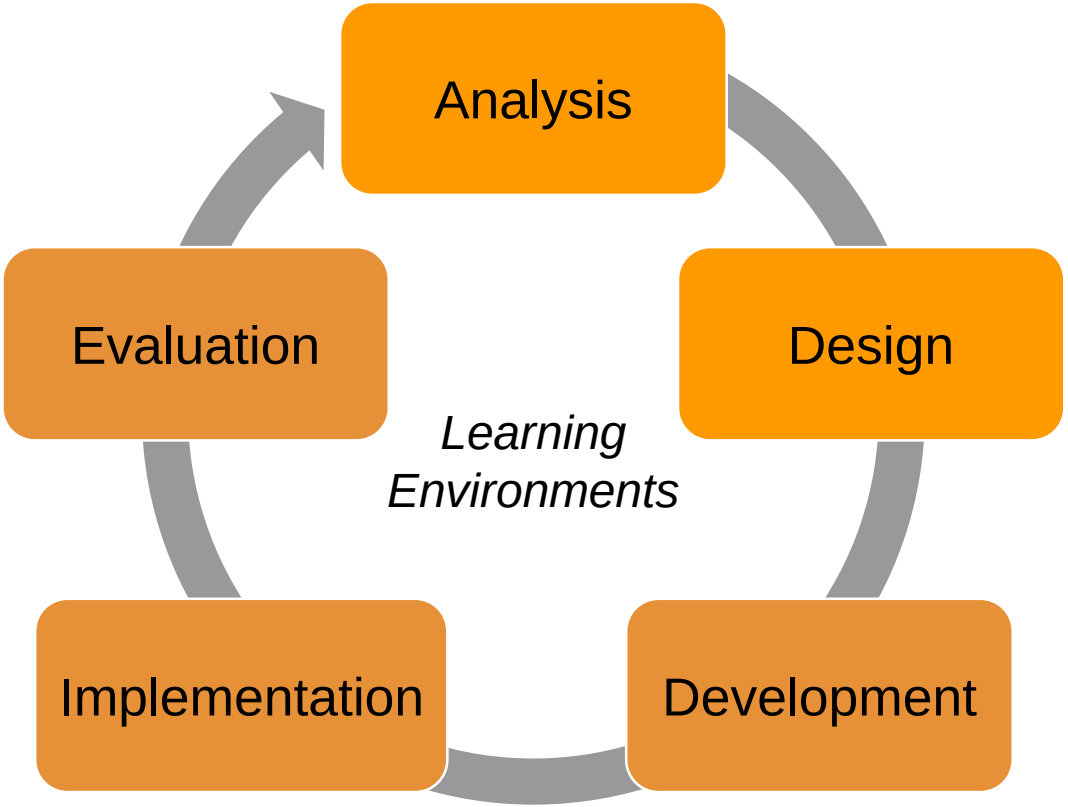


Gamification frameworks

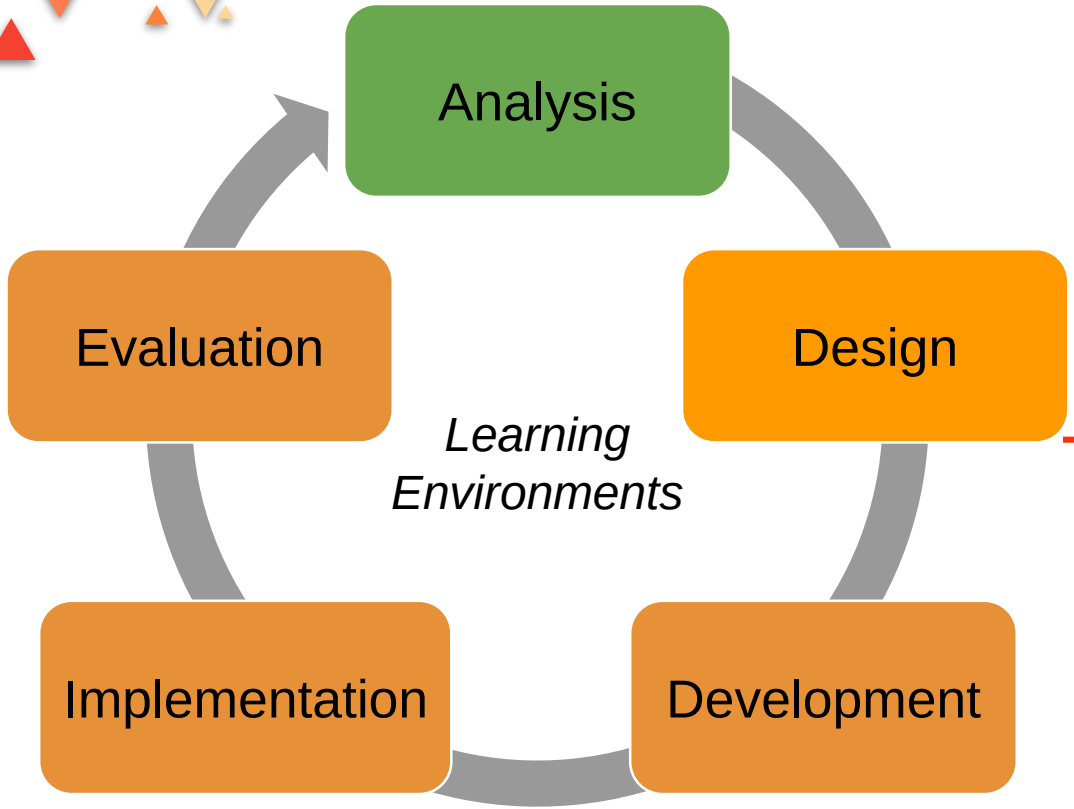


Gamiflow

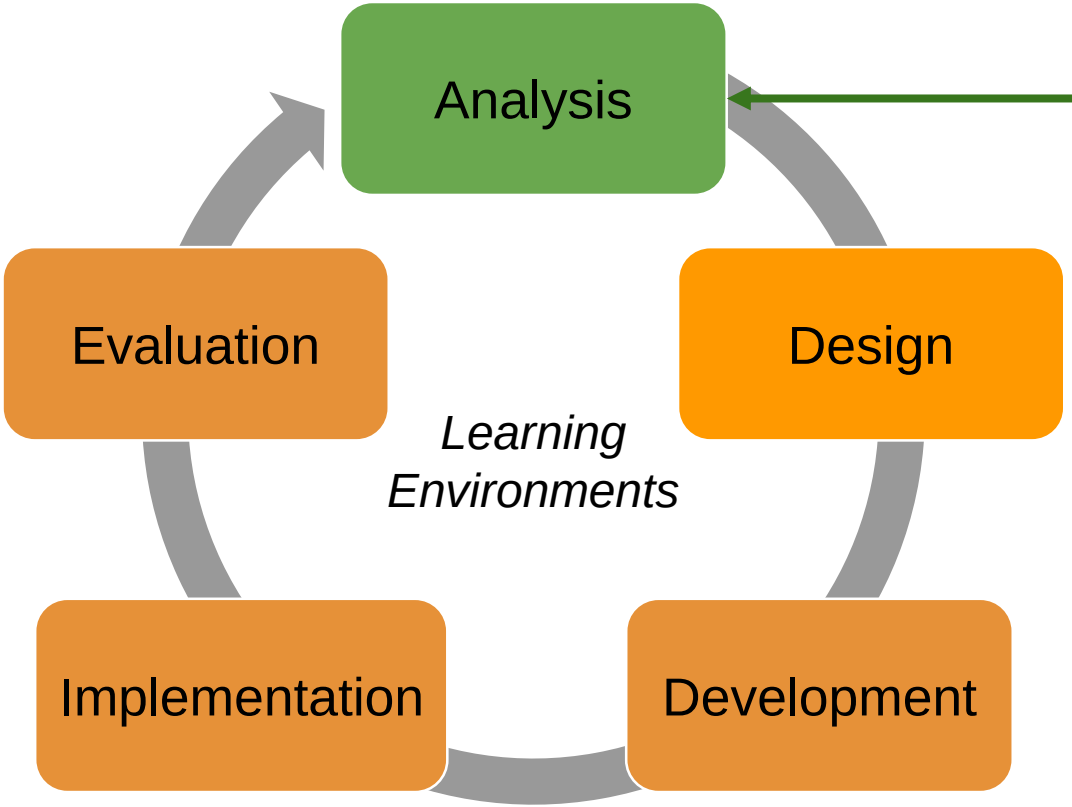
A framework to **gamify** learning environments based on the **flow** theory



Five iterative stages based on the traditional instructional design ADDIE model

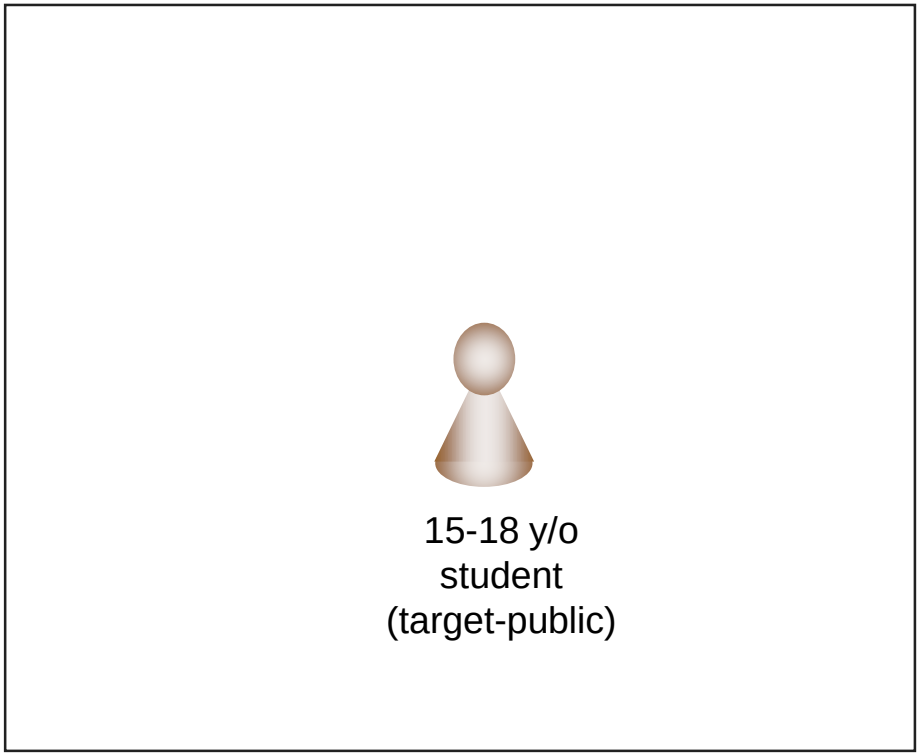


Analysis Phase



1. Describing the characteristics of the non-game context
2. Identifying the engagement problems
3. Understanding the motivational problems based on flow theory
4. Defining the engagement goals
5. Delineating the target-behaviors
6. Identifying the player profiles

(A.1) Describing the characteristics of the non-game context

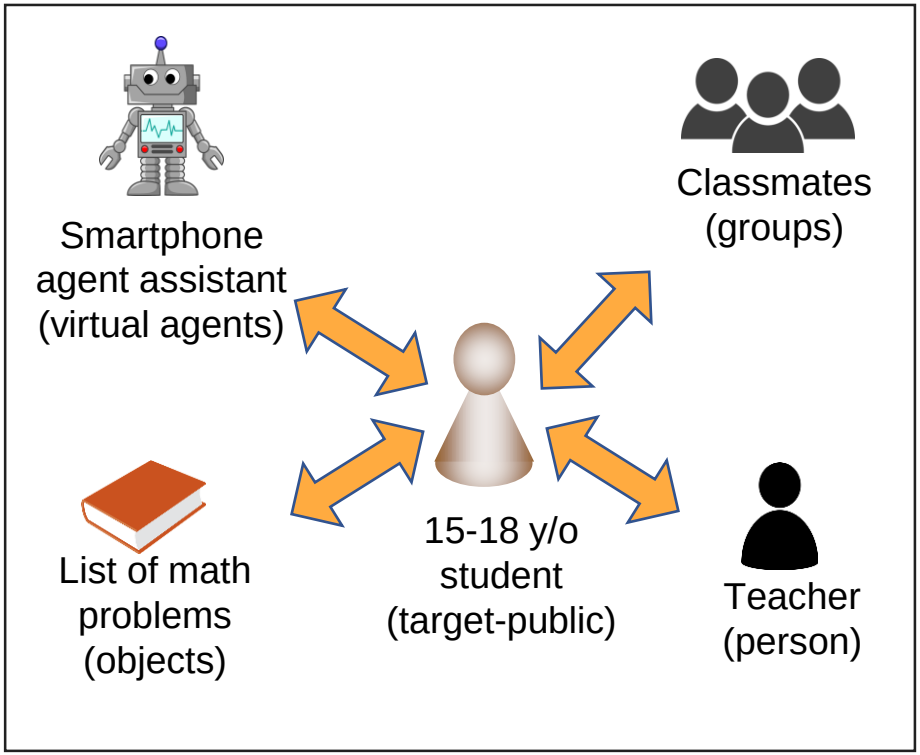


Non-game context: math classroom of upper secondary education level school

Target-public: 15 to 18 years old students

Involved entities:

(A.1) Describing the characteristics of the non-game context



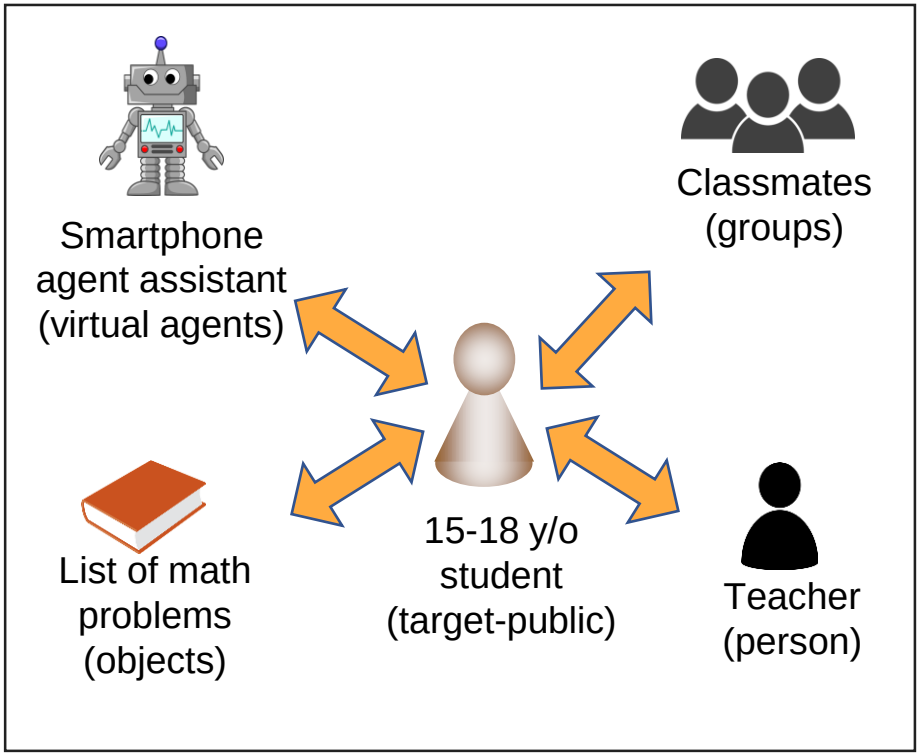
Non-game context: math classroom of upper secondary education level school

Target-public: 15 to 18 years old students

Involved entities:

- Teacher
- Classmates
- Smartphone agent assistant
- Math problem book
- ….

(A.1) Describing the characteristics of the non-game context



Non-game context: math classroom of upper secondary education level school

Target-public: 15 to 18 years old students

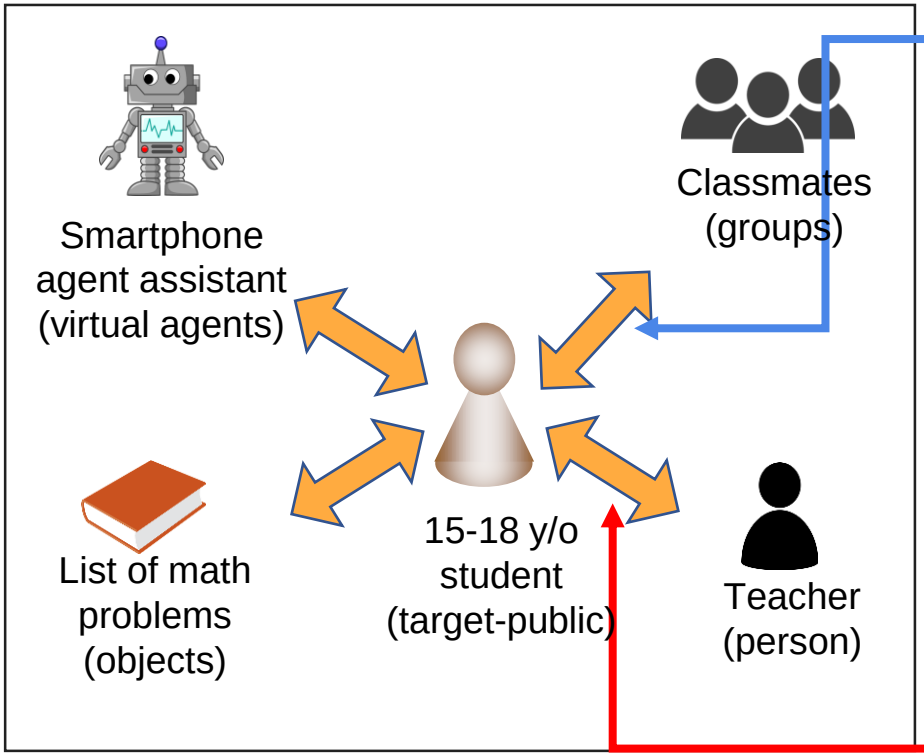
Involved entities:

- Teacher
- Classmates
- Smartphone agent assistant
- Math problem book
- ….

Non-game context objectives: Improve skill/knowledge into maths

- **Metric**: 0 to 10 score
- **Instrument**: summative/formative assessment)

(A.1) Identifying the observable interactions



Observable interactions:

- Asking a tip about how to solve an exercise
- Solving exercises in CL groups
- ...

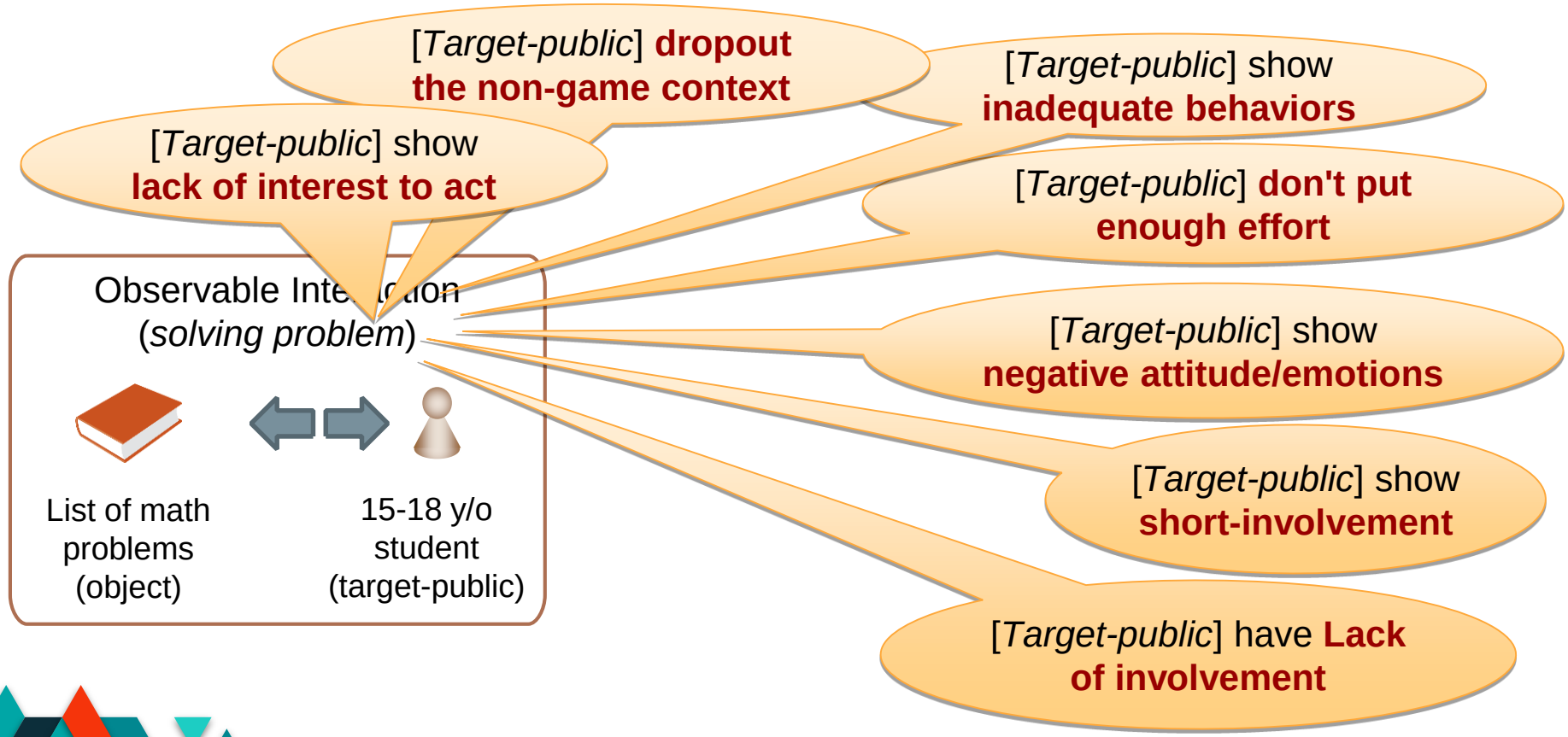
- **Type of Interaction**: synchronous, direct.
- **Restriction related to entity**: only friend

- **Type of Interaction**: asynchronous, indirect.
- **Restriction related to entity**: none

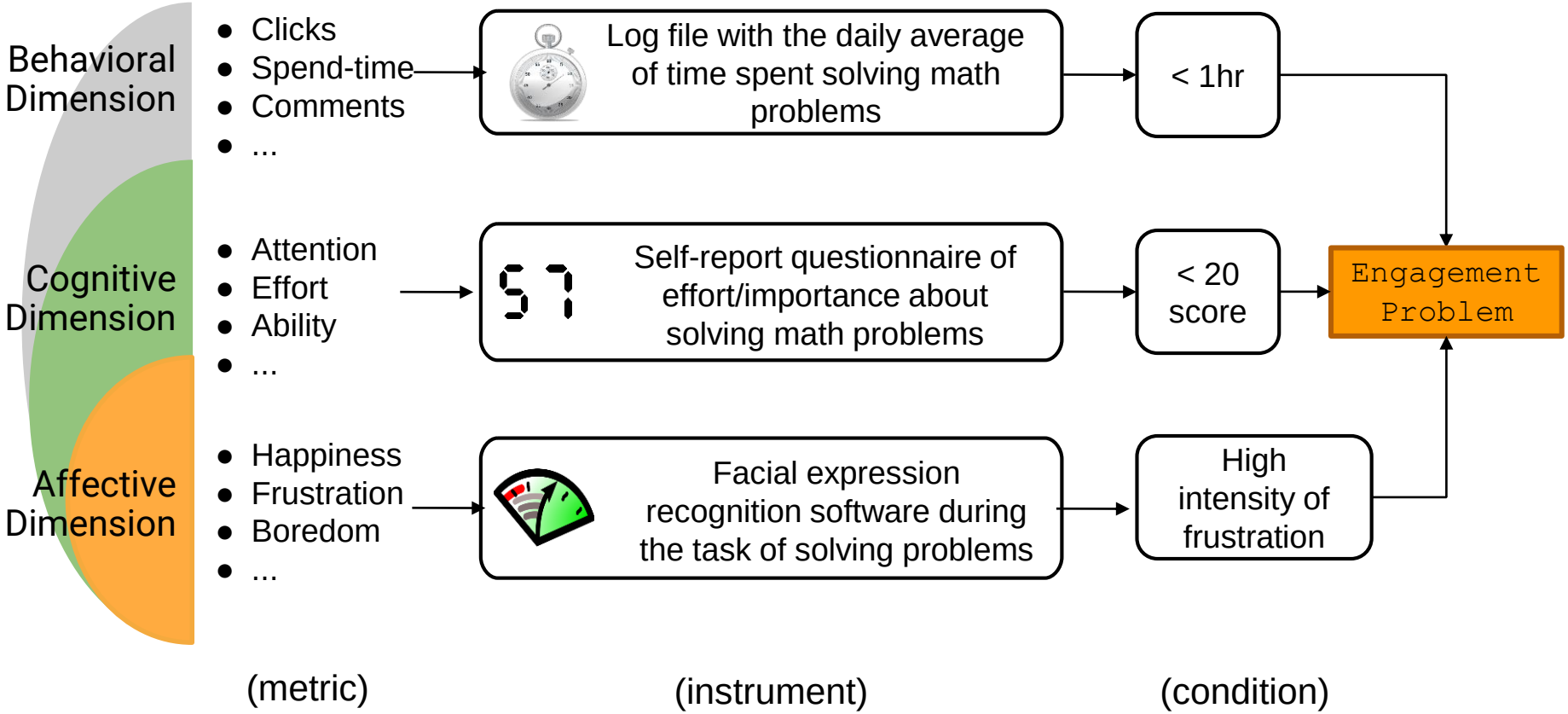
Observable interactions:

- Asking question about the lesson
- Request more exercises through email
- ...

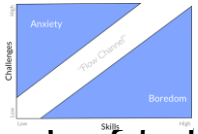
(A.2) Identifying the engagement problems



Engagement Problem: E.g. Lack of involvement



(A.3) Understanding the motivational problems based on flow theory



(1) Lack of balance between ability/challenge

[Target-public] believe that their abilities are not enough to deal with the challenge, they believe that their abilities are not related with the situation, or they feels that the situation do not require their abilities

(2) Lack of objective and short-term goals

[Target-public] do not know what to do, they do not know what is expected to be achieved, or their goals are not clearly established

(3) Lack of immediate and clear feedback

It is unclear for the [target-public] how well are doing the things, or they feel that things are not progressing according to what their is doing.

(A.4) Defining the engagement goals

Engagement goal:
- Increase the average time spent solving math problems > 2hrs
- Improve the score of effort through self-report questionnaire > 40

Motivational goal
- Balance the perceived ability/challenge
- Make explicit the objective and short term-goals
- Give direct and clear feedback

Motivational problem
- Lack of balance between ability/challenge
- Lack of objective and short term-goals
- Lack of immediate and clear feedback

Expected positive effect on non-game context objective: Improvement on the scores of summative/formative assessments

Observable Interaction (*solving problem*)

List of math problems (object)

15-18 y/o student (target-public)

Why?

Engagement problem: E.g. Lack of involvement
- Daily average of time solving math problems < 1hr
- Score of self-report questionnaire of effort < 20

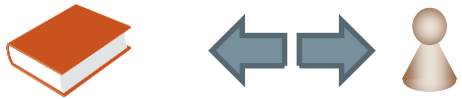
(A.5) Delineate the target-behavior

Engagement goal:

- Increase the average time spent solving math problems > 2hrs
- Improve the score of effort through self-report questionnaire > 40

Expected positive effect on non-game context objective: Improvement on the scores of summative/formative assessments

Observable Interaction
(*solving problem*)



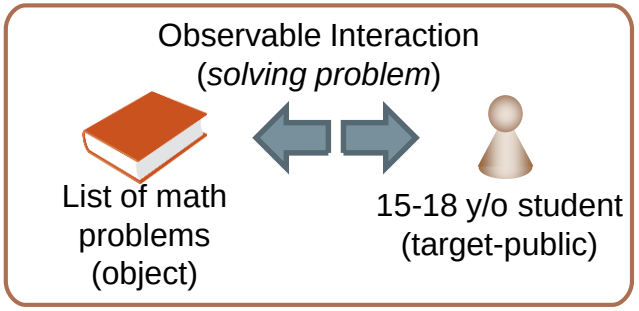
List of math problems (object)

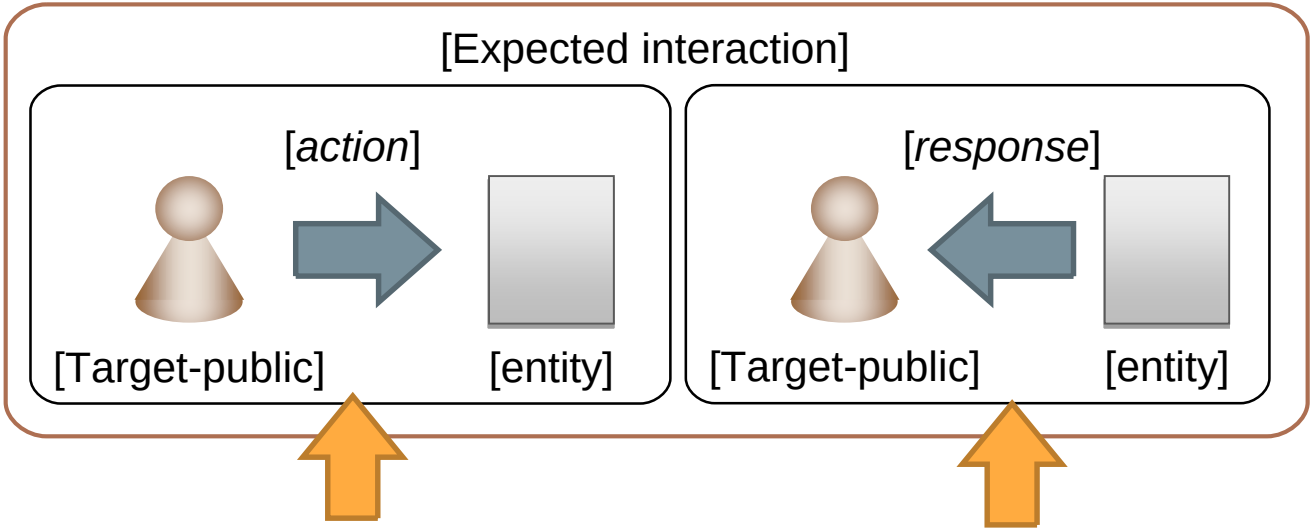
15-18 y/o student (target-public)

Delineate the target-behavior is to describe **what means to achieve the engagement goals** as **interaction sequences of expected interactions** between the **target-public** and the **involved entities** in the context of the **observable interaction**

(A.5) Delineate the target-behavior

To delineate target-behaviors from observable interactions, we suggest to use the structure ...





E.g. Delineate the target-behavior

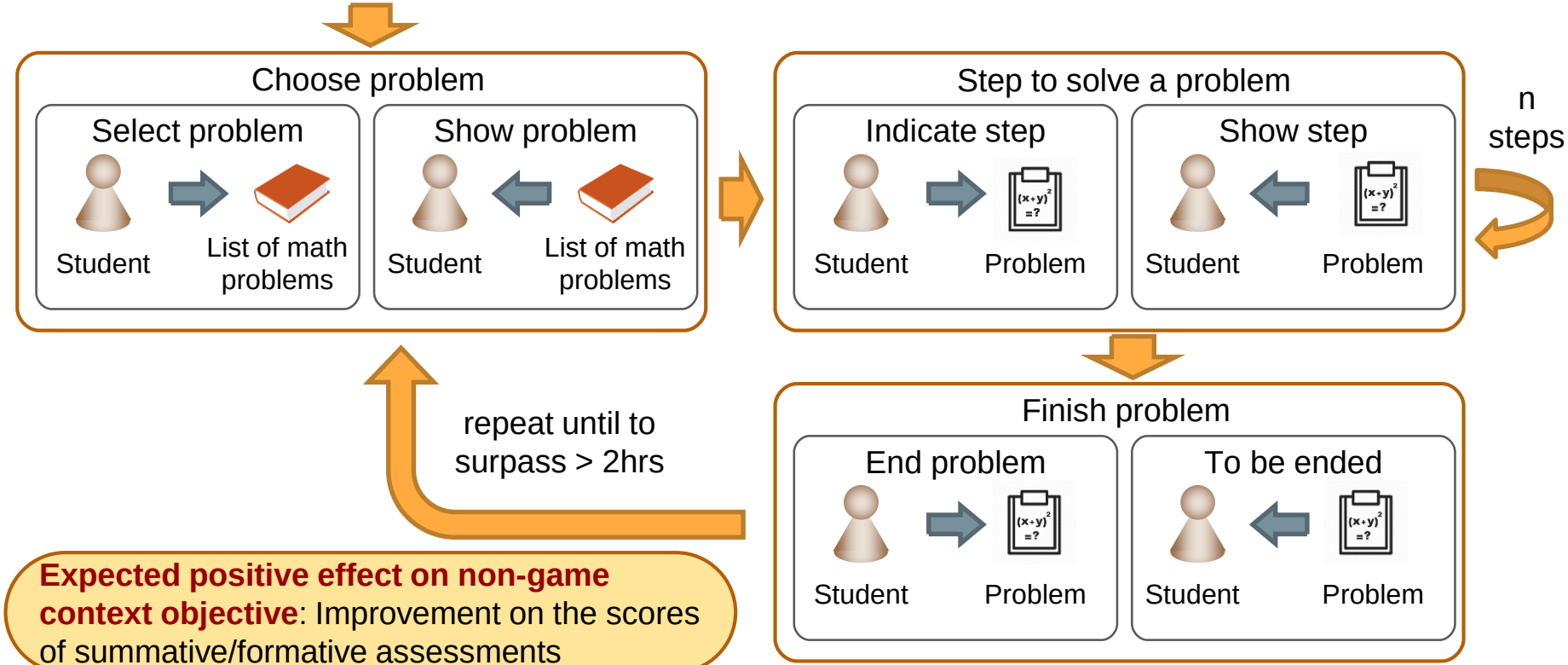
Engagement goal:

- Increase the daily average time-spent solving math problems > 2hrs

Observable Interaction
(*solving problem*)

List of math problems (object)

15-18 y/o student (target-public)



Expected positive effect on non-game context objective: Improvement on the scores of summative/formative assessments

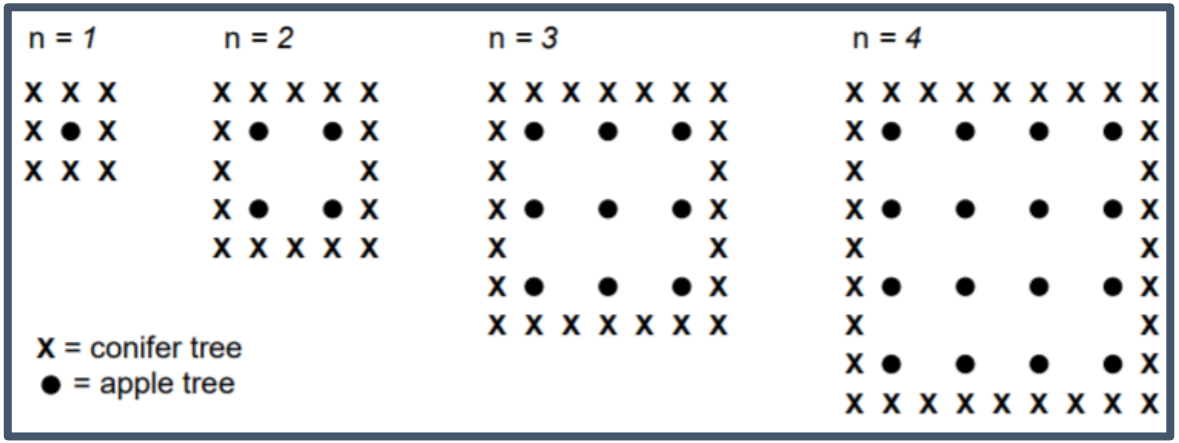
Hands-on & Heads in (1)

Objective: Demonstrate ability to delineate target behavior

Scenario 01

Instructional goal: *deduct a given math formula*

A farmer plants apple trees in a square pattern. In order to protect the apple trees against the wind he plants conifer trees all around the orchard.
The pattern of apple trees and conifer trees for any number (n) of rows of apple trees:



Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		

Q2. What is the formula to deduct The number of conifer trees?

Xn | X^2n | n^2 | X/n

Scenario 01

Engagement Problem

On a Online Math Course close to **30% of the participants drop out the course** when they reach topics related to this instructional goal.

Engagement goal:

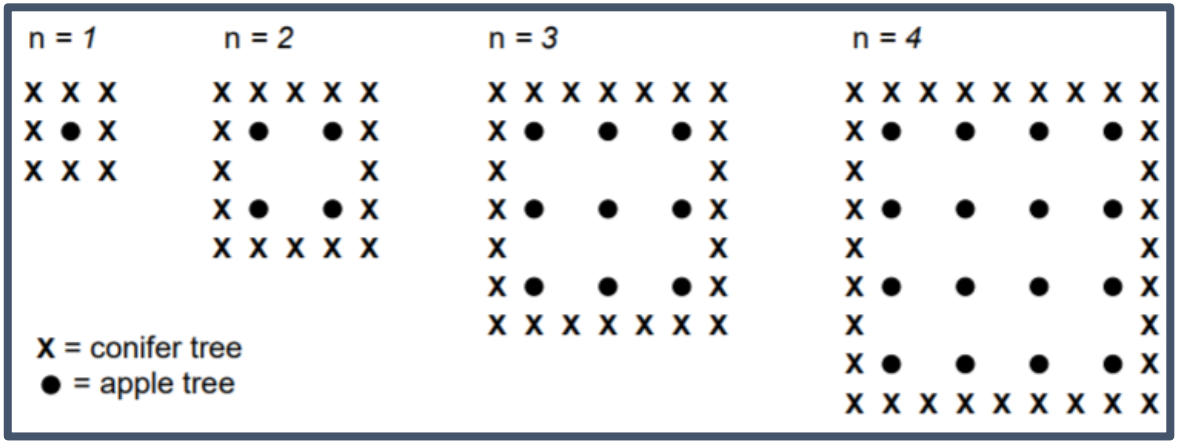
- Decrease into 10% of participant who drop out the course when they reach topics related to this instructional goal

Expected positive effect on non-game context objective: Improvement +2 points on the scores of PISA assessments

Scenario 01

Instructional goal: *deduct a given math formula*

A farmer plants apple trees in a square pattern. In order to protect the apple trees against the wind he plants conifer trees all around the orchard.
The pattern of apple trees and conifer trees for any number (n) of rows of apple trees:



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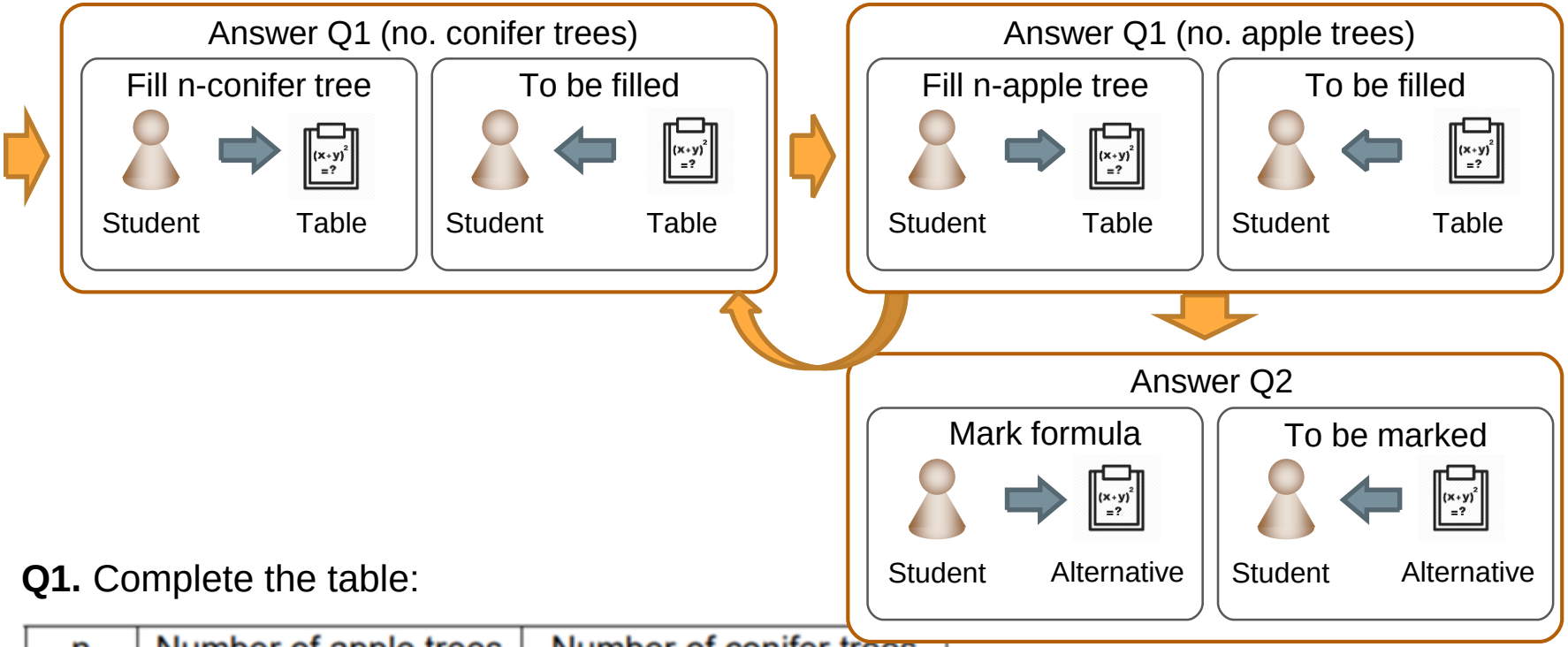
Hands-on & Heads in (1)

Objective: Demonstrate ability to delineate target behavior
Solution



Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	*16*
3	*9*	*24*
4	*16*	*32*
5	*25*	*40*

Q2. What is the formula to deduct The number of conifer trees?

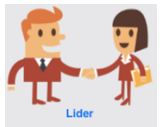
Xn	**X^2n**	n^2	X/n

Analysis Phase

(A.6) Identifying the Player Profiles

Target-Public (Student)

Enjoy the teamwork and get satisfaction from group achievements, individual accomplishments are not relevant



Enjoy to make meaningful relationships with others

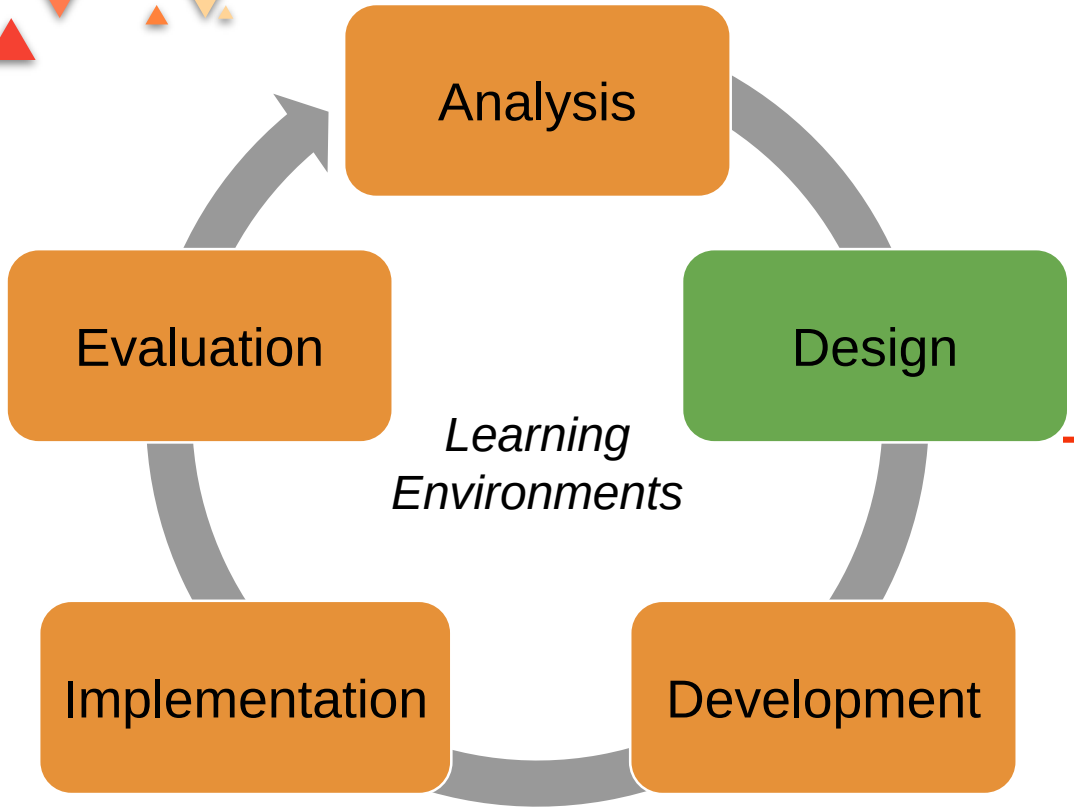
Using the QPJ-BR to identify what the target-public like

Target-public is **Socializer**

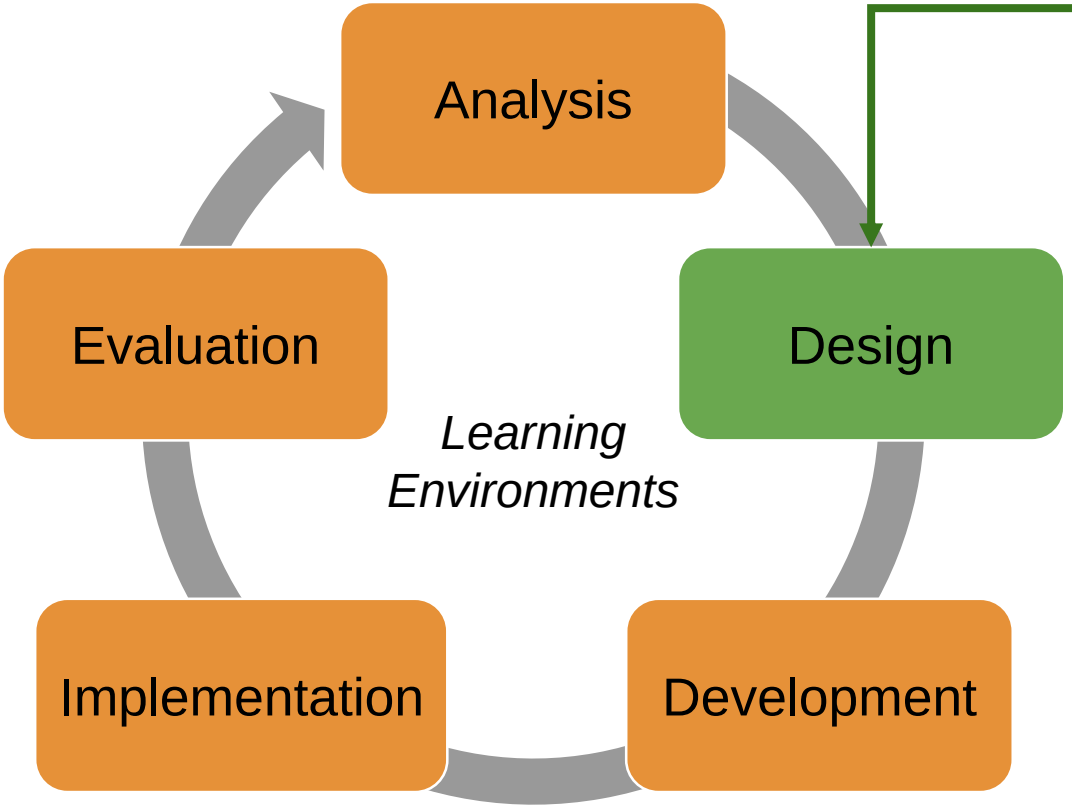
Enjoy to chat and meet other players, like to explain the rules, strategies, and even some tricks for others to do well.

Hands-on & Heads in (2)

Objective: Demonstrate ability to identify Player Profiles



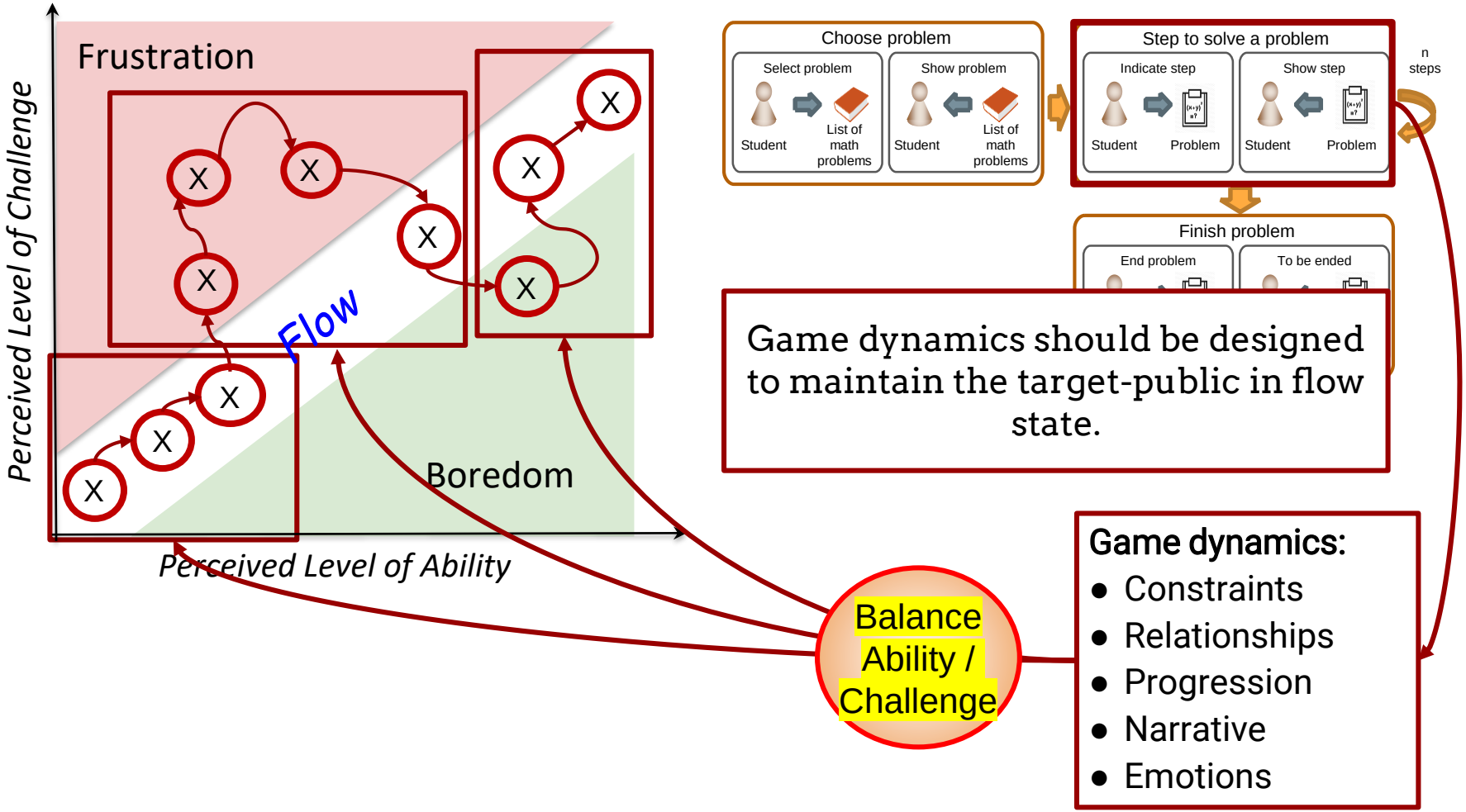
Design Phase

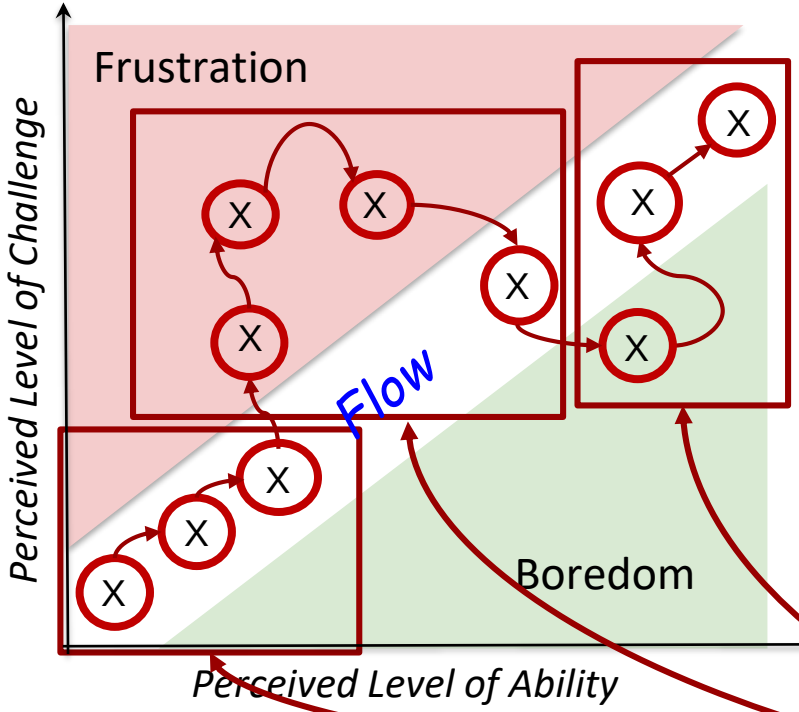


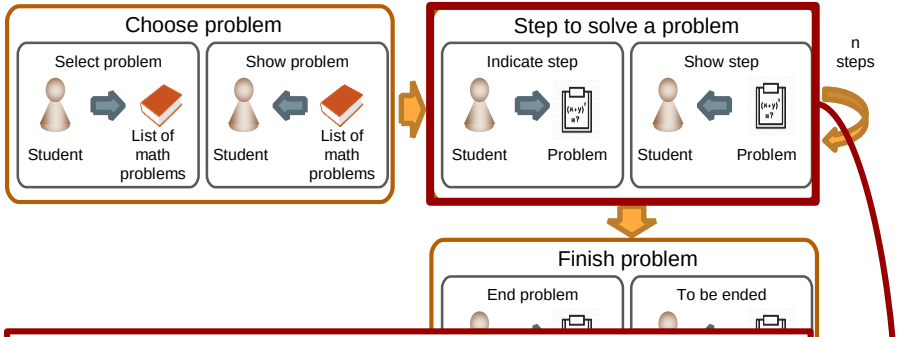
1) Content Gamification
   a) Delineate game dynamics for the target-behaviors
   b) Align game dynamics for each player profile
   c) Identify game dynamics to maintain balance, avoid boredom, and avoid frustration
   d) Define player roles
   e) Define game mechanics and game components
   f) Define the gameplay
2) Structural Gamification

Design Phase

(D.1.a) Delineating game dynamics for the target-behaviors


Frustration
Flow
Boredom
Perceived Level of Challenge
Perceived Level of Ability
Choose problem
Select problem
Student
List of math problems
Show problem
Student
List of math problems
Step to solve a problem
Indicate step
Student
Problem
Show step
Student
Problem
n steps
Finish problem
End problem
To be ended
Game dynamics should be designed to maintain the target-public in flow state.
Balance Ability / Challenge
Game dynamics:
Constraints
Relationships
Progression
Narrative
Emotions





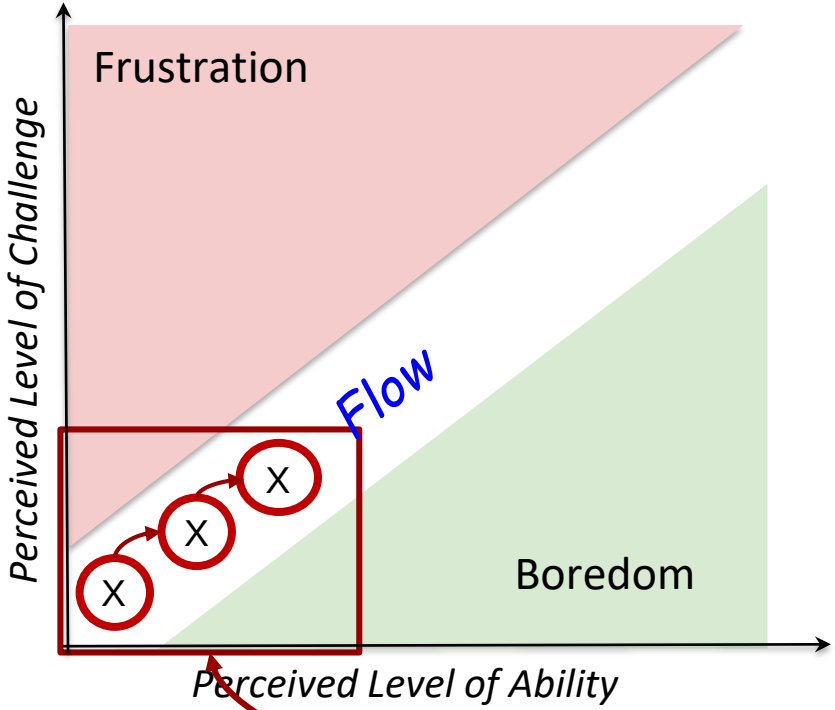
Game dynamics should be designed to maintain the target-public in flow state.

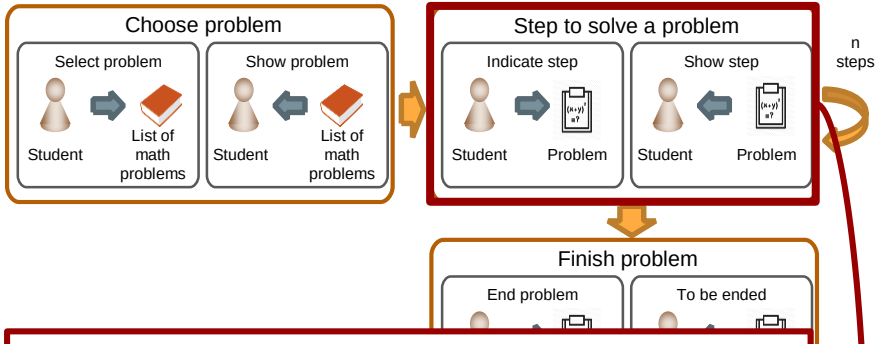
Balance Ability / Challenge

Game dynamics:

- Constraints
- Relationships
- Progression
- Narrative
- Emotions

Be creative, there is not jet rule here!!!.
We provide some guidelines as suggestions to the design





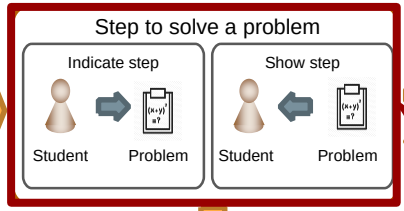
Game dynamics should be designed to maintain the target-public in flow state.

Game dynamics:

- Constraints
- Relationships
- Progression
- Narrative
- Emotions

Balance Ability / Challenge

To maintain balance of ability/challenge when the target-public is in flow state, the most commonly used game-dynamics are progression, narrative and emotions



amics should be designed
n the target-public in flow state.

Game dynamics:

- Constraints
- Relationships
- Progression
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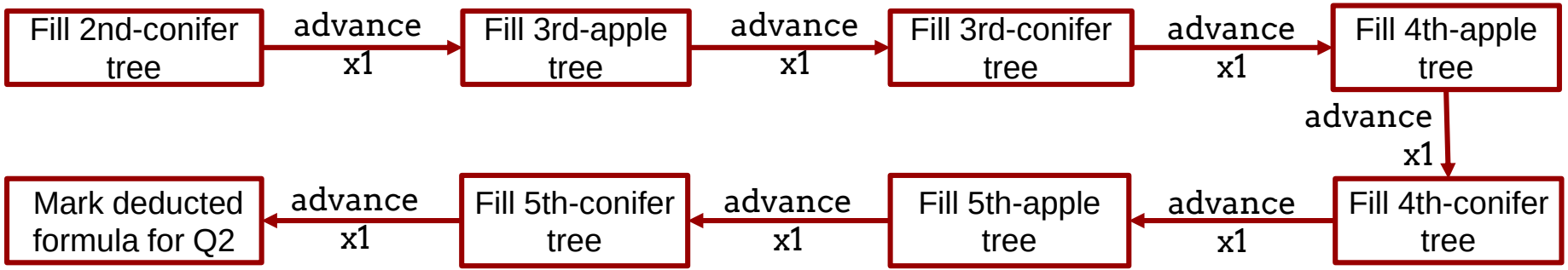
- Emotions

Balance Ability / Challenge

To maintain balance of ability/challenge when the target-public is in flow state, the most commonly used game-dynamics are progression, narrative and emotions

E.g. Game-dynamic of **progression** for the Scenario 01

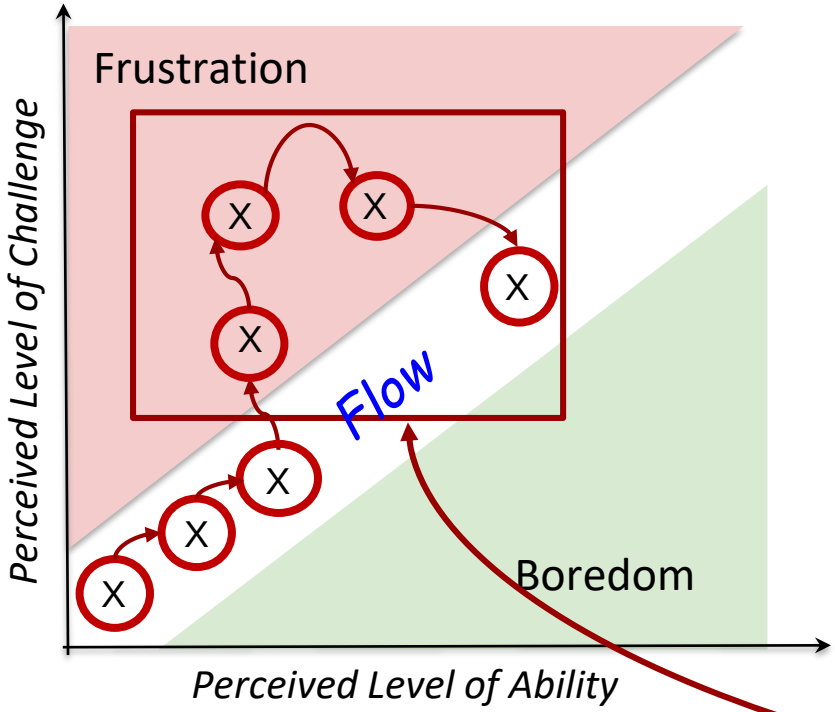


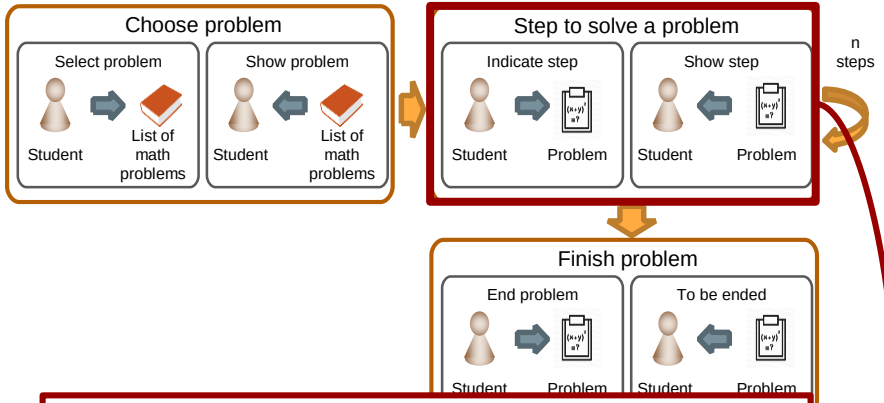
Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		

Q2. What is the formula to deduct The number of conifer trees?

Xn	X^2n	n^2	X/n



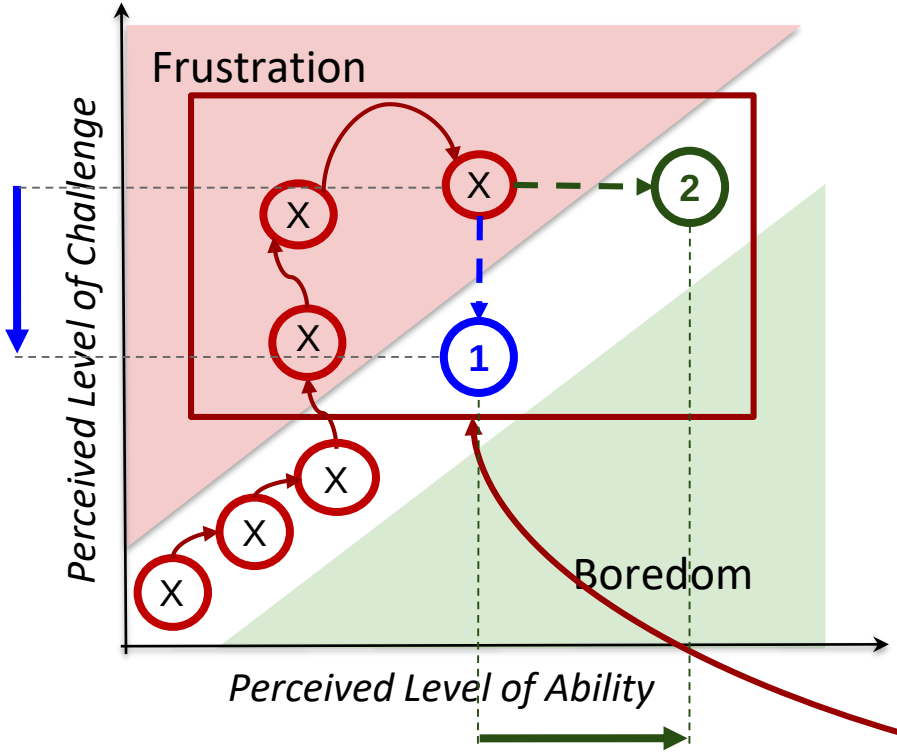


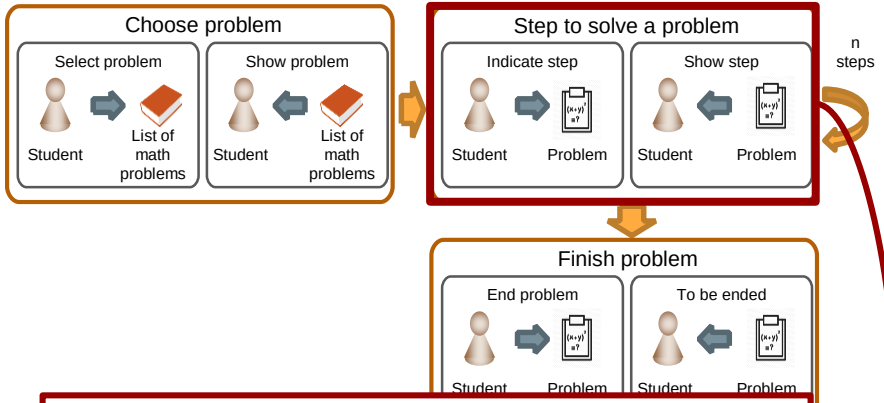
Game dynamics should be designed to avoid the frustration

Balance Ability / Challenge

Game dynamics:

- Constraints
- Relationships
- Progression
- Narrative
- Emotions





Game dynamics should be designed to avoid the frustration

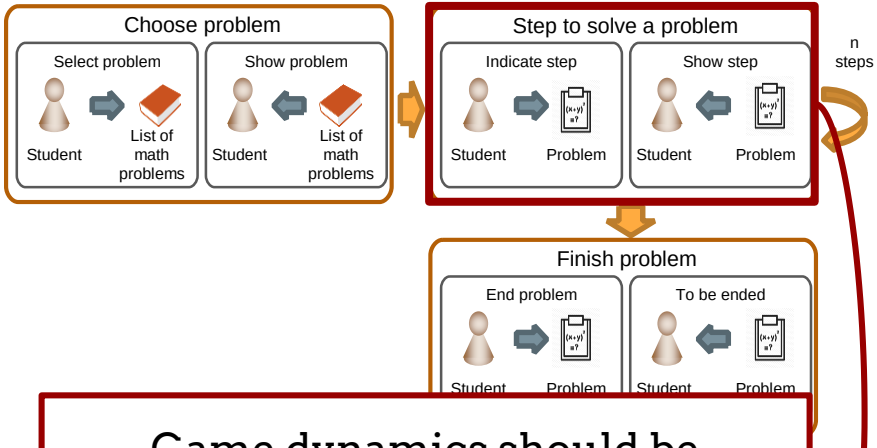
Balance Ability / Challenge

Game dynamics:

- Constraints
- Relationships
- Progression
- Narrative
- Emotions

To avoid the frustration, the game-dynamic should **reduce the level of challenge (1)** or **increase the the level of ability (2)** for the target-public

Frustration



Game dynamics should be designed to avoid the frustration

Balance
Ability / Challenge

Game dynamics:

- Constraints
- Relationships
- Progression
- Narrative
- Emotions

To avoid **frustration**, the most commonly used game-dynamics are constraints and relationship

E.g. Game-dynamic of **constraints** to avoid **frustration** in the Scenario 01

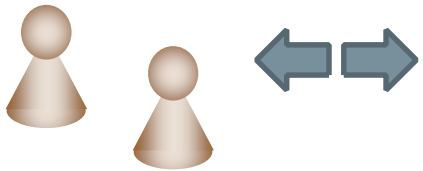
Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	[8] [12] [16] [20]
3	[7] [9] [11]	[20] [24] [28] [32]
4	[12] [14] [16] [18]	[28] [32] [36] [40]
5	[20] [25] [30]	[32] [36] [40] [44]

A **constraints that limit the numbers** to complete the table will avoid the frustration because this game-dynamic reduces the level of challenge

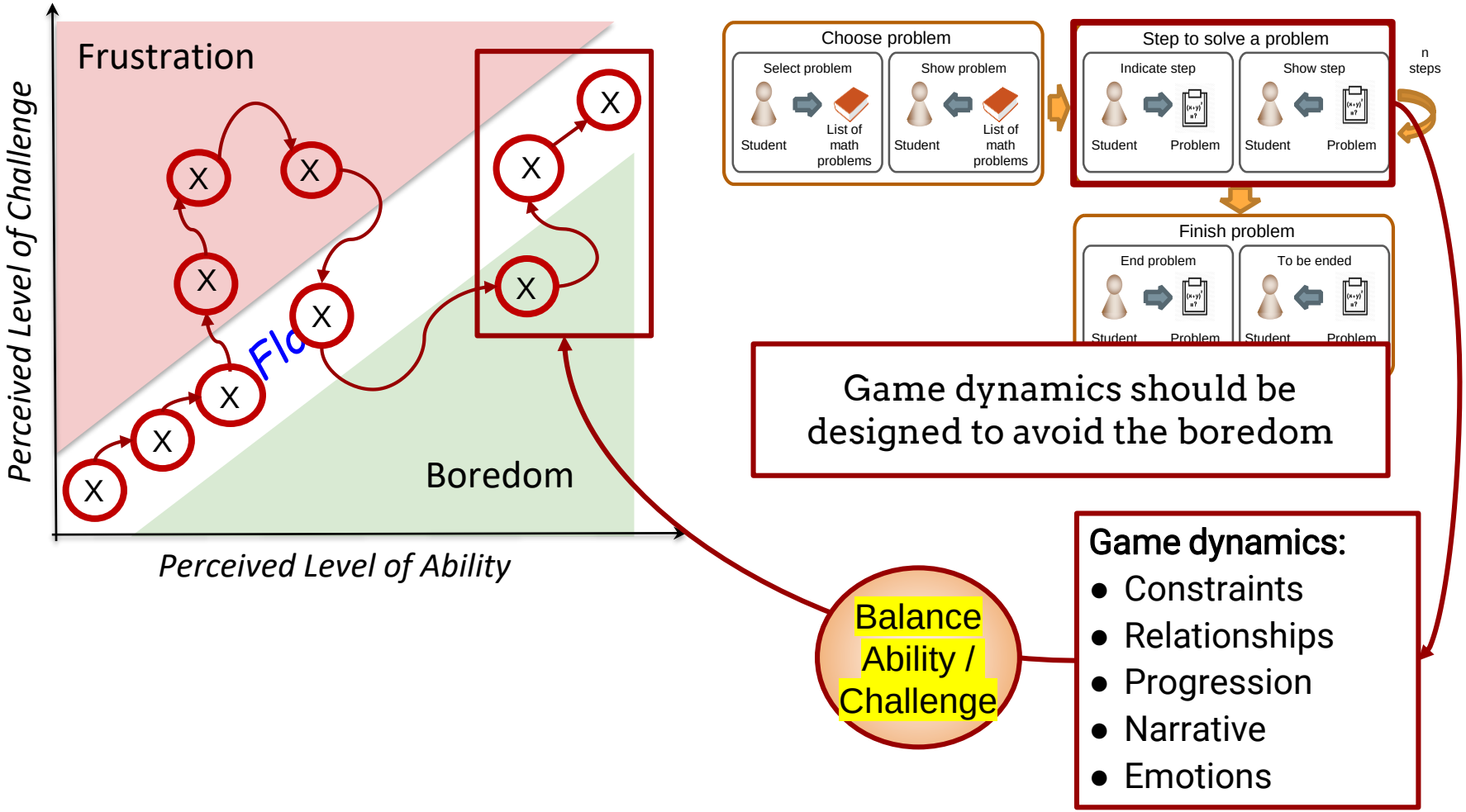
E.g. Game-dynamic of **relationship** to avoid **frustration** in the Scenario 01

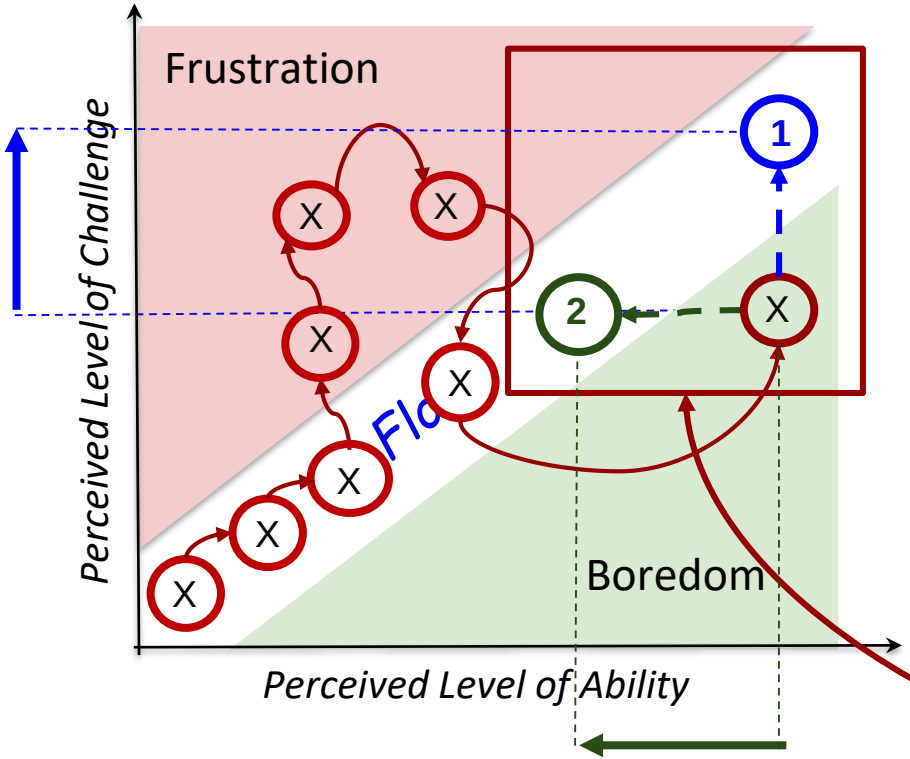
A **group formation** to complete the task **is relationship** that reduces the level of challenge

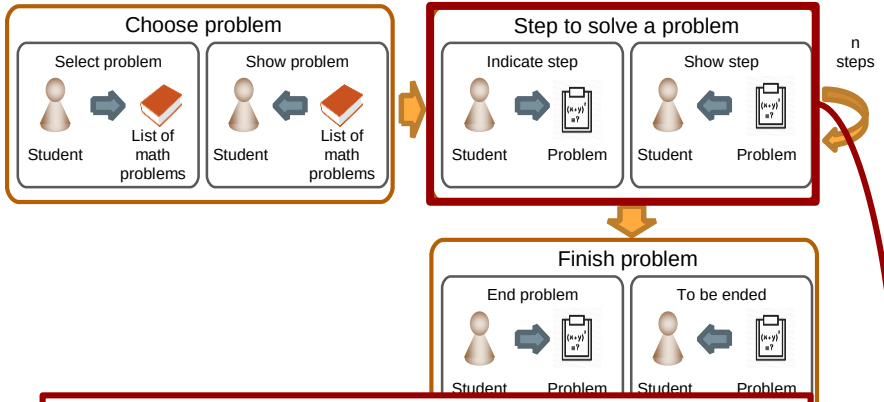


pair-group

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		


Frustration
Boredom
Flo
Perceived Level of Challenge
Perceived Level of Ability
Choose problem
Select problem
Student
List of math problems
Show problem
Student
List of math problems
Step to solve a problem
Indicate step
Student
Problem
Show step
Student
Problem
n steps
Finish problem
End problem
Student
Problem
To be ended
Student
Problem
Game dynamics should be designed to avoid the boredom
Balance Ability / Challenge
Game dynamics:
Constraints
Relationships
Progression
Narrative
Emotions





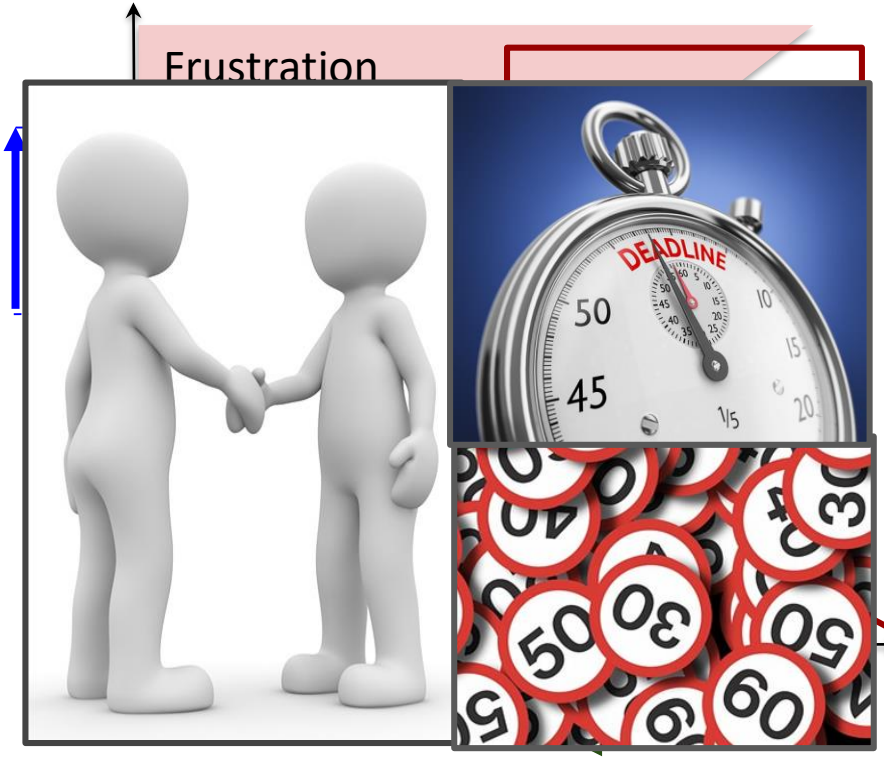
Game dynamics should be designed to avoid the boredom

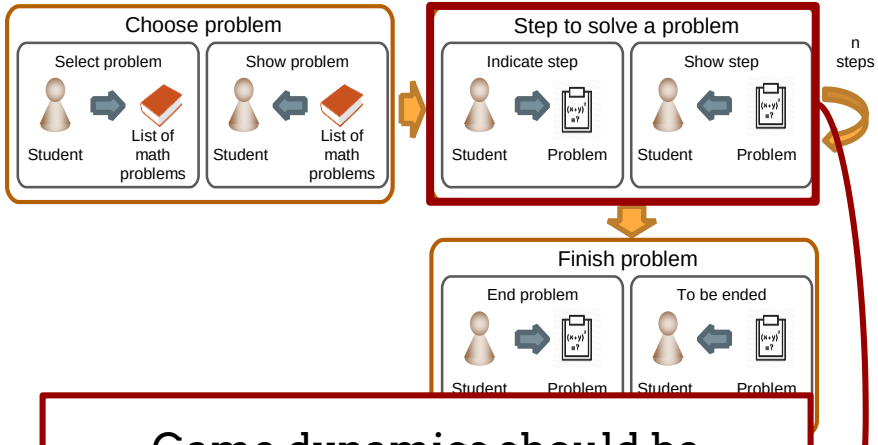
Balance Ability / Challenge

Game dynamics:

- Constraints
- Relationships
- Progression
- Narrative
- Emotions

To avoid the boredom, the game-dynamic should **increase the level of challenge** or **decrease the the level of ability** for the target-public





Game dynamics should be designed to avoid the boredom

Balance Ability / Challenge

Game dynamics:

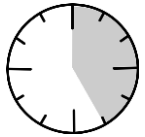
- Constraints
- Relationships
- Progression
- Narrative
- Emotions

To avoid **boredom**, the most commonly used game-dynamics are constraints and relationship

E.g. Game-dynamic of **constraints** to avoid **boredom** in the Scenario 01

Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		



A **time limit** to complete the problem is a game dynamic to increase the challenge avoiding the boredom

E.g. Game-dynamic of **relatedness** to avoid **boredom** in the Scenario 01

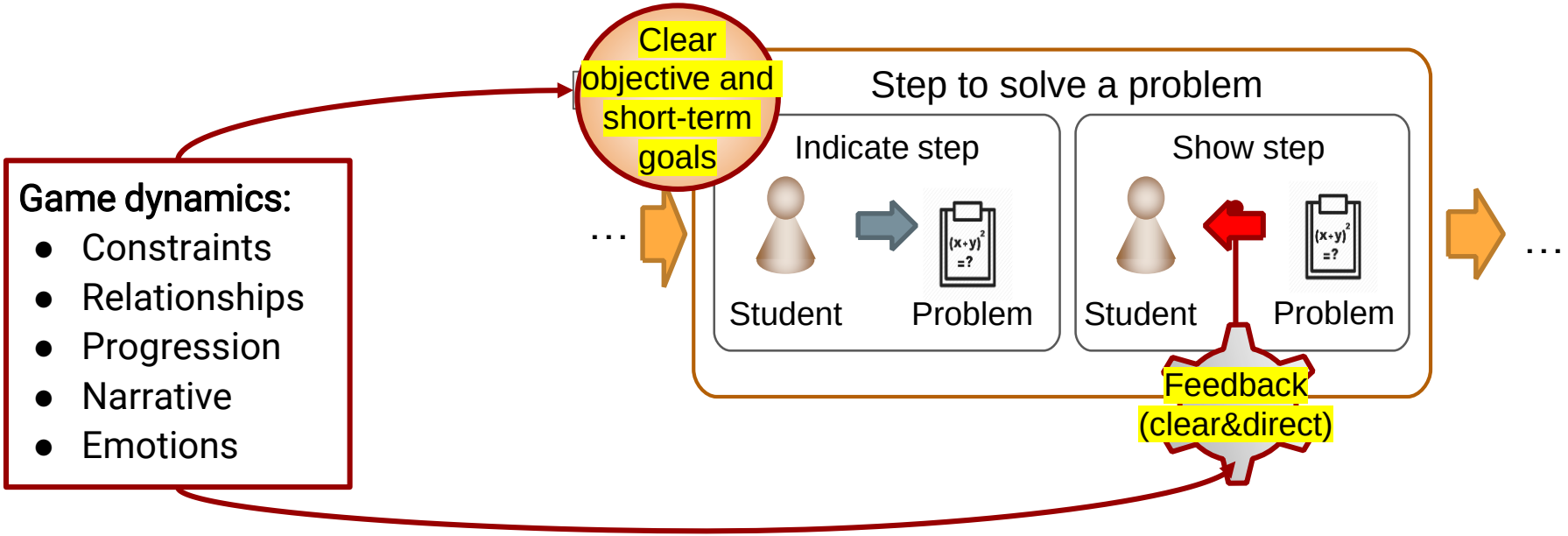
A **social pressure** showing performance in the task is a game dynamic that increase the challenge avoiding the boredom

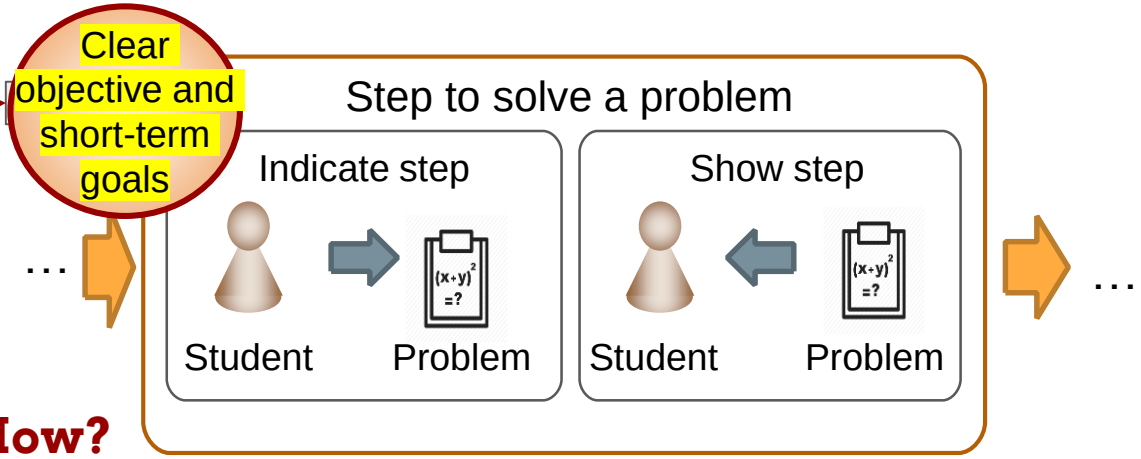
Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		

Adjusting the game-dynamics

After to define how the game-dynamics will be used to maintain balance of ability/challenge, it's time to define how these game-dynamics are related to the clear objective and short-term goals, and to the clear & direct feedback





Game dynamics:

- **Constraints**
- Relationships
- Progression
- Narrative
- Emotions

How?

- Indicate the **restrictions and rules** defined by the constraints **as part of the objectives and short-term goals**

Q1. Complete the table **by marking the corresponding numbers of conifer trees and apple trees for each row**:

Objective & short-term goals

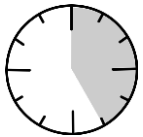
n	Number of apple trees	Number of conifer trees
1	1	8
2	4	[8] [12] [16] [20]
3	[7] [9] [11]	[20] [24] [28] [32]
4	[12] [14] [16] [18]	[28] [32] [36] [40]
5	[20] [25] [30]	[32] [36] [40] [44]

A **constraints that limit the numbers** to complete the table will avoid the frustration because this game-dynamic reduces the level of challenge

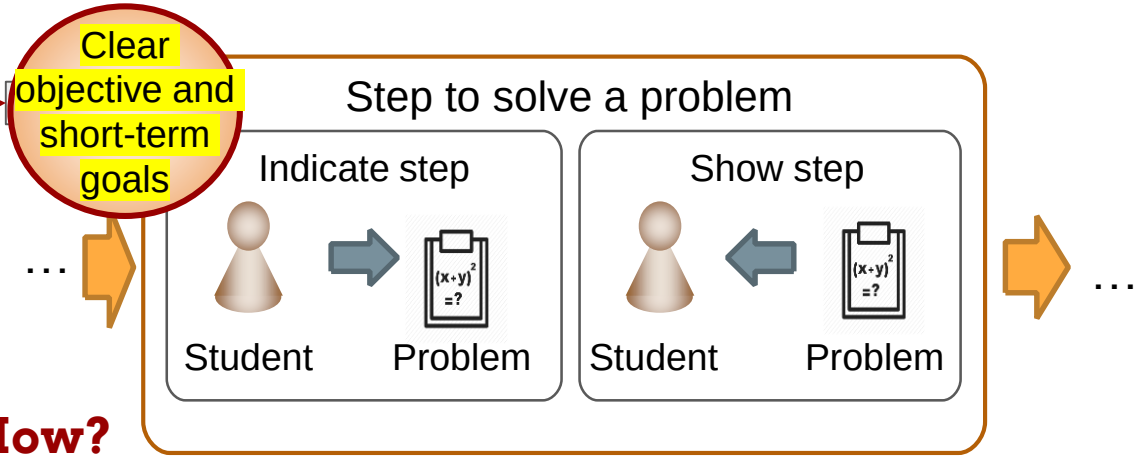
Q1. Complete the table **before the time limit exceeds**:

Objective & short-term goals

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		



A **time limit** to complete the problem is a game dynamic to increase the challenge avoiding the boredom



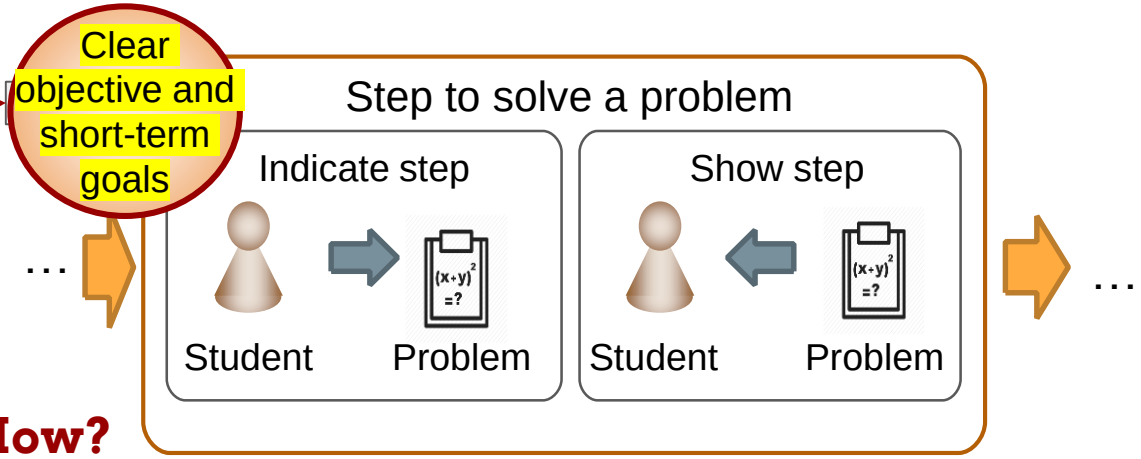
Game dynamics:

- Constraints
- **Relationships**
- Progression
- Narrative
- Emotions

How?

- Indicate the restrictions and rules defined by the constraints as part of the objectives and short-term goals

- Indicate the **social interaction and communication** defined by the relationship **as part of the objectives and short-term goals**



Game dynamics:

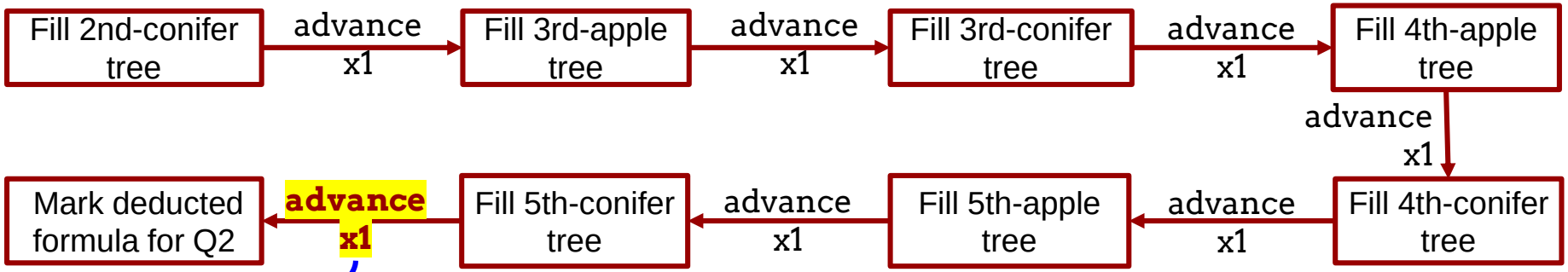
- Constraints
- Relationships
- Progression
- Narrative
- Emotions

How?

- Indicate the restrictions and rules defined by the constraints as part of the objectives and short-term goals
- Indicate the social interaction and communication defined by the relationship as part of the objectives and short-term goals

- The **advancement** of the progression, the **acts/events** of the narrative, and the **emotions** engender by the game-dynamic **should be aligned to the objective and short-term goals**

E.g. Game-dynamic of **progression** for the Scenario 01



The advance of (Q2) for the progression doesn't see to be properly aligned with the required effort to answer the question (Q2)

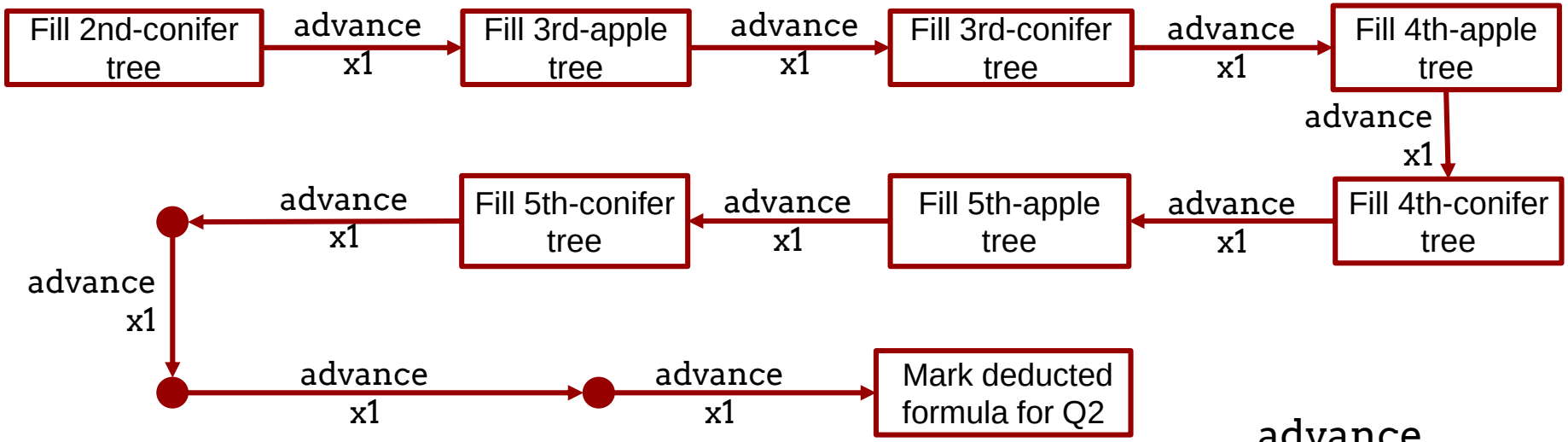
Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		

Q2. What is the formula to deduct The number of conifer trees?

Xn | X^2n | n^2 | X/n

E.g. Game-dynamic of **progression** for the Scenario 01



advance x4 for Q2

Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		

Q2. What is the formula to deduct The number of conifer trees?

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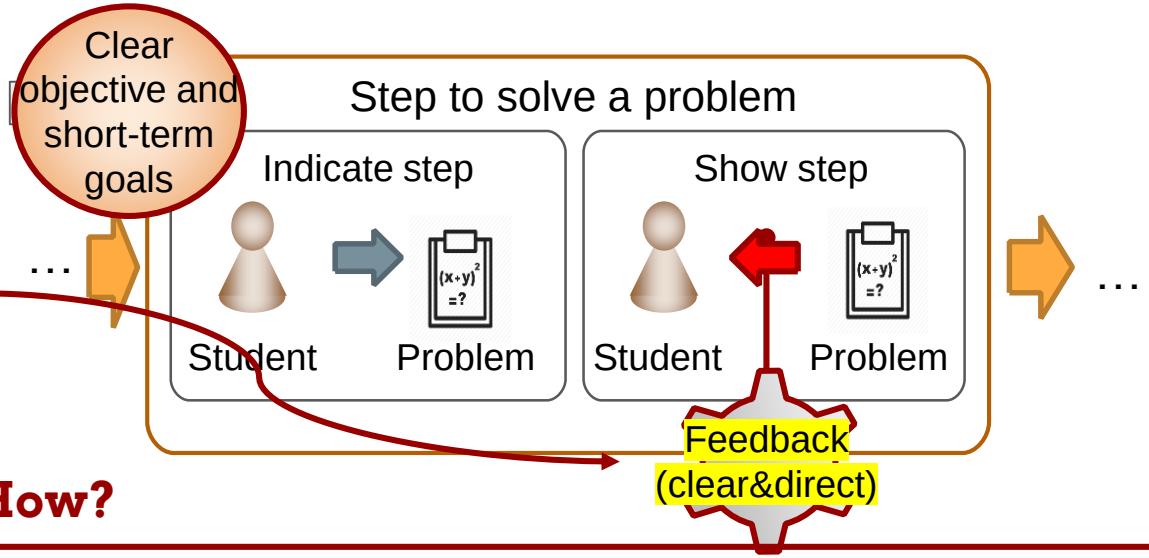


Game dynamics:

- **Constraints**
- Relationships
- Progression
- Narrative
- Emotions

How?

- **Actions that break the restrictions and rules** defined by the constraints should be always presented **as negative feedback**

E.g. Game-dynamic of **constraints** to avoid **frustration** in the Scenario 01

Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	*16*
3	*9*	*24*
4	***15***	[28] [32] [36] [40]
5	[20] [25] [30]	

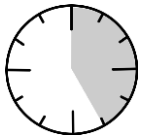
ERROR: You can only introduce the numbers [12] [14] [16] [18]

When a non available number is introduced, a feedback indicating the **breakout of a rule** should be indicated

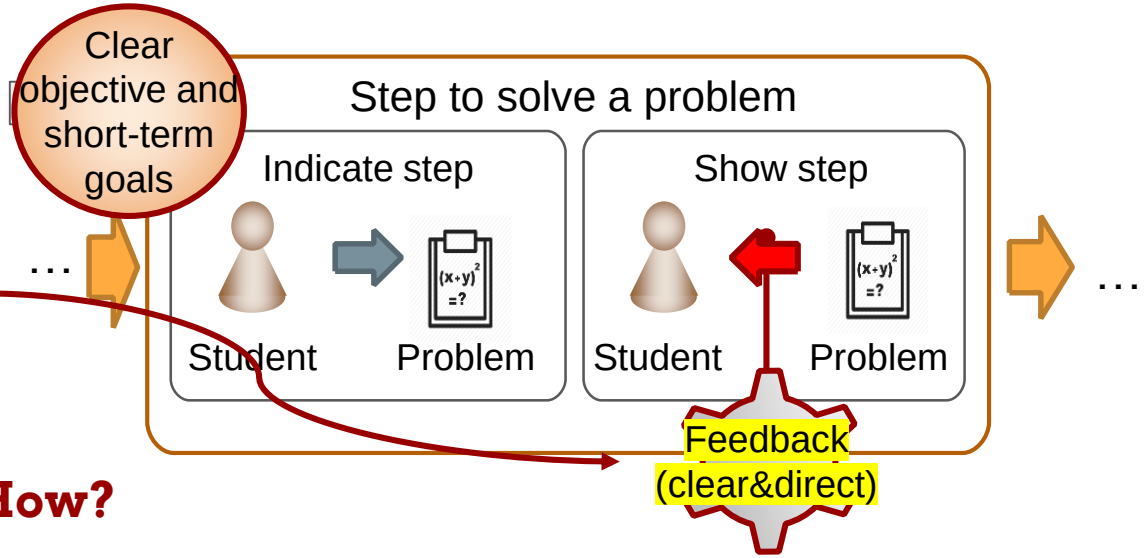
E.g. Game-dynamic of **constraints** to avoid **boredom** in the Scenario 01

Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	*16*
3	*9*	*24*
4	*16*	
5		



When the **timeout** is reached, a feedback should be given



Game dynamics:

- Constraints
- **Relationships**
- Progression
- Narrative
- Emotions

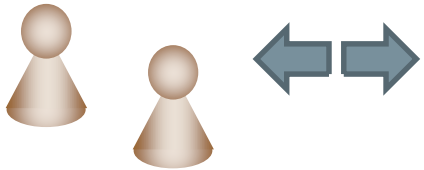
How?

- Actions that break the restrictions and rules defined by the constraints should be always presented as negative feedback

- Feedback should be **presented during the social interaction and communication** defined by the relationship

E.g. Game-dynamic of **relationship** to avoid **frustration** in the Scenario 01

A **group formation** to complete the task **is relationship** that reduces the level of challenge



pair-group

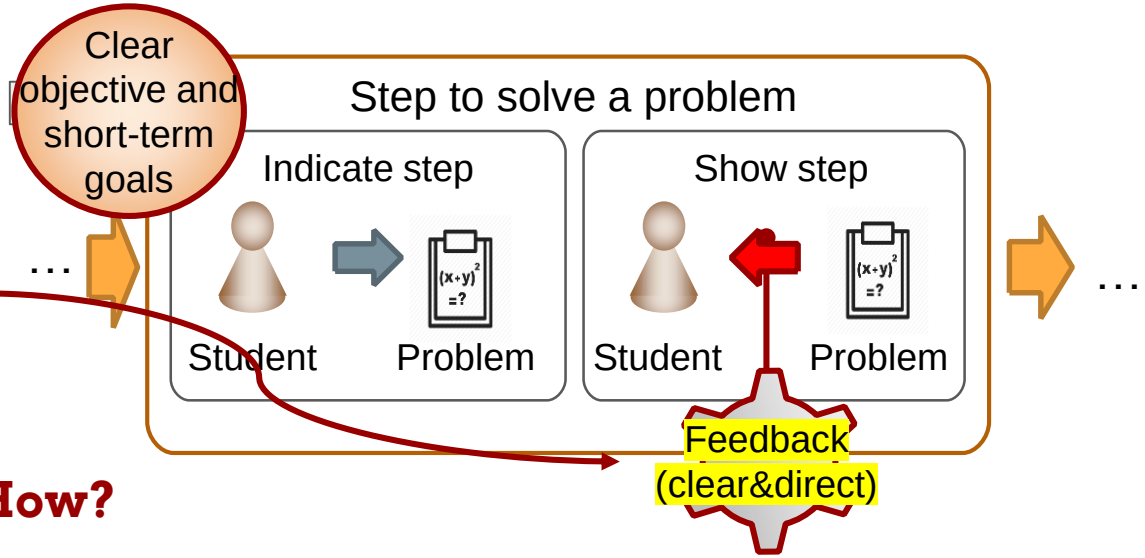
n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		

E.g. Game-dynamic of **relatedness** to avoid **boredom** in the Scenario 01

A **social pressure** showing performance in the task is a game dynamic that increase

Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	



Game dynamics:

- Constraints
- Relationships
- Progression
- Narrative
- Emotions

How?

- Actions that break the restrictions and rules defined by the constraints should be always presented as negative feedback
- Feedback should be presented during the social interaction and communication defined by the relationship

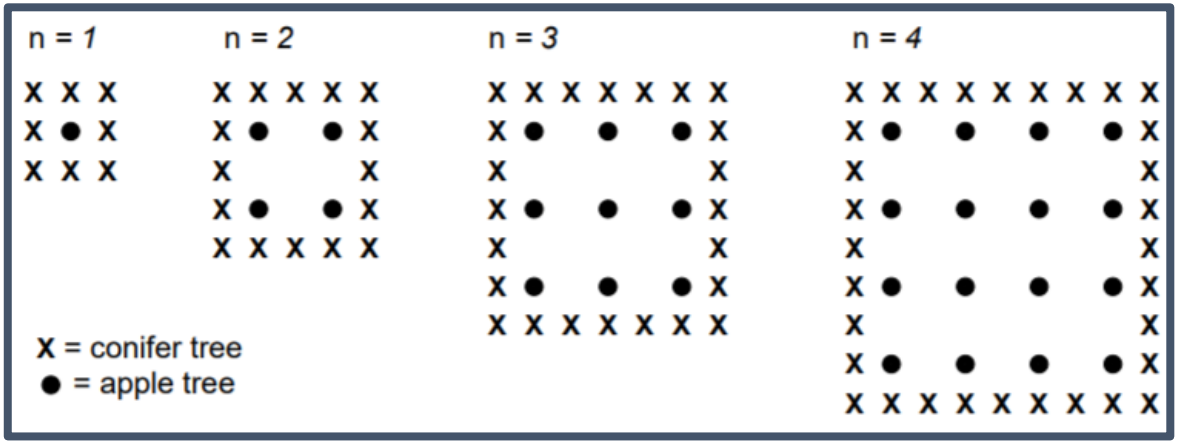
- The **advancement** of the progression, the **acts/events** of the narrative, and the **mechanisms that trigger emotions** should be defined **as part of the feedback**

(D.1.a) Align game dynamics for each player profile

Scenario 01

Instructional goal: *deduct a given math formula*

A farmer plants apple trees in a square pattern. In order to protect the apple trees against the wind he plants conifer trees all around the orchard.
The pattern of apple trees and conifer trees for any number (n) of rows of apple trees:



Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		

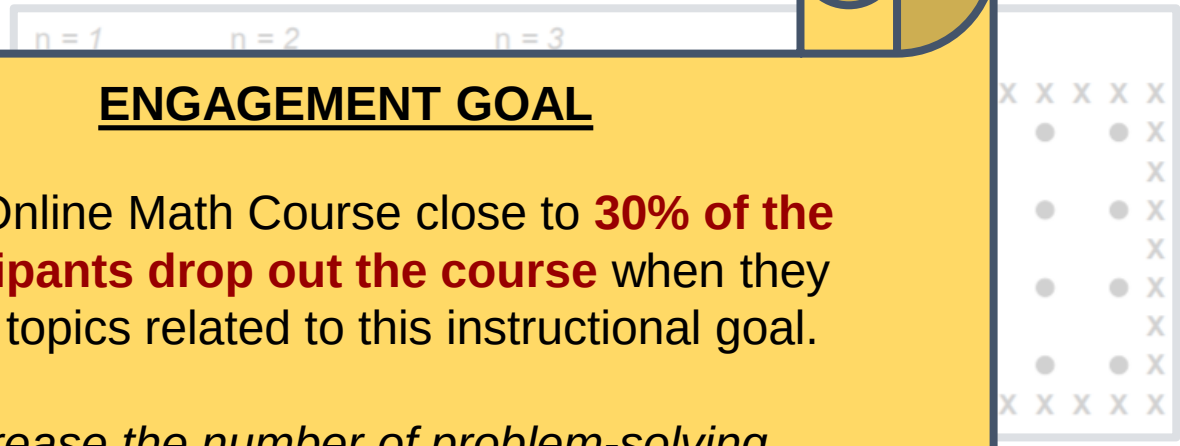
Q2. What is the formula to deduct The number of conifer trees?

Xn | X^2n | n^2 | X/n

Scenario 02

Instructional goal: *deduct a given math formula*

A farmer plants apple trees in a square pattern. In the middle of the apple trees, he plants conifer trees in the orchard.
The pattern of conifer trees for rows of apple t



Q1. Comple

n	Num		8
1			
2			
3			
4			
5			

Q2. What is the formula to deduct The number of conifer trees?

Xn | X^2n | n^2 | X/n

ENGAGEMENT GOAL

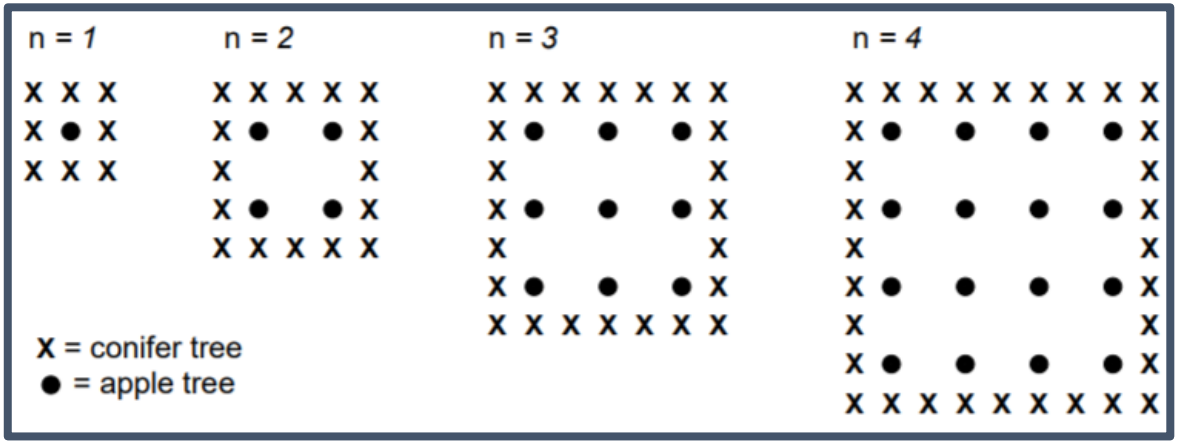
On a Online Math Course close to **30% of the participants drop out the course** when they reach topics related to this instructional goal.

Increase the number of problem-solving questions correctly answered

Scenario 01

Instructional goal: *deduct a given math formula*

A farmer plants apple trees in a square pattern. In order to protect the apple trees against the wind he plants conifer trees all around the orchard.
The pattern of apple trees and conifer trees for any number (n) of rows of apple trees:



Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	*16*
3	*9*	*24*
4	*16*	*32*
5	*25*	*40*

Q2. What is the formula to deduct The number of conifer trees?

Xn | X^2n | n^2 | X/n

Scenario 01

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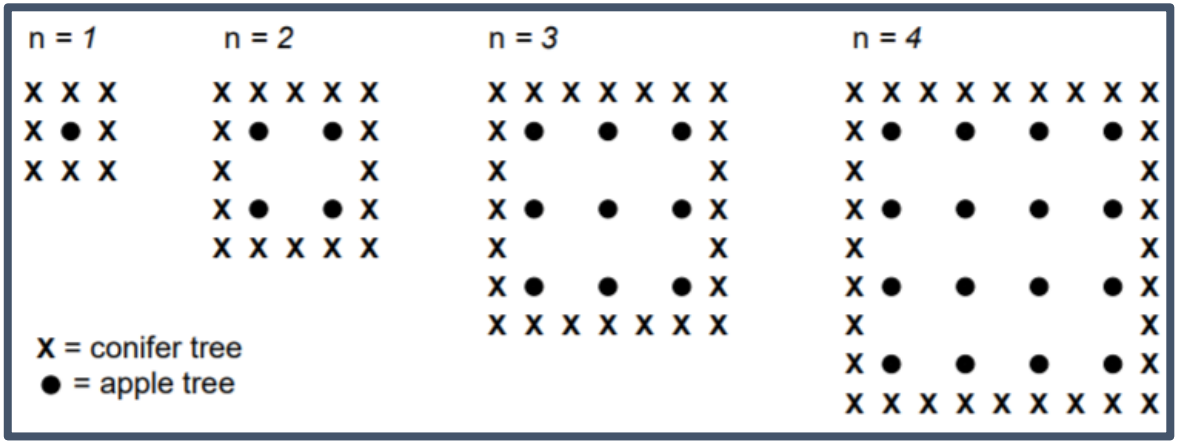
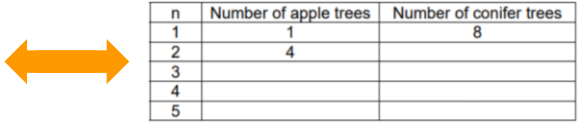


Q1. Complete the table:

n	Number of apple trees
1	1
2	4
3	
4	
5	



n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		

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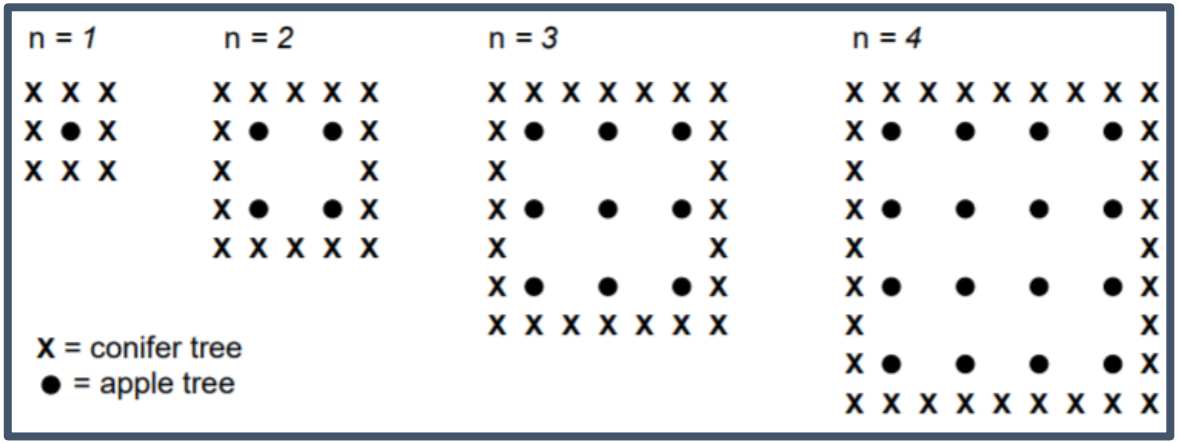


Q2.
What is the formula to deduct
The number of conifer trees?

Xn

X^2n

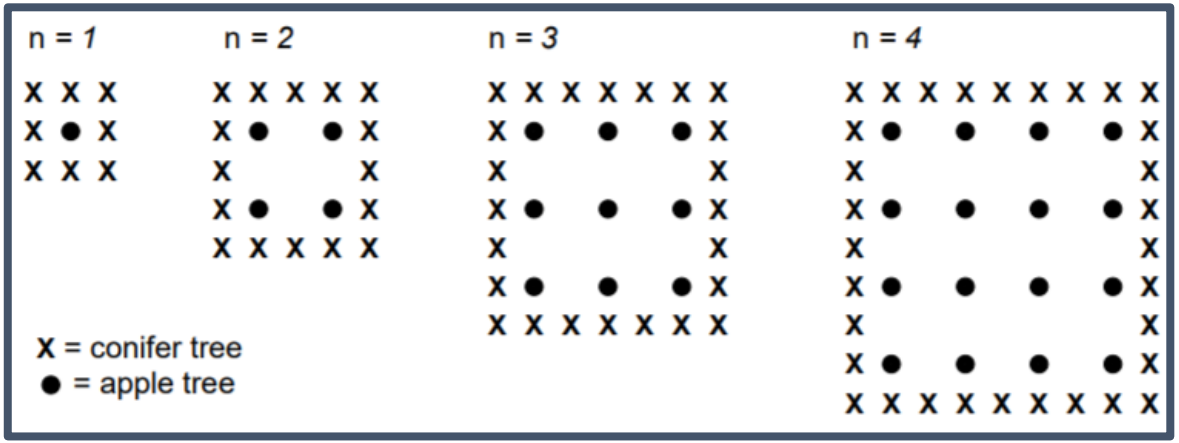
n^2

_____

Scenario 02

Instructional goal: *deduct a given math formula*

A farmer plants apple trees in a square pattern. In order to protect the apple trees against the wind he plants conifer trees all around the orchard.
The pattern of apple trees and conifer trees for any number (n) of rows of apple trees.



~~**Q1.** Complete the table:~~

Q1. Deduce the rule that allows complete the table and write on:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3		
4		
5		

Q2. What is the formula to deduct The number of conifer trees?

Xn | X^2n | n^2 | X/n

Scenario 01

Instructional goal: *deduct a given math formula*

A farmer plants apple trees in a square pattern. In order to protect the apple trees against the wind he plants conifer trees all around the orchard.
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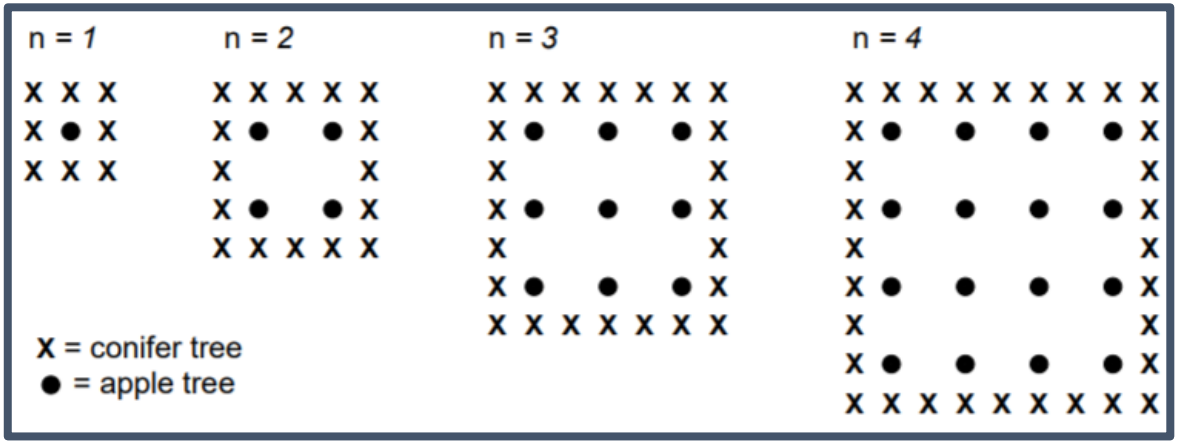

Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	
3	*9*	
4	*16*	
5	*25*	

Q2. What is the formula to deduct The number of conifer trees?

Xn | X^2n | n^2 | X/n

Scenario 01

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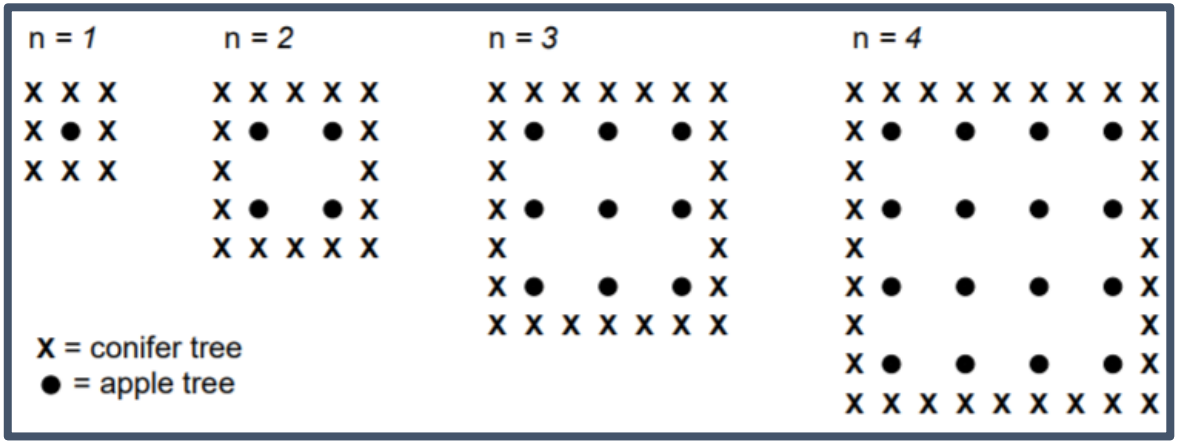

Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	*12* ✗
3	*9* ✓	
4	*16* ✓	
5		

Q2. What is the formula to deduct The number of conifer trees?

Xn | X^2n | n^2 | X/n

Scenario 01

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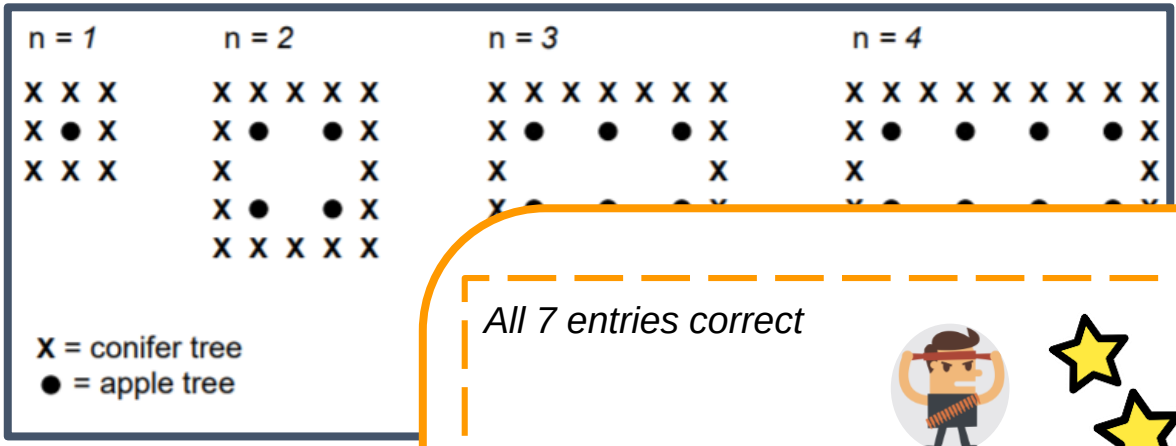

Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	*16* ☑
3	*9* ☑	*24* ☑
4	*16* ☑	*12* ☒
5	*50* ☒	*74* ☒

All 7 entries correct

5-7 entries correct

Scenario 01

Instructional goal: *deduct a given math formula*

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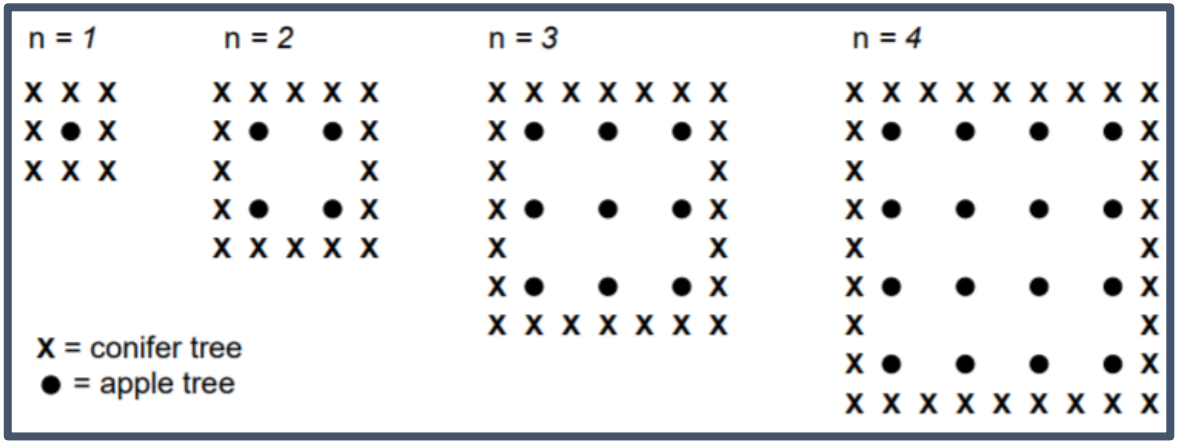

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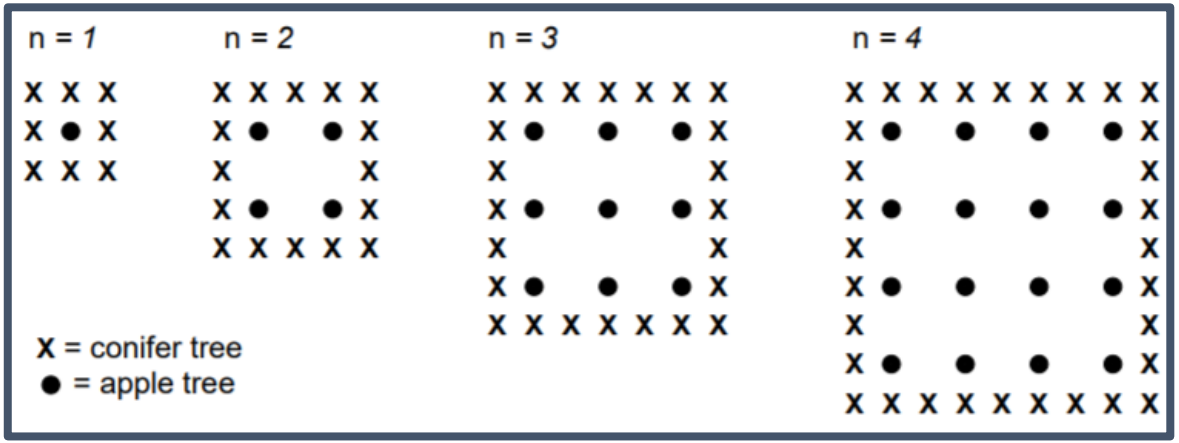

Q1. Complete the table:

n	Number of apple trees	Number of conifer trees
1	1	8
2	4	*16*
3	*9*	*24*
4	*16*	*32*
5	*25*	*40*

Q2. What is the formula to deduct The number of conifer trees?

Xn | X^2n | n^2 | X/n

Scenario 01

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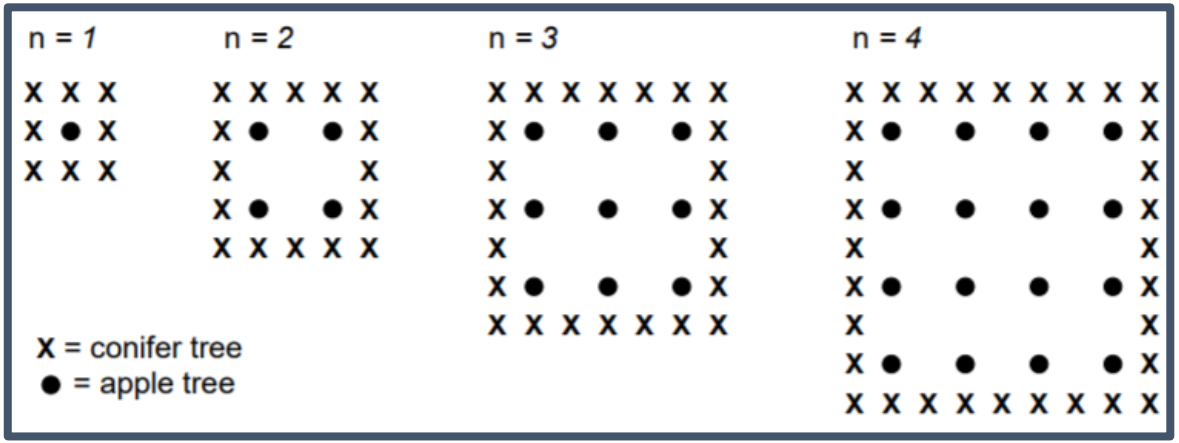

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4	*16*	*32*
5	*25*	*40*

Q2. What is the formula to deduct The number of conifer trees?

Xn | X^2n | n^2 | X/n

Scenario 01

Instructional goal: *apply a given math formula*

A result of global warming is that the ice of some glaciers is melting. Twelve years after the ice disappears, tiny plants, called lichen, start to grow on the rocks.

Each lichen grows approximately in the shape of a circle. The relationship between the diameter of this circle and the age of the lichen can be approximated with the formula:

$$d = 7.0 \times \sqrt{(t - 12)} \quad \text{for } t \geq 12$$

Where *d* represents the diameter of the lichen in millimetres, and *t* represents the number of years after the ice has disappeared.

Using the formula, calculate the diameter of the lichen, 16 years after the ice disappeared.

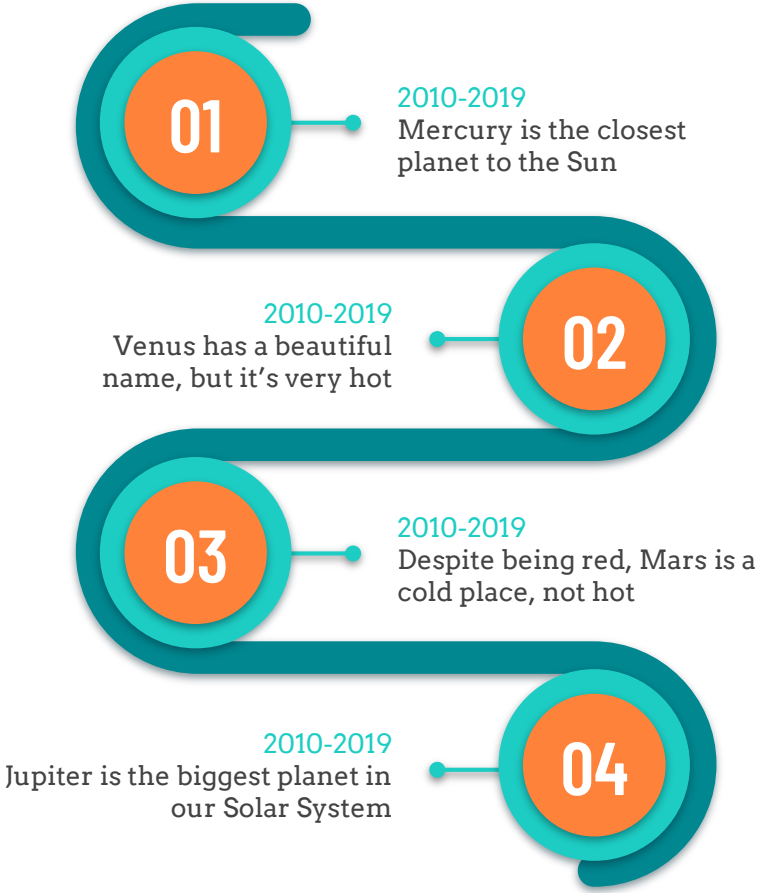
Step 1 Step 2 Step 3 Step 4

TABLE OF CONTENTS

ABOUT ME

Mercury is the closest planet to the Sun and the smallest one in the Solar System—it's only a bit larger than our Moon. The planet's name has nothing to do with the liquid metal since it was named after the Roman messenger god, Mercury

EXPERIENCE


01
2010-2019
Mercury is the closest planet to the Sun
02
2010-2019
Venus has a beautiful name, but it's very hot
03
2010-2019
Despite being red, Mars is a cold place, not hot
04
2010-2019
Jupiter is the biggest planet in our Solar System

JOB POSITION 1

COMPANY NAME HERE 2006-2010

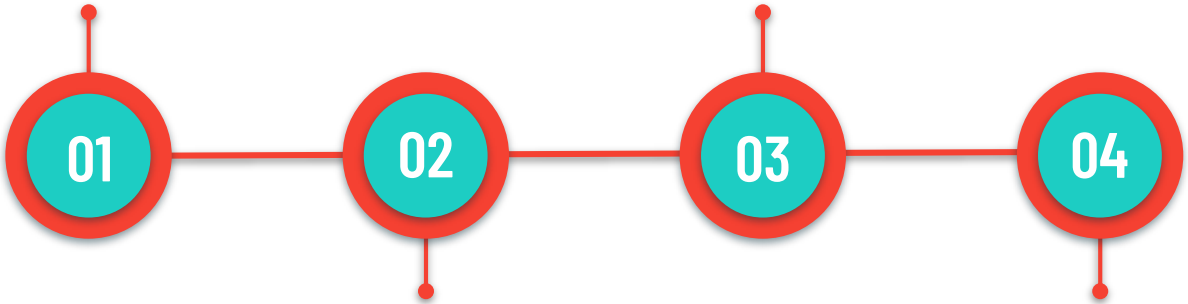
Job / position title here

- List your responsibilities for this job
- Adapt this to your needs
- Try to keep it short
- Get straight to the point
- Don’t omit important information

EDUCATION

2010-2019
Venus has a beautiful name, but it's terribly hot

2010-2019
Mercury is the closest planet to the Sun



2010-2019
Despite being red, Mars is a cold place, not hot

2010-2019
Jupiter is a gas giant and the biggest planet in our Solar System

INSTITUTION 1

INSTITUTION NAME HERE 2000-2006

Principal subjects / occupational skills covered:

- List the subjects here
- Sort them by relevance
- Adapt this to your needs
- Try to keep it short
- Get straight to the point

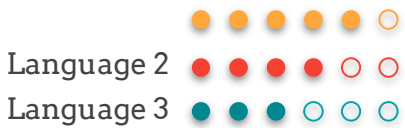
COMMUNICATION SKILLS

COMMUNICATION SKILLS

Mother tongue(s)

- Language 1
- Language 2

Other language(s)



TECHNICAL SKILLS

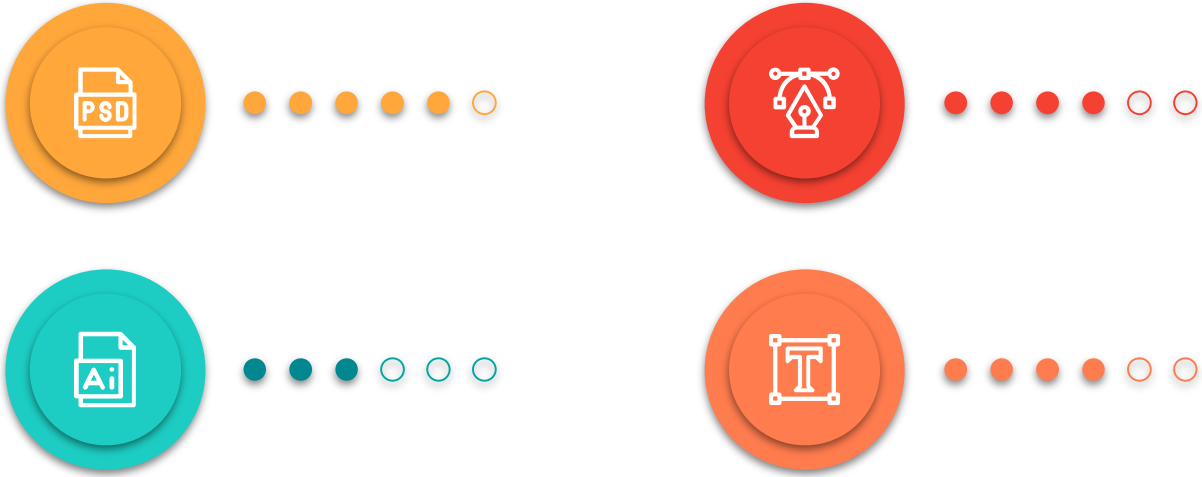
Venus
Venus has a beautiful name, but it's terribly hot

Mercury
Mercury is the smallest planet in our Solar System

Mars
Despite being red, Mars is a cold place, not hot

Jupiter
It's a gas giant and the biggest planet in our Solar System

COMPUTER SKILLS



VOLUNTEER WORK

Venus
Venus has a beautiful name, but it's terribly hot

Mars
Despite being red, Mars is a cold place, not hot

Mercury
Mercury is the closest planet to the Sun

Jupiter
It's a gas giant and the biggest planet in our Solar System

HOBBIES

Venus
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Mercury
Mercury is the closest planet to the Sun

Mars
Despite being red, Mars is a cold place, not hot

Jupiter
It’s a gas giant and the biggest planet in our Solar System

CONTACT

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PHONE	001 664 123 4567
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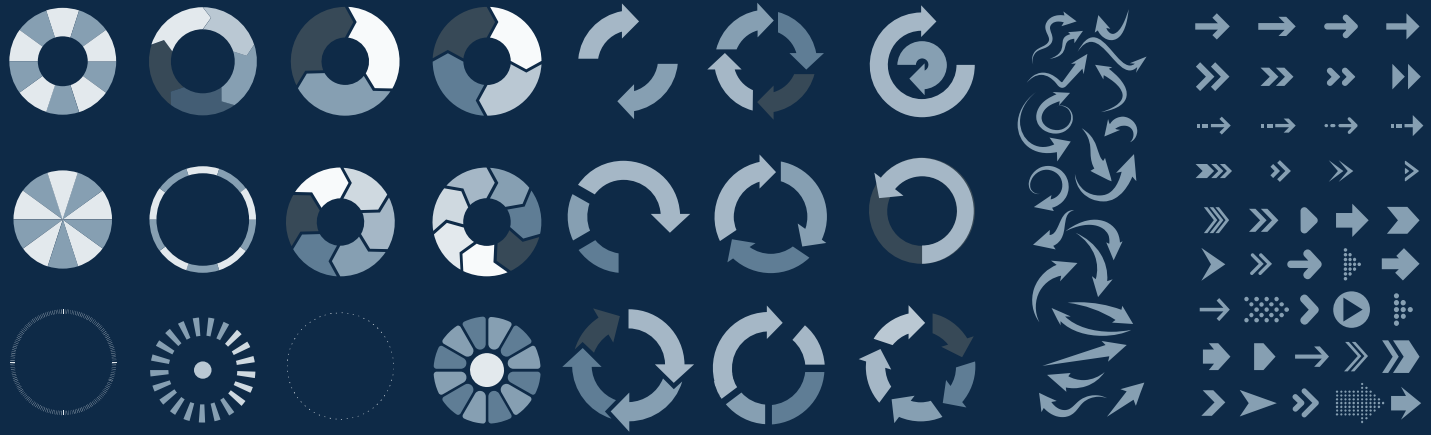

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