Establishing an Appealing Cross-Platform Innovative Educational Gamified Learning System Product: A Complete User Experience Case Study

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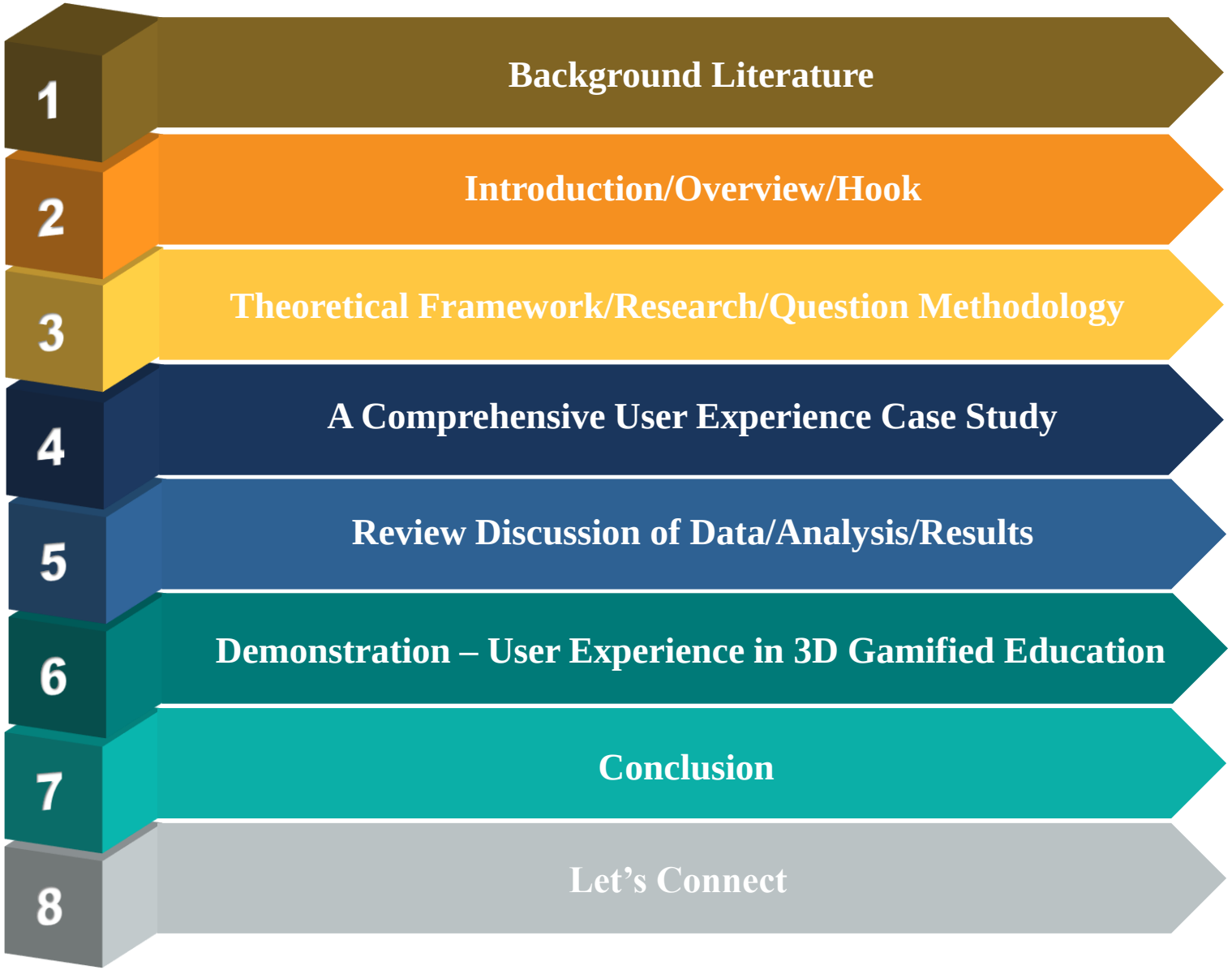


1. Background Literature

Literature Review: Gamification in Education

Learning: The Process of Attaining new Comprehension, Apprehension, Expertise, Principles, Virtues, Comportment and Inclinations (Gross, 2010)

Gamification in Education: The Use of Game-Based Mechanisms and Game Dynamics to Stimulate Learners' Incentives, Peculiarity and Engagement, while Enhancing Their Problem Solving, Critical Thinking and Interpersonal Skills, so that Specific Educational Objectives are Acquired (Kapp, 2016)

Gamified Education Enables Learners to Develop their Cognitive, Emotional and Social Competencies, through Active Game-Play Experimentation, Motivation and Engagement, thence, Holistically Improving the Process of Learning (Lee & Hammer, 2014)

Comparing the Amount of Freedom that a Game Allows for (Gamification vs Game-Based Learning), to the Breadth of its Application within the Classroom, there Exist "Circle B" Educational Gamified Products: "Less Game, Greater Teaching Application" (EdSurge, 2023)

The Science of Gamification in Education

2. Introduction/Overview/Hook

What is *howlearn*

Research Project, Funded by the Hellenic Republic Ministry of Development and Investments

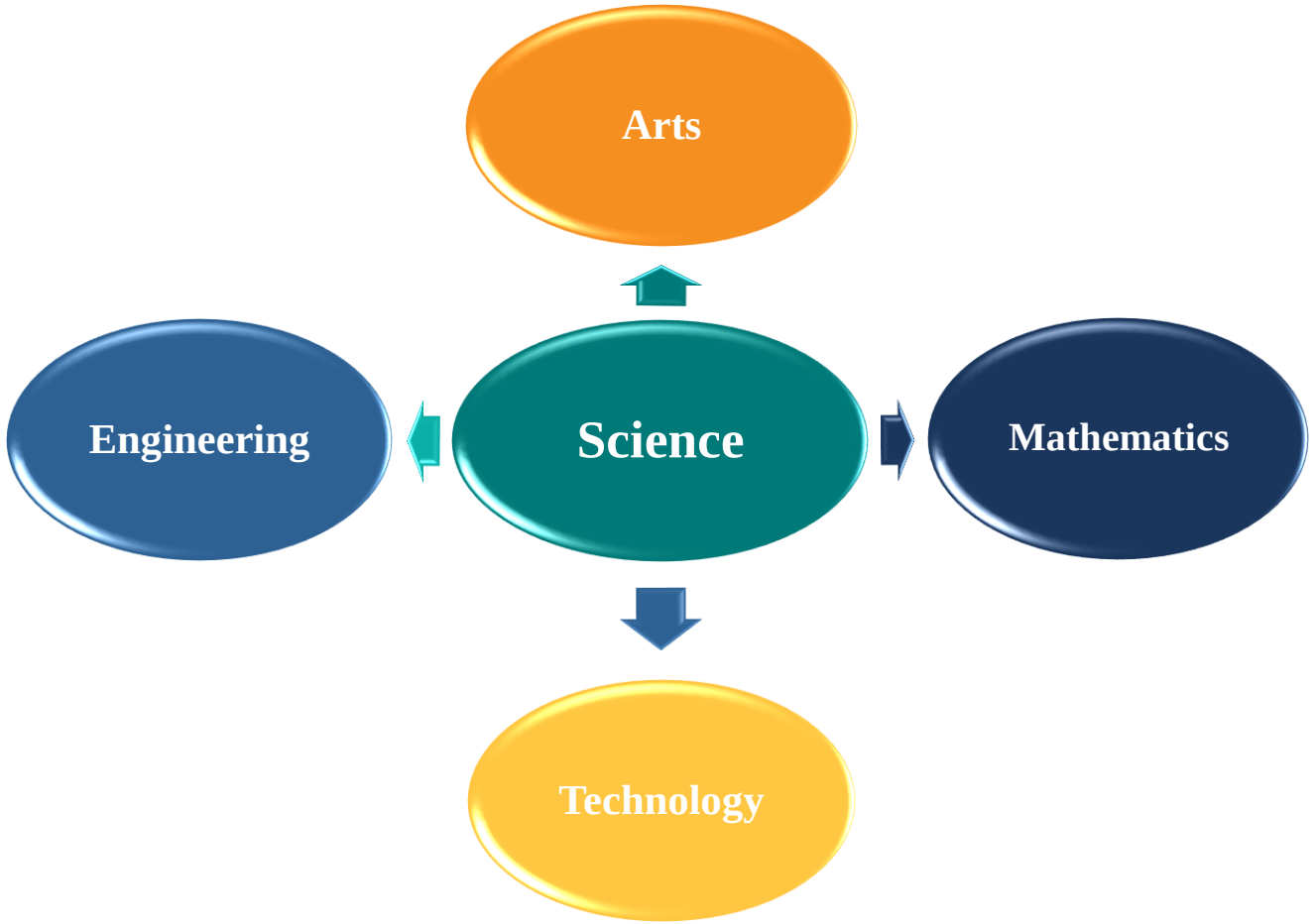
Cross-Platform (Windows, Android/iOS, Web) Innovative Learning System Product, using Gamification Techniques, in 3D Virtual Environments, where Learners Complete Real – Life Thematic Educational Activities/Experiments

Upon Completion → Personalized Feedback (Focus On: Weaknesses, Interests, Class Competency)

How? – The System "Learns" from the Data, through Artificial Intelligence and Machine Learning Algorithms

Its Menu is Accessibility Friendly, while the Library of Experiments and the Repository of Virtual 3D Objects Enables Educational Institutions and Instructors to Constantly Reformulate and Upgrade their Teaching Material, based on their Learners Needs, thus Intensifying the Idea of Constructive, Collective and Learner – Centric Education

howlearn Focuses On STEAM



howlearn's STEAM – Related Gamified 3D Educational Activities/Experiments

2 Interactive Storytelling and Decision-Making Educational Scenarios on Entrepreneurship and Innovation

10 Virtual Thematic Experimental Laboratory Simulations in:

Physics,

Chemistry and

Biology

5 Virtual Labs in:

Mechanics and

ICT

10 Interactive Storytelling (Narration) Scenarios in:

English and

Mathematics

5 Simulations and Case Studies in:

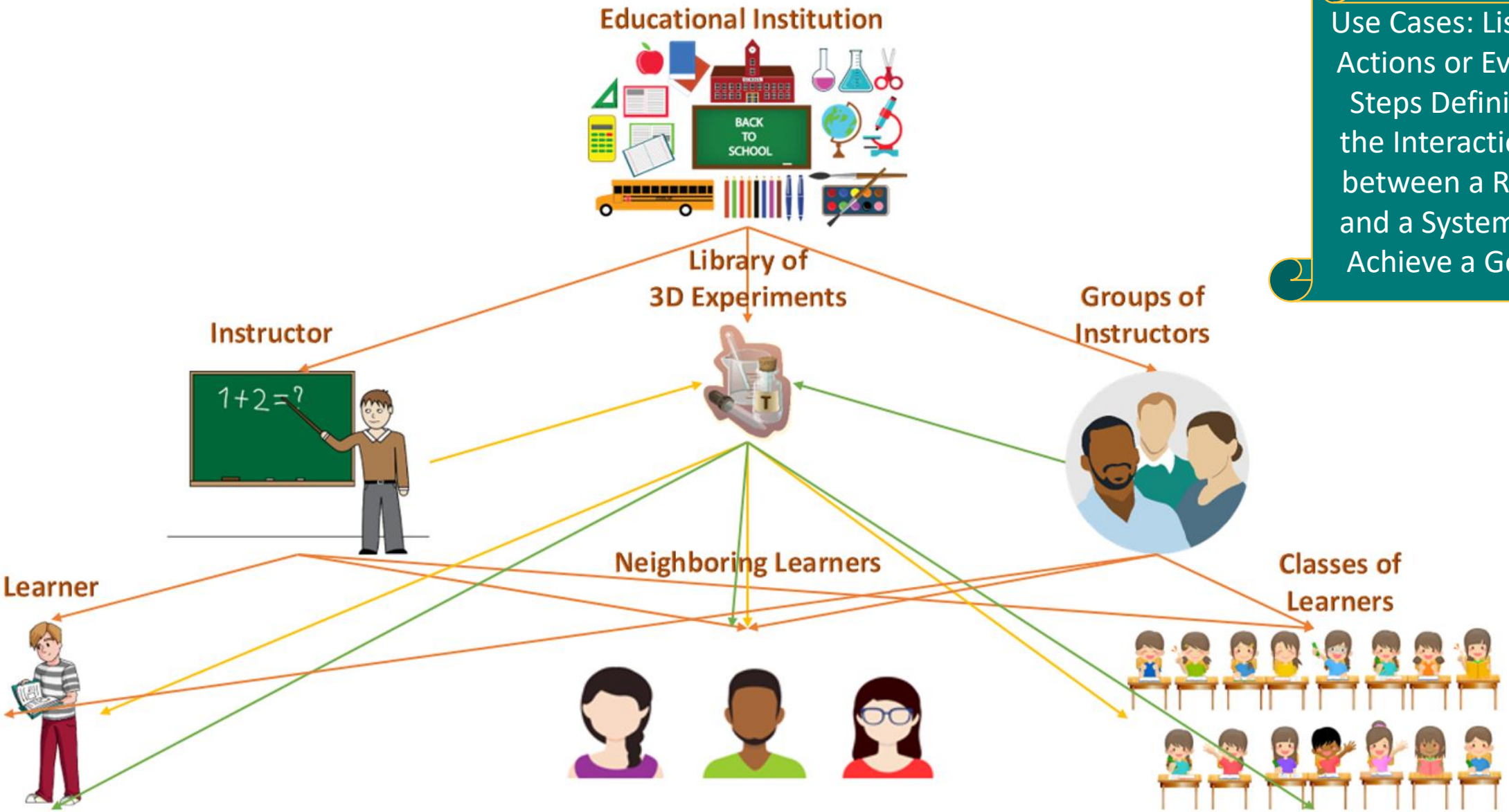
Literature and

Arts

howlearn Hopes To

Use Cases of *howlearn*

Use Cases: List of Actions or Event Steps Defining the Interactions between a Role and a System to Achieve a Goal



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ML and AI in *howlearn*

Factor Analysis & Dimensionality Reduction

- Principal Component Analysis – Singular Value Decomposition

Outlier/Anomaly Detection

Clustering

- K-Means – DBScan

Classification

- Support Vector Machines – Naïve Bayes Classifier – K-Nearest Neighbors[KNN] – Decision Trees / Random Forests

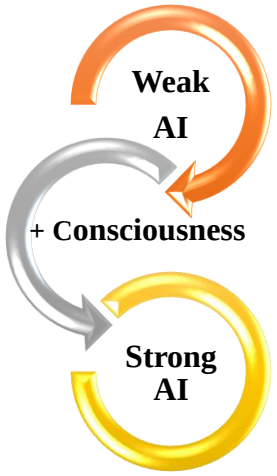
Regression

- Linear Regression – Logistic Regression / Ordinal Logistic Regression

Recommendation Systems

- Collaborative Filtering – Content Filtering – Hybrid Filtering

What is AI and ML



1. Assigns Human – Like Qualities to Digital Experiences

2. Perceives its Environment

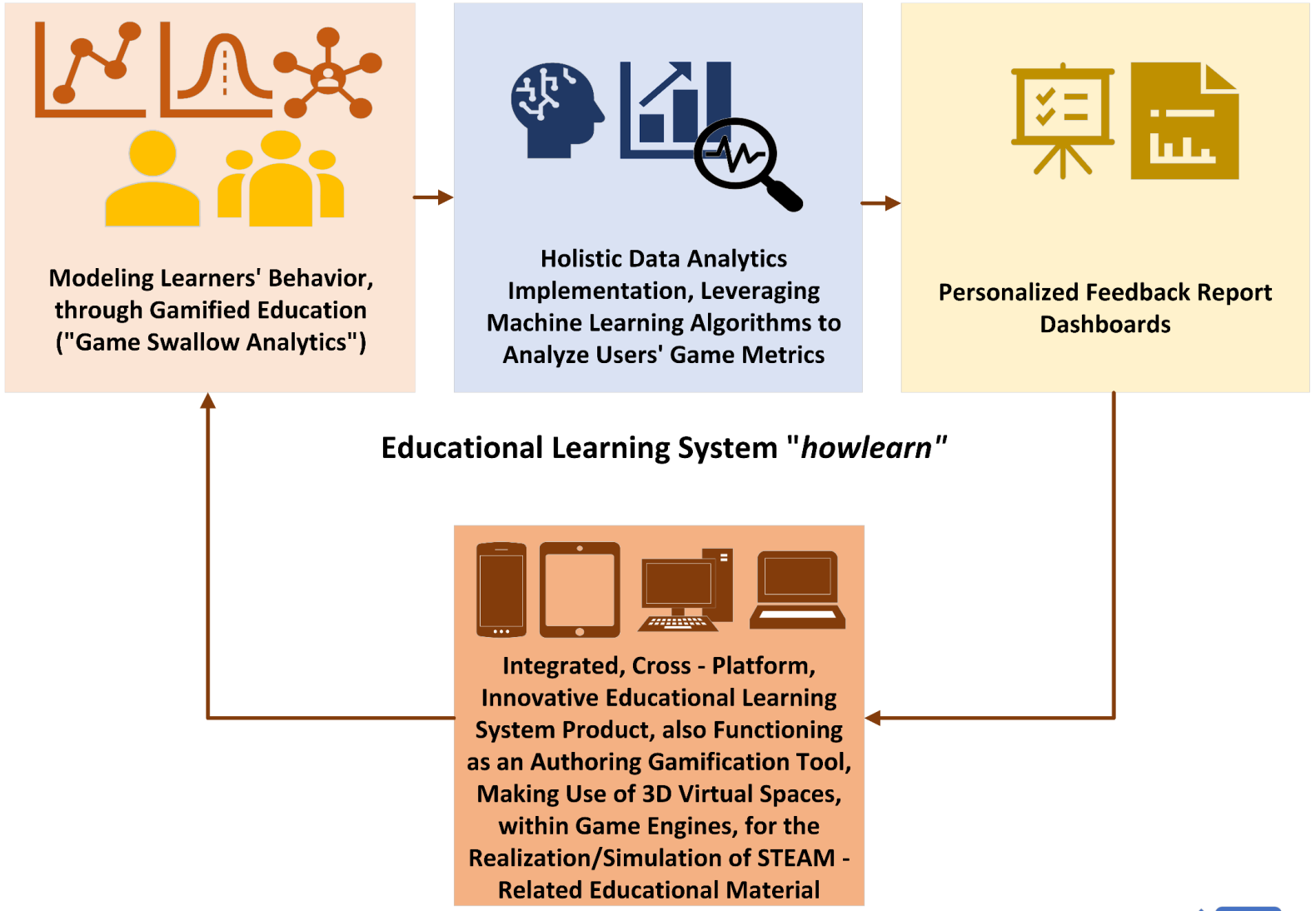
3. Mimics How People Think

1. Learns From Examples in Large Amounts of Data

2. Program that Writes Itself Based On Examples

3. Classifies, Recommends, Predicts, Groups, Segments

Visual Conceptualization of the Innovation within the Educational Learning System *howlearn*



3. Theoretical Framework/Research/Question Methodology

User Experience – User Experience Design – User Experience Research and Data Analysis in *howlearn*

UX: The Way in which a User Interacts With, Perceives and Gets Acquainted with a Product, System or Service

A Person's Perception of the Usefulness, Convenience, Adaptability and Efficacy of the Product in Question (Norman & Nielsen, 2016)

1

UXD: The Process of Identifying Users' Experience with Products, Based On Interaction Designs, Supported by Empirical or Scientific Evidence (Norman & Nielsen, 2016)

2

Namely: Convenience, Functionality, Attractiveness, Brand Identity and Overall Product Performance

UXD's Design Solutions are Guided By Extensive Research, Data Analysis and Pilot Testing Findings

3

UXR: The Process of Gaining Valuable Insights on Users' Behaviors, Wants and Needs, via Observation Techniques and Feedback Methodologies *(i.e. Usability Studies)* (Goodman & Kuniavsky, 2012)

UXR is an Iterative Process, Used at Any Stage of Product Development, Always Focusing on the Formulation of User-Centered Designs (Hall, 2013)

4

The Analysis of Data, Generated by UXR, Helps Determine Application-Related and System-Related Product Issues (UX Booth Editorial Team, 2018). Design Solutions are, then, Ready to be Prototyped and Tested, Prior to the Product's Final Launch

howlearn's User Experience Research

Questionnaires Examining How Secondary Education Students/Learners and Teachers/Instructors Perceive Gamification in Education

- **First Ordinal Logistic Regression Model – Students'/Learners' Questionnaire:**

$$logit(P(Teaching\ Support\ System) \leq \mathbf{1}) = \mathbf{0.45} - \mathbf{1.89} * Means\ of\ Motivation - (\mathbf{-0.57}) * Sex$$
$$logit(P(Teaching\ Support\ System) \leq \mathbf{2}) = \mathbf{1.20} - \mathbf{1.89} * Means\ of\ Motivation - (\mathbf{-0.57}) * Sex$$

- **Second Ordinal Logistic Regression Model – Students'/Learners' Questionnaire:**

$$logit(P(Teaching\ Support\ System) \leq \mathbf{1}) = \mathbf{0.47} - \mathbf{2.04} * Means\ of\ Skills' Enhancement$$
$$logit(P(Teaching\ Support\ System) \leq \mathbf{2}) = \mathbf{1.28} - \mathbf{2.04} * Means\ of\ Skills' Enhancement$$

- **Ordinal Logistic Regression Model – Teachers'/Instructors' Questionnaire:**

$$logit(P(Teaching\ Support\ System) \leq 1) == \mathbf{-2.45} - (\mathbf{-2.31}) * Negative\ Impact\ on\ the\ Educational\ Process$$
$$logit(P(Teaching\ Support\ System) \leq 2) == \mathbf{-1.21} - (\mathbf{-2.31}) * Negative\ Impact\ on\ the\ Educational\ Process$$

User Experience Research – Ordinal Data Analysis Findings

Ordinal Logistic Regression of the Students'/Learners' Questionnaire Data Analysis

($n = 156$ Students/Learners)

Learners' Questionnaire

The Constitution of a Gamified Product as a Teaching Support System:

1. Acts as a Means of Motivation
2. Vastly Contributes to the Enhancement of their (Hard and Soft) Skills

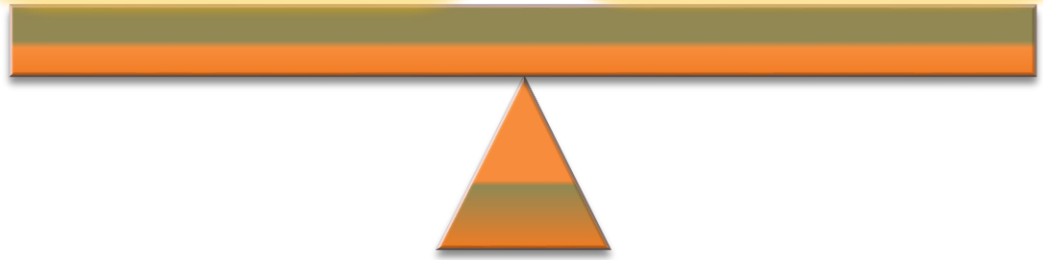
Note:
Sex Slightly Modifies Learners' Perception on Motivation.

Instructors' Questionnaire

The Constitution of a Gamified Product as a Teaching Support System:

1. Although Intensifying the Learning Process,
2. It is Considered Probable that it would, Negatively Affect the Educational Process, as a Whole

Note: Contradictory Finding:
Insight: Instructors Fear that Gamified Education is Time Consuming and Might be Judged by Parents



Ordinal Logistic Regression of the Teachers'/Instructors' Questionnaire Data Analysis

($n = 23$ Teachers/Instructors)

4. A Comprehensive User Experience Case Study

Defining *howlearn*'s User Pain Points, Personas and User Stories

Pain Points

- Problems Occurring During the Initial Encounter with the Learning System's User Experience, on 3 Levels of Investigation:
- Interaction Level: Accessibility Issues
- Customer – Journey Level: Navigationally Troublesome Information Architecture Design
- Relationship Level: Lack of Cross – Platform Product Responsiveness → Perplex and Baffling Navigation

Personas

- Fictional Characters in "User - Centered Digital Design" Illustrating the Product's End Users (Lidwell et al., 2010) and their Fictional Personal Characteristics, Behavior, Goals, Skills, Attitudes, Wants, Needs and Reasons of Indignation to Help Define the Product's Final Morphology and Visual Design

User Stories

- Informal, Natural Language Description (in a Single, Short and Specific Proposal) of End Users' Ideal Learning Management Features, Transcribed, Either on Index Cards or Digitally (Dimitrijević et al. 2015)
- Phrase Structure: "As…, I wish to/I want to…, So that…", Accompanied With an Acceptance Criteria Statement of the Form: "Given that…, When…, Then" (Garreta-Domingo, 2021)

Persona and User Story of Educational Institution

Ionideios Model High School of Piraeus

Sotiros Dios 17, Piraeus 185 35

210 4513425

mail@ion-piraeus.att.sch.gr

Internet Use	●●●●○
Social Media	●●○○○
Familiarization with Technological Advancements	●●●○○

About

The establishment is located in Piraeus, Greece. Within the school unit, one may find a fully functional IT Laboratory, equipped with 20 desktops and 1 server.

Wants and Needs

- Daily usage of modern technology, as an accompaniment to all lectures.
- Turn learning into a more enjoyable process, both for teachers and students.
- Application of alternative ways of assessment.
- Move professors to the creation not only of alternative ways of teaching but also of assessment.
- Digitalization of all modules, so that they are directly accessible by the whole of the teacher/student community.

Root Causes of Indignation

- Traditional method of teaching.
- Lack of students' active participation throughout the educational process.
- Curricula requiring computational knowledge.
- Non-digitized modules.

Use Case: Educational Institution	**Priority: 3**
User story **As** an Educational Institution, {type of user} **I want to** be able to use digital learning spaces, as a means towards the enhancement of the learning process, {action} **So that** new/refined innovative educational activities are assigned, both to the teaching staff and the students/classes of the school unit. {benefit}	
Acceptance Criteria **Given that** the Educational Institution is interested in creating digital learning spaces, **When** they start using a cross-platform learning system product, like *howlearn,* **Then,** they will be able to fully digitize and improve their school's educational processes and online learning.	

Persona and User Story of Instructor

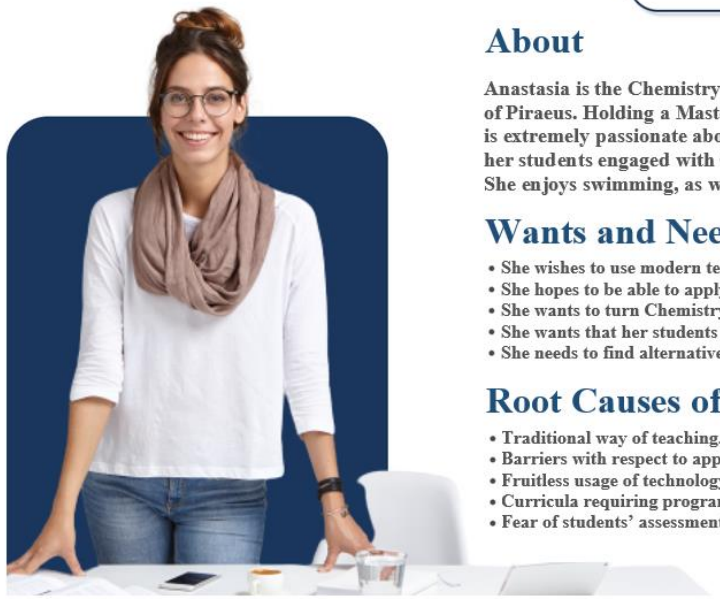
Anastasia Stavrou

35 years old

Piraeus, Greece

Chemistry Teacher, Ionideios Model High School of Piraeus

Internet Use	●●●●○
Social Media	●●○○○
Familiarization with Technological Advancements	●●●●○



About

Anastasia is the Chemistry Teacher of Ionideios Model High School of Piraeus. Holding a Master Degree in Education Technology, she is extremely passionate about her work and wishes to get all of her students engaged with Chemistry and its modern applications. She enjoys swimming, as well as going to the movies.

Wants and Needs

- She wishes to use modern technology in her day-to-day teaching life.
- She hopes to be able to apply all of her M.Sc. attained knowledge, within the classroom.
- She wants to turn Chemistry learning into a fun educational process.
- She wants that her students are no longer afraid of educational assessment systems.
- She needs to find alternative ways of assessment.

Root Causes of Indignation

- Traditional way of teaching.
- Barriers with respect to applying theory to practice.
- Fruitless usage of technology by students.
- Curricula requiring programming knowledge.
- Fear of students' assessment over her teaching capabilities.

Use Case: Instructor	**Priority: 1**
User story **As** an Instructor, **I want my students to have access to technology-based, monitored education,** **So that** their progress is easily detectable, circumstance which would help to further modify and adjust the material to their personalized needs.	
Acceptance Criteria **Given that** the Instructor wants to get acquainted with their students' performance data, **When** they start using a cross-platform learning system product, like *howlearn,* **Then,** they will be able to assess their student's personalized needs and adjust the material accordingly.	

Persona and User Story of Learner

Nick Papadopoulos

15 years old

Piraeus, Greece

High School Student, Ionideios Model High School of Piraeus

Internet Use	●●●●●
Social Media	●●●●○
Familiarization with Technological Advancements	●●●●●
School Performance	●●●○○

About

Nick is a High School student of the Ionideios Model High School of Piraeus. He is thoroughly interested in technology and is a strong believer of the convergence of the latter with the whole of the educational process. In his spare time, he enjoys playing football and spending time on social media. He is not particularly into studying, yet, he is fond of Chemistry and Physics and would love to pursue a career related to them.

Wants and Needs

- He wishes to practically implement all that he learns in class.
- He wants modern technology to be applied in class, on the daily.
- He wants to undergo more enjoyable ways of assessment.
- He wishes for computer-supported lectures to be accompanying all modules, not just the IT related ones.
- He wishes that all educational processes were more fascinating and intriguing.

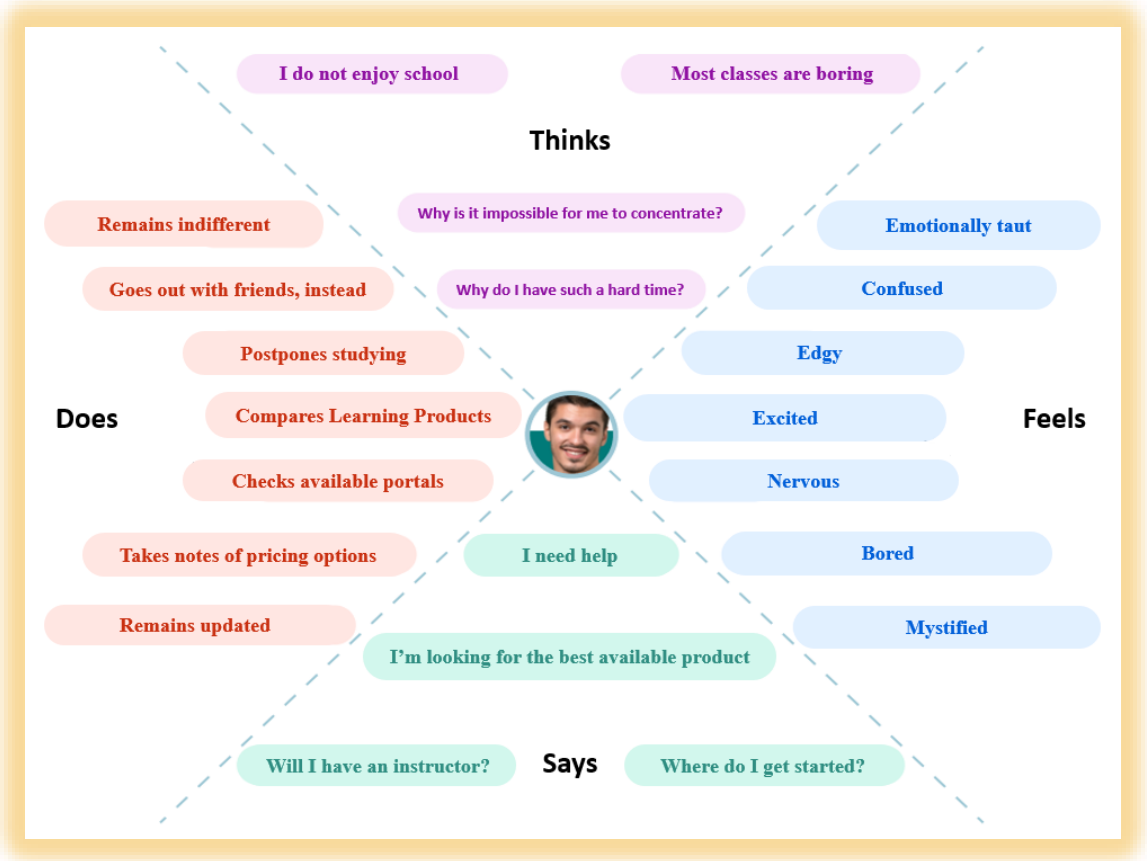
Root Causes of Indignation

- Traditional method of teaching.
- Lack of application of theory to practice.
- Lack of laboratory facilities, within the school unit.
- No usage of technological advancements, within the school unit.
- Lack of technical know-how, within the teaching community (professors).
- Lack of personalized feedback.

Use Case: Learner	**Priority: 1**
User story **As** a Learner, **I want to** be able to use my computer, in all modules, **So that** learning becomes a more enjoyable process.	
Acceptance Criteria **Given that** the Learner wishes that their education becomes a joyful process, **When** they start using a cross-platform learning system product, like *howlearn,* **Then,** they will, eventually, start to become more and more engaged in the learning process, as they continue to interact with the product.	

Empathy Map and Problem Statement of Learner

Empathy Map



Problem Statement

Nick Papadopoulos$_{\{user\ name\}}$ is a ***High School Student***$_{\{user\ characteristics\}}$
who needs ***access to alternative ways of lecturing***$_{\{user\ need\}}$
since
he is interested in applying modern technology, as a means of better understanding of the school material, as this will turn teaching into a more enjoyable, to him, personalized, experience$_{\{insight\}}$.

Empathy Map Pills

Think Feel Say Do

Usability Study and Jamboard Affinity Diagram

Usability Study

Usability study: parameters

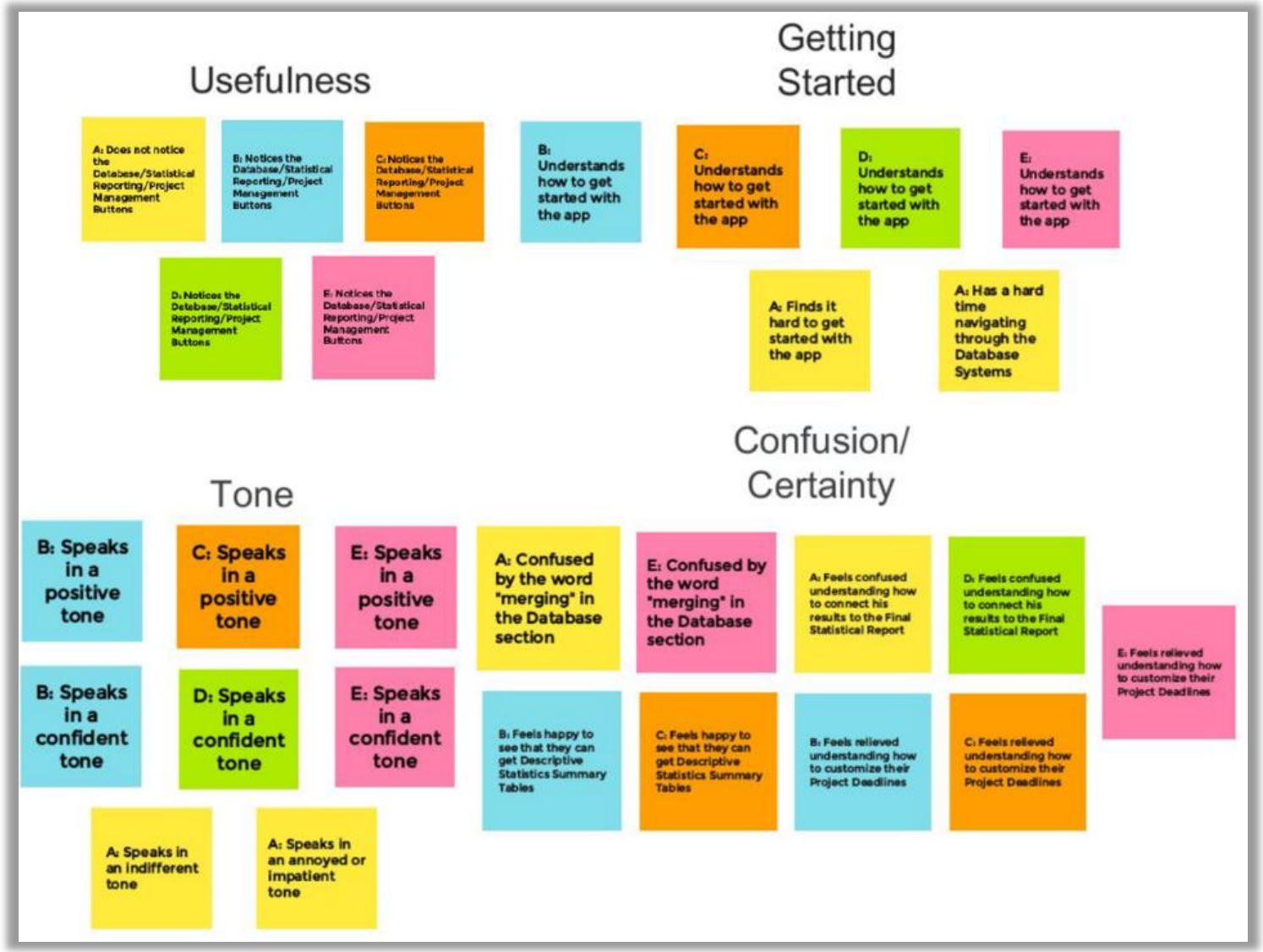
Study type:
Unmoderated Stratified Usability Study

Location:
Greece, Remote

Participants:
5 participants

Length:
30-60 minutes

Jamboard Affinity Diagram



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howlearn's Logos

Before

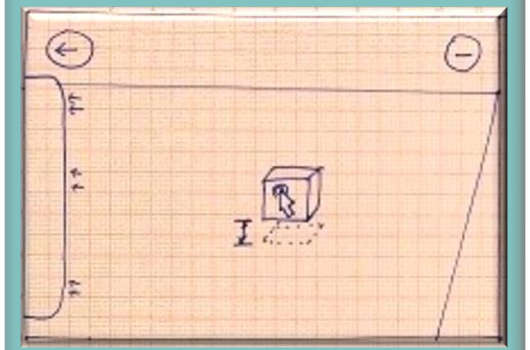
After

5. Review Discussion of Data/Analysis/Results

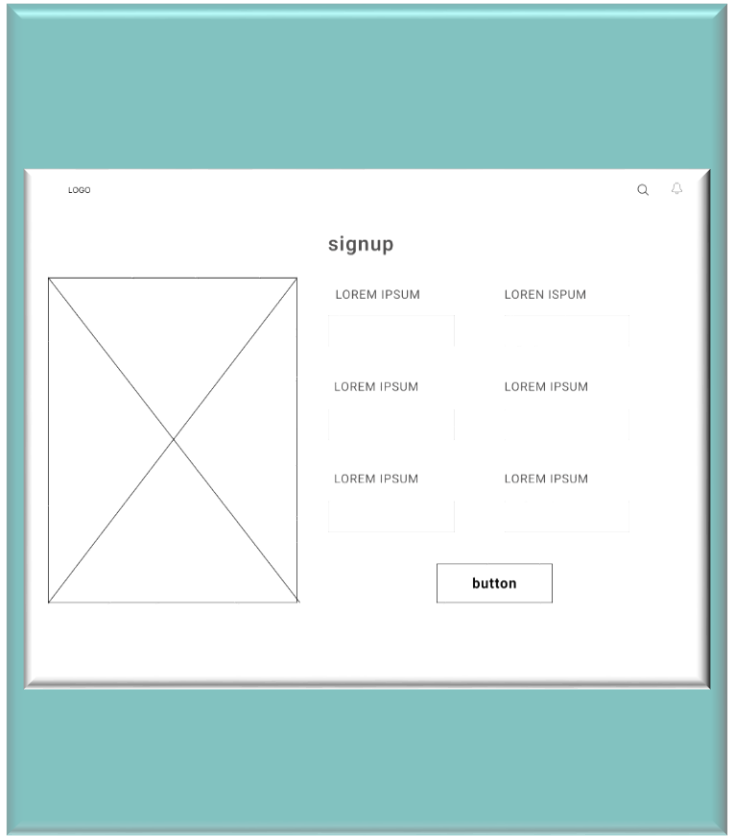
From Paper Wireframes and Low-Fidelity Digital Wireframes to High – Fidelity Prototypes

Before

Paper Wireframe

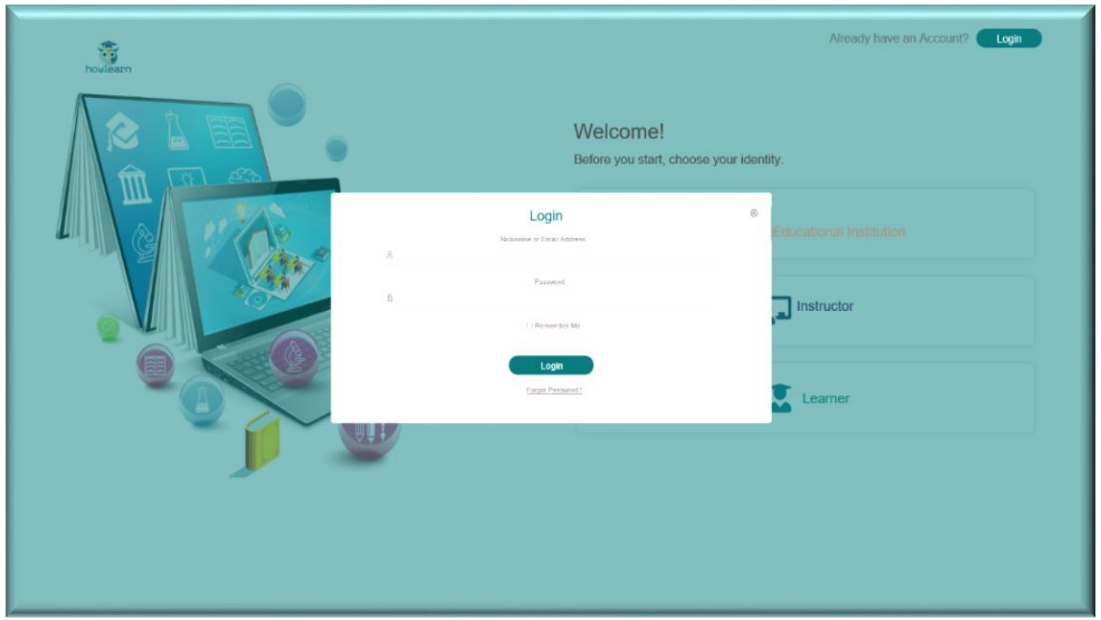


Low-Fidelity Digital Wireframe



After

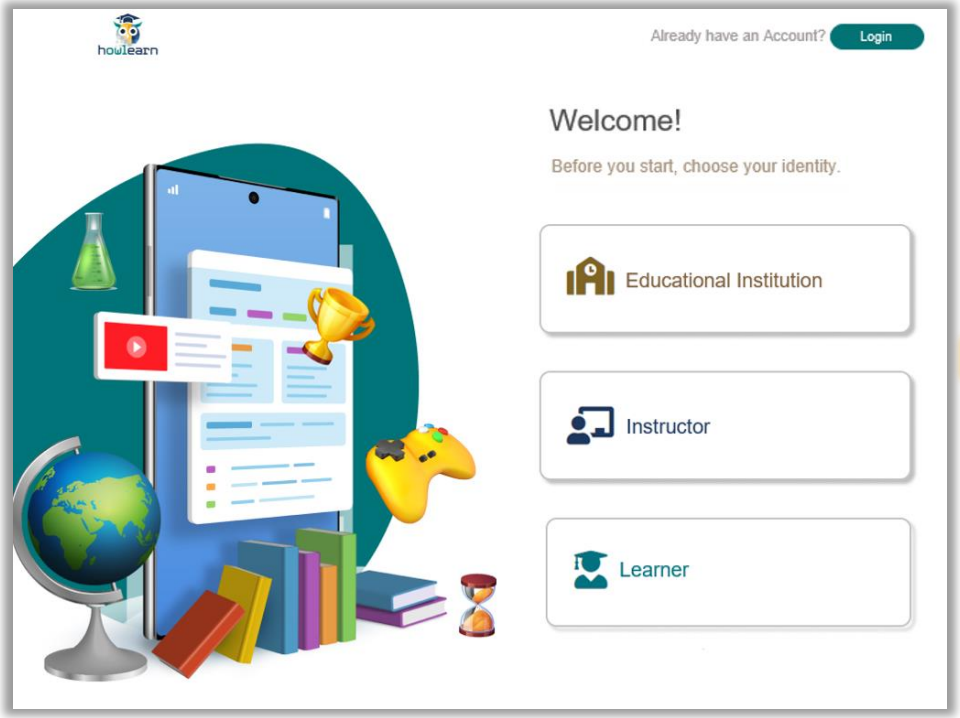
High – Fidelity Prototype



From Mockups to High-Fidelity Prototypes

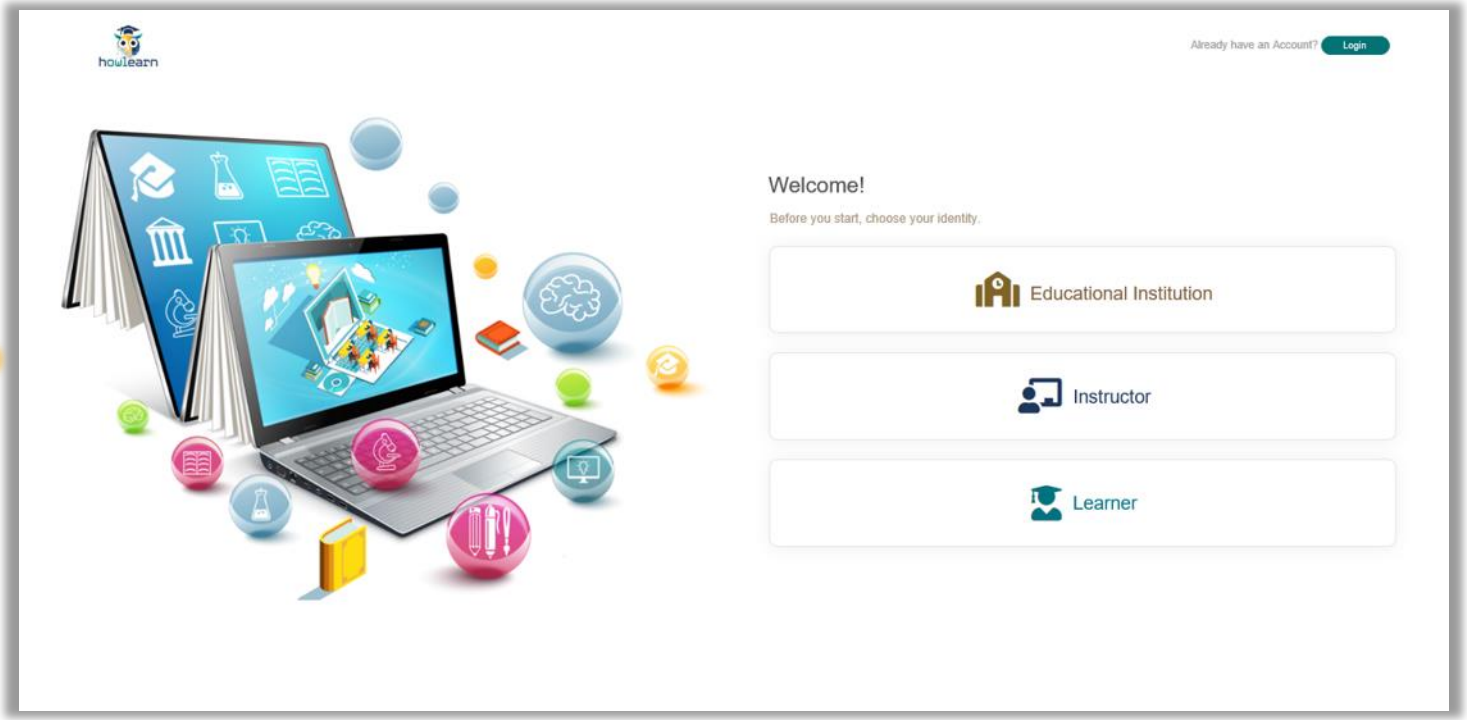
Before

Splash Screen - Mockup

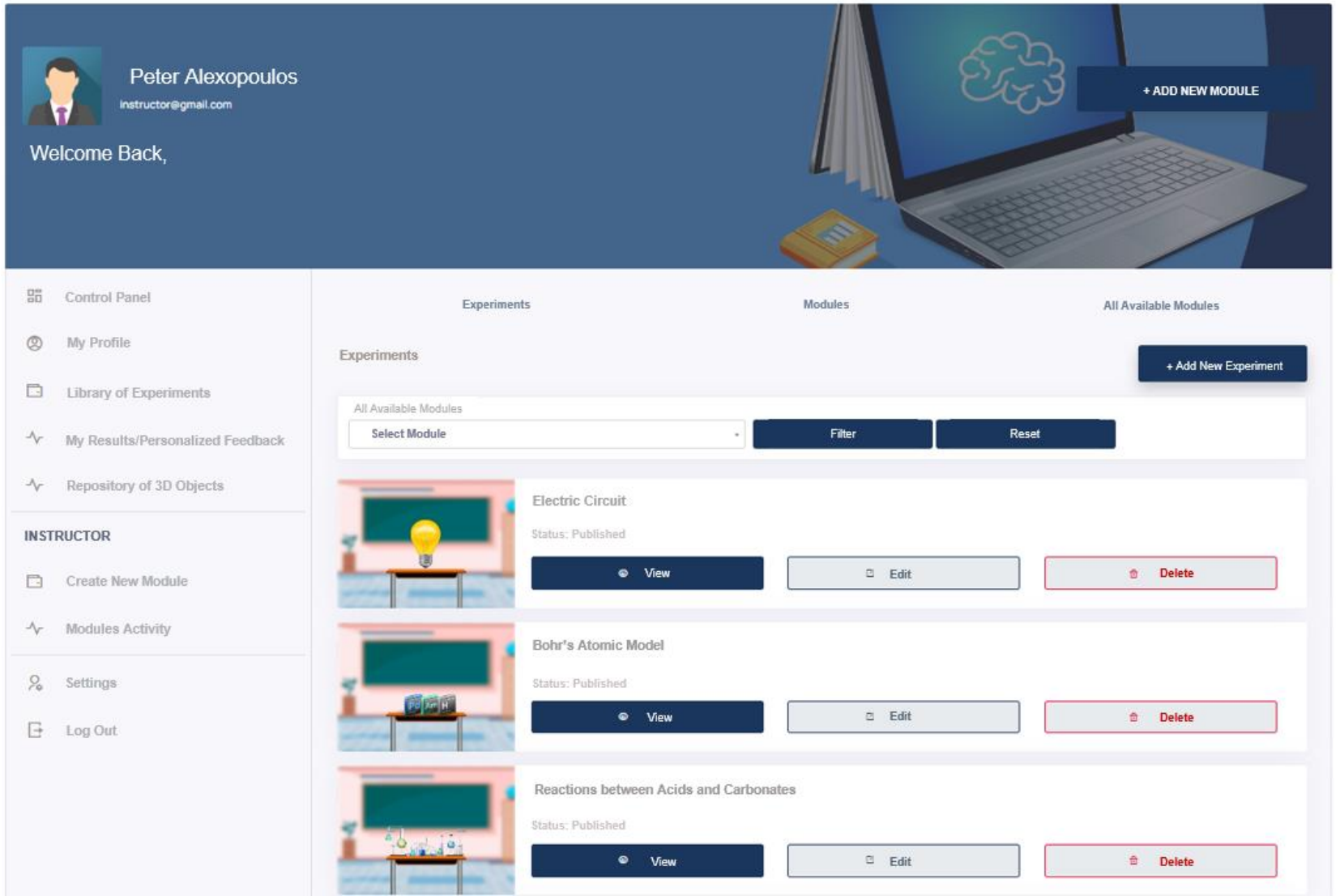


After

Splash Screen – High Fidelity Prototype

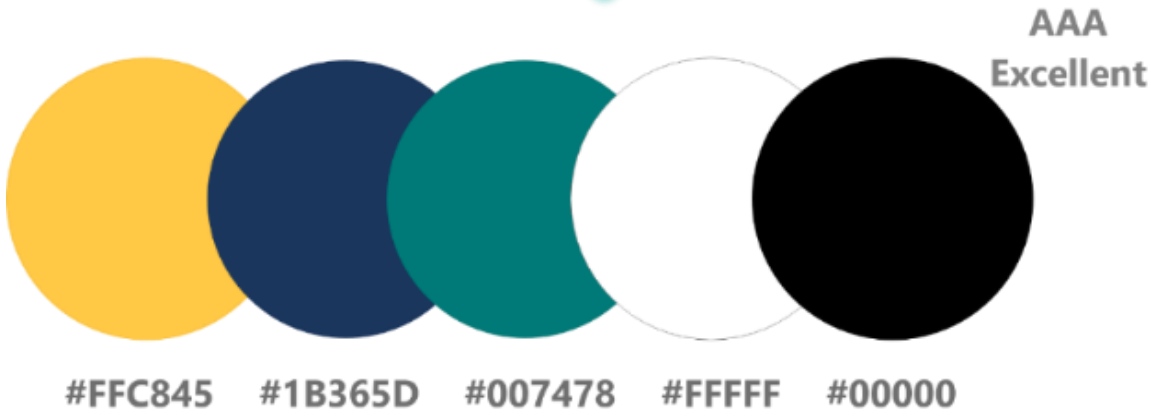


Landing Page – High-Fidelity Prototype



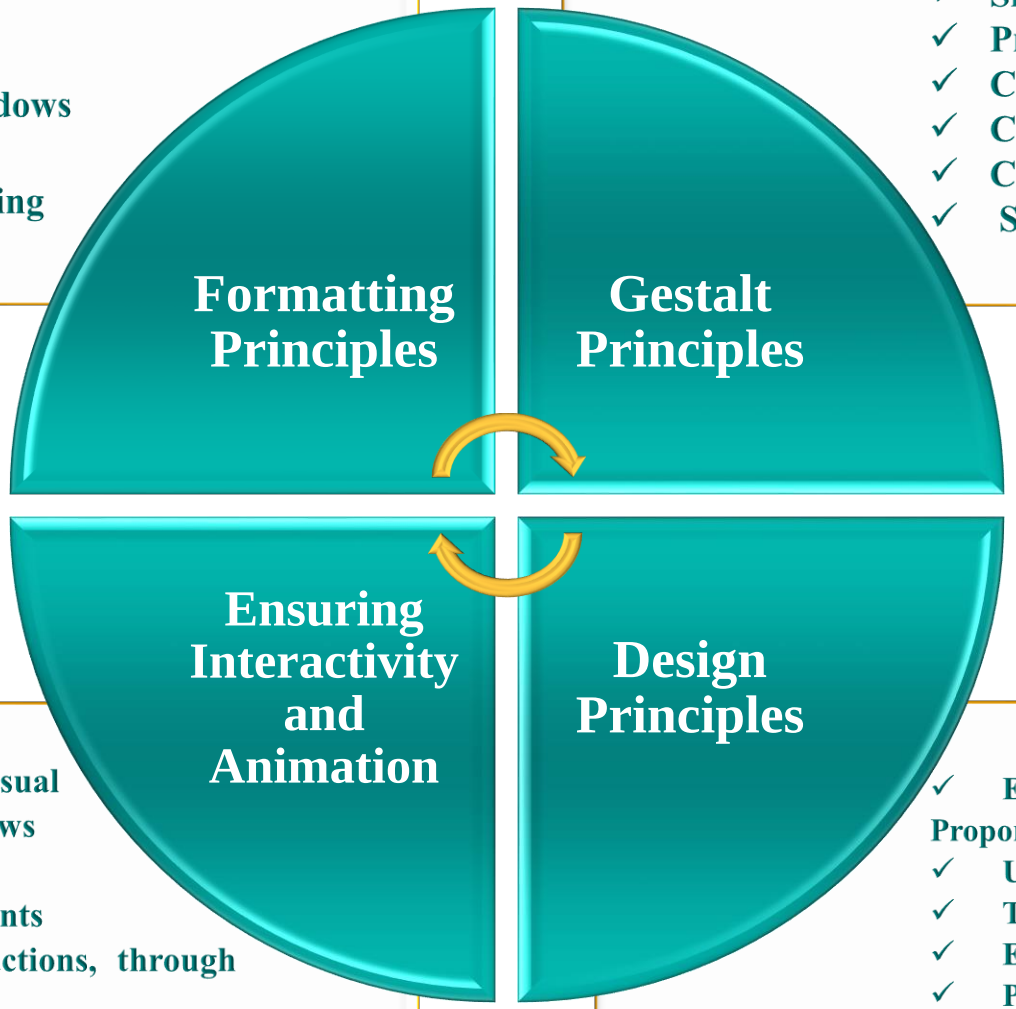
Accessibility in *howlearn*'s User Experience

Our proposed Integrated Educational Learning System complies with the WCAG ("Web Content Accessibility Guidelines") guidelines, as established by the Worldwide Web Consortium ("W3C") initiative, governing accessibility guidelines on the world wide web, to make web content more accessible, to a wider spectrum of people with low vision, color blindness, photosensitivity and combinations thereof, accumulating a score of AAA – "Excellent"



howlearn's User Experience Design Principles

The frameworks within which, the appropriate selection, creation and organization of the User Experience elements and features of a specific product of investigation, ultimately, lead to easy-to-use, user-friendly designs (Masooma, 2019)



- ✓ Layout Grids
- ✓ Containment:

Dividers, Borders, Fills, Shadows

- ✓ Spacing:

Negative Spacing, Line Spacing

- ✓ Similarity
- ✓ Proximity
- ✓ Common Region
- ✓ Closure
- ✓ Continuation
- ✓ Symmetry

- ✓ Progressive Addition of Visual Elements and Navigational Flows
- ✓ Addition of Gestures
- ✓ Addition of Motion Elements
- ✓ Creation of Final Interactions, through Connection Nodes

- ✓ Emphasis, Hierarchy, Scale, Proportion
- ✓ Unity, Variety
- ✓ Typography, Color, Iconography
- ✓ Elevation, States and Size
- ✓ Product Identity *(Brand Identity)*
- ✓ Elements, Components, Themes

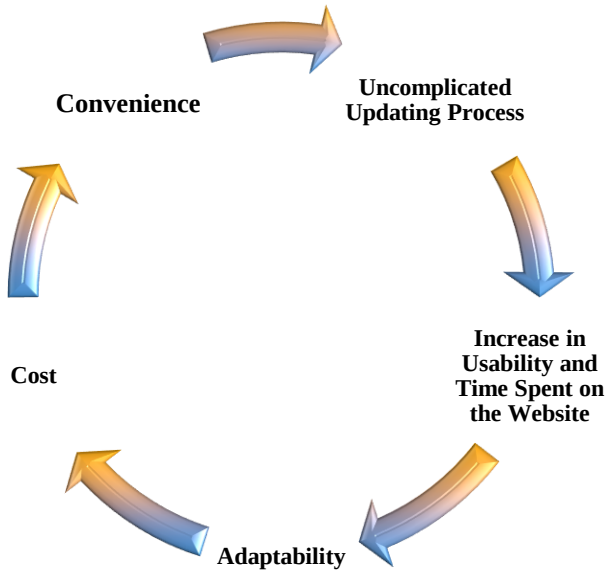
howlearn's Responsive Design Mockups for iOS (iPhone SE) Mobile Screens

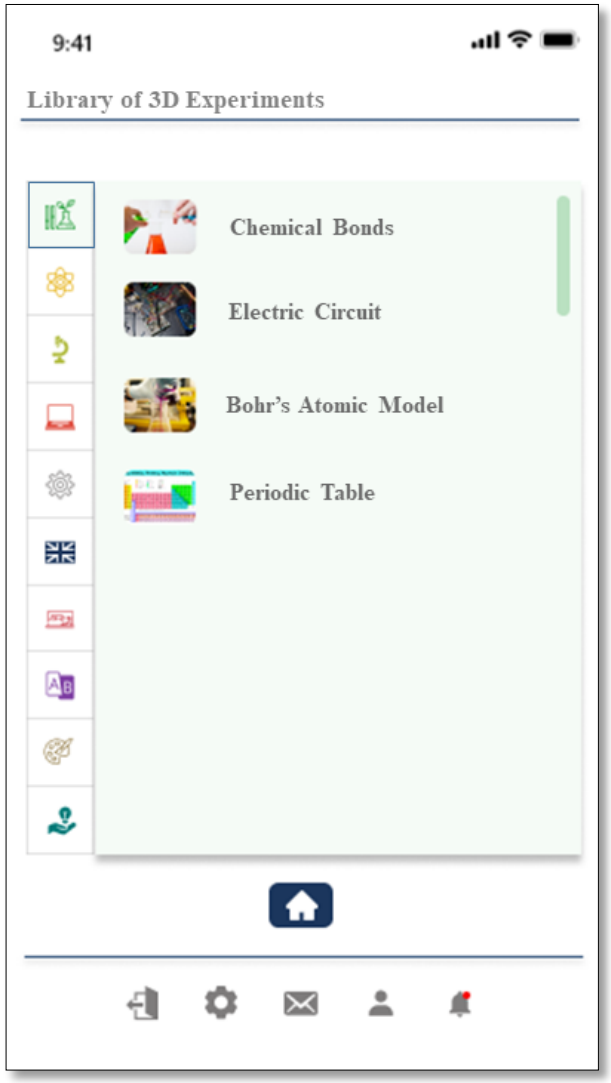
Responsive Design:

The Subsection of Web Design Concentrated on the Dynamic and Immediate Adaptation of a Web Page, on a Variety of Potential Devices, Window or Screen Sizes, from Min to Max Display Size, to Ensure Usability and Contentment

(Marcotte, 2010 – Schade, 2014)

Advantages of Responsive Design

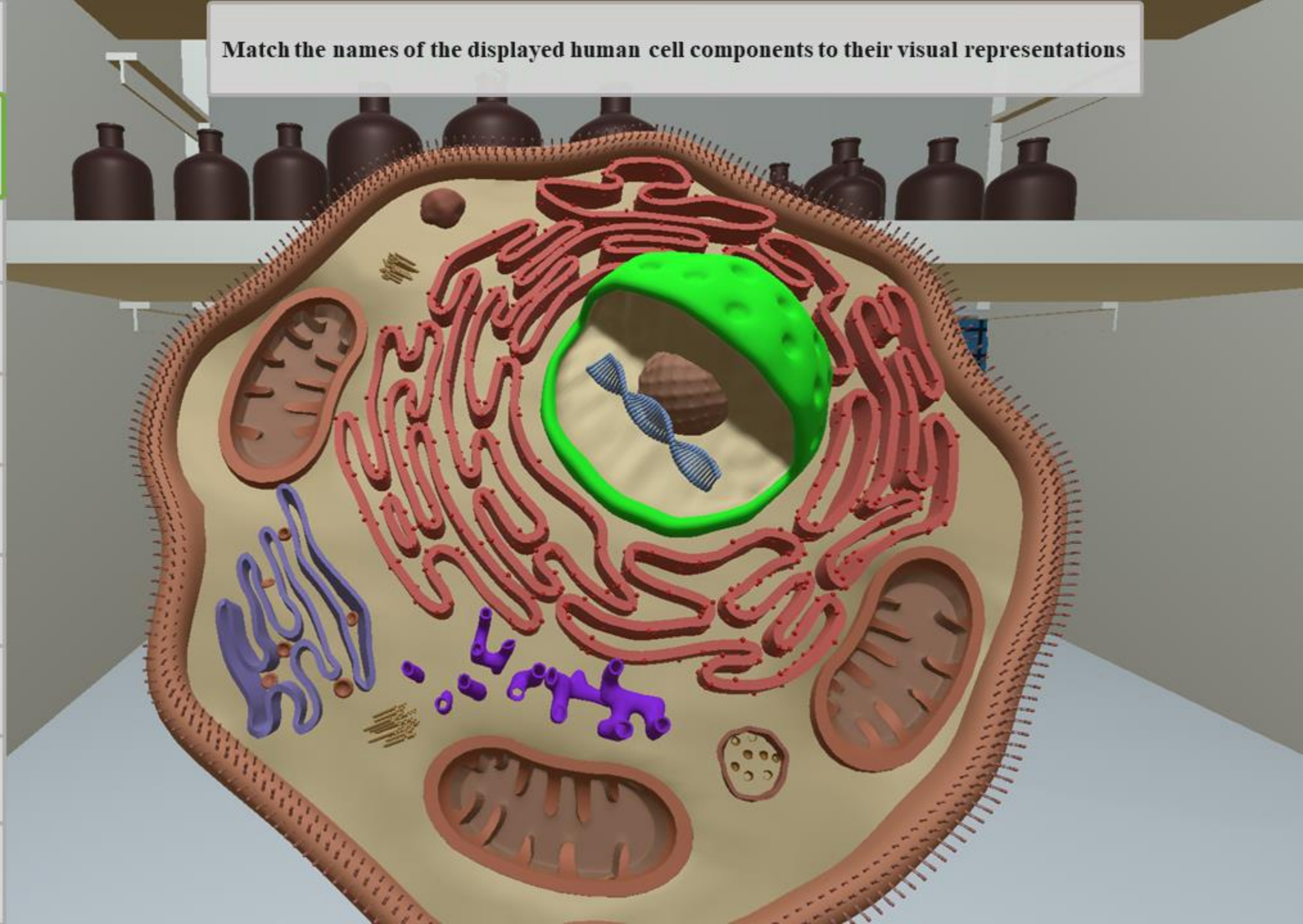




6. Demonstration – User Experience in 3D Gamified Education


First off, locate and select the Beaker.

Match the names of the displayed human cell components to their visual representations



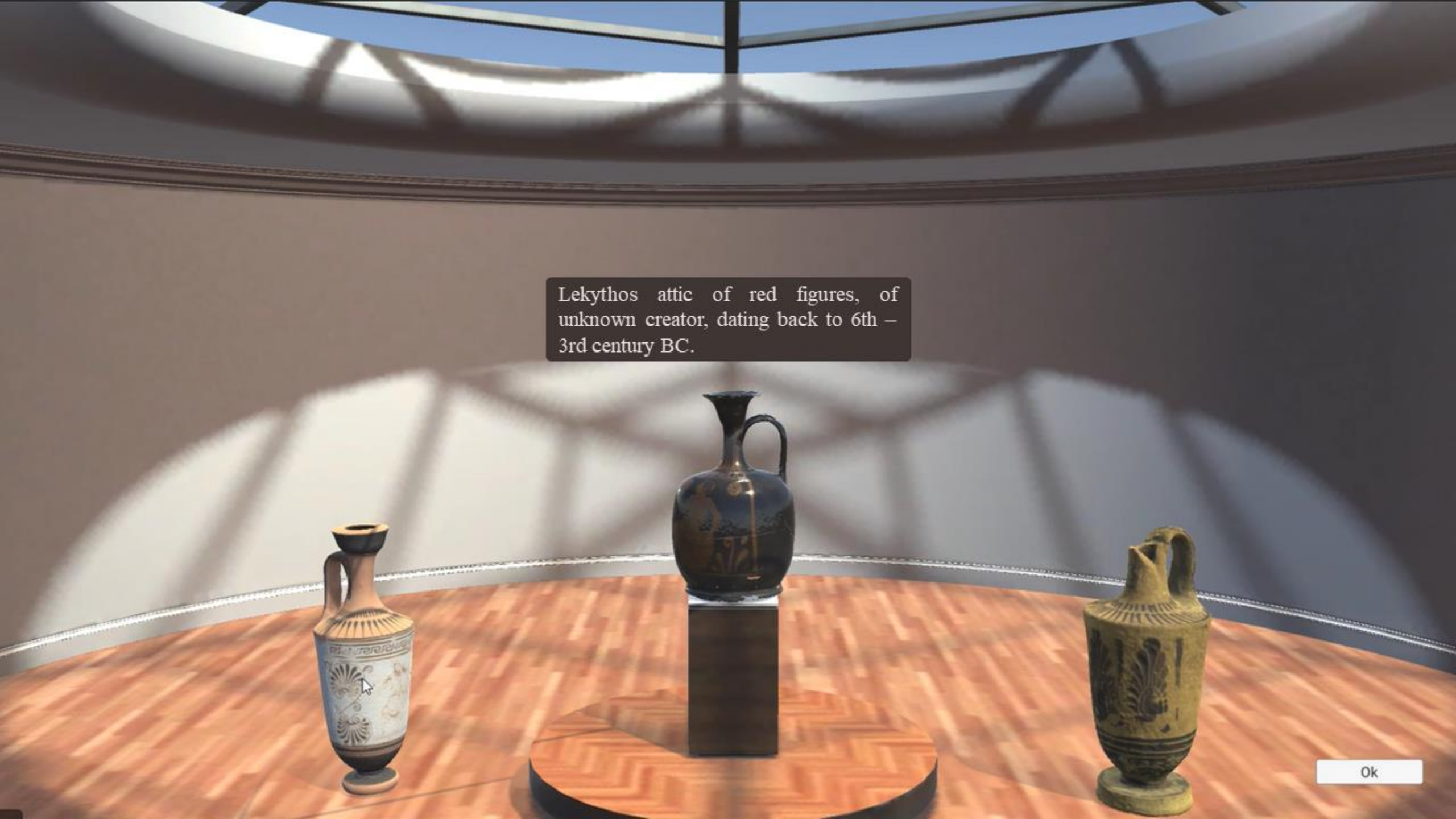
- Nucleolus
- Nucleus
- Ribosome
- Vesicle
- Rough Endoplasmic Reticulum
- Golgi Apparatus
- Smooth Endoplasmic Reticulum
- Mitochondrion
- Cytoplasm
- Centriole

Work out the following words, by using elements of the Periodic Table:

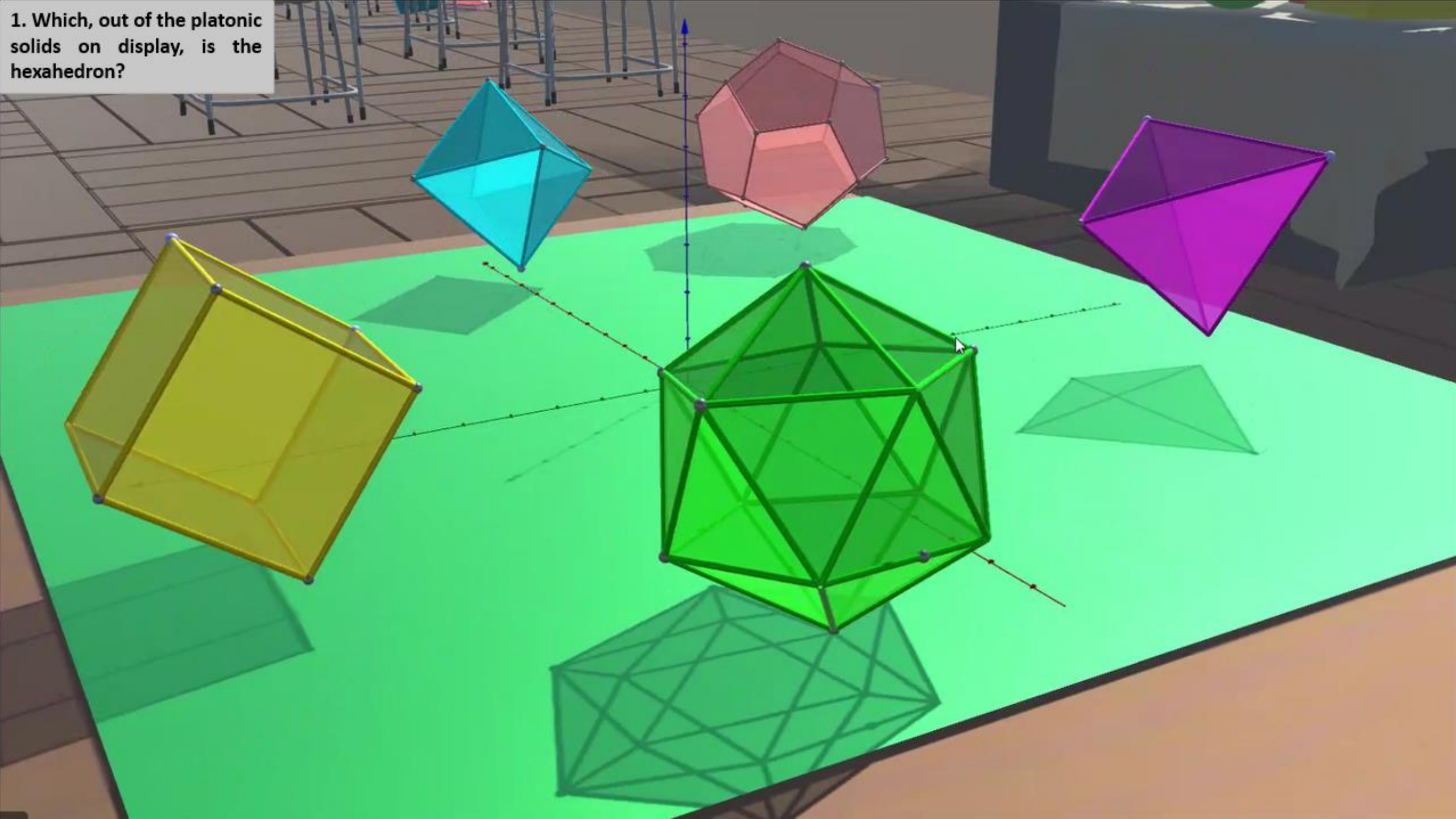
2. Pace


First off, locate and select the pottery wheel.


1. Which, out of the following ancient Greek pottery vessels, represents Lekythos?
Let's master the nomenclature, morphology and utility of some of the most well-known pottery vessels of Ancient Greece.

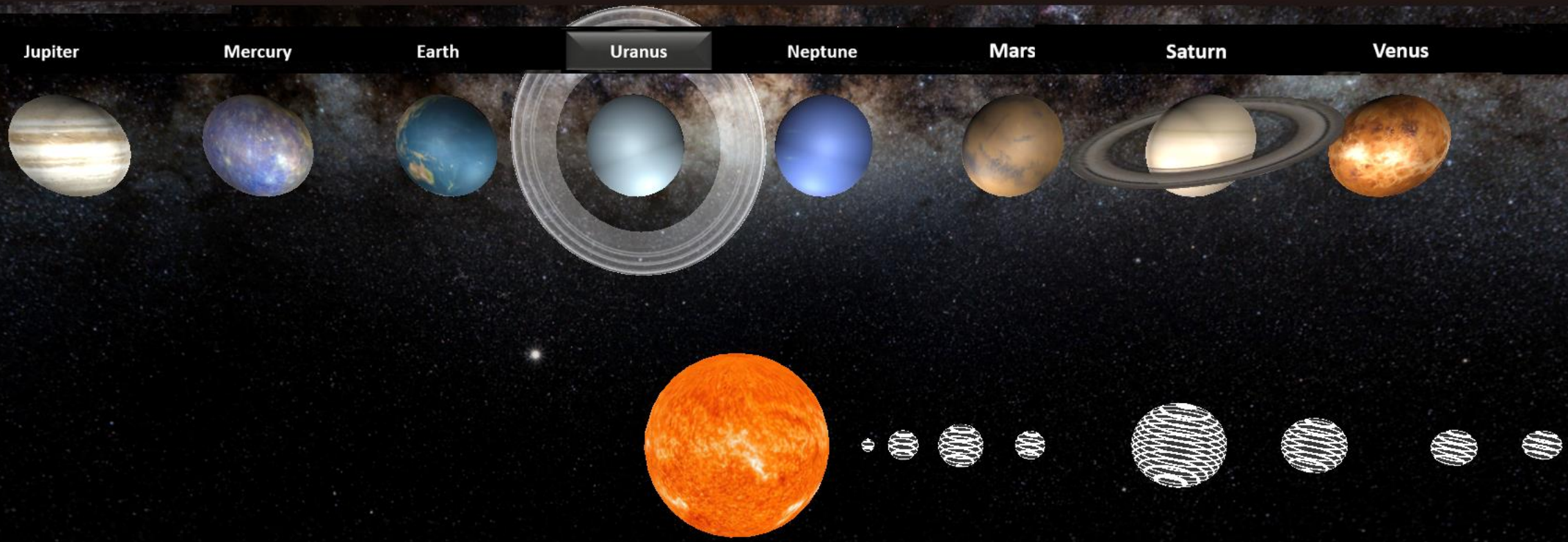

Lekythos attic of red figures, of unknown creator, dating back to 6th – 3rd century BC.
Ok

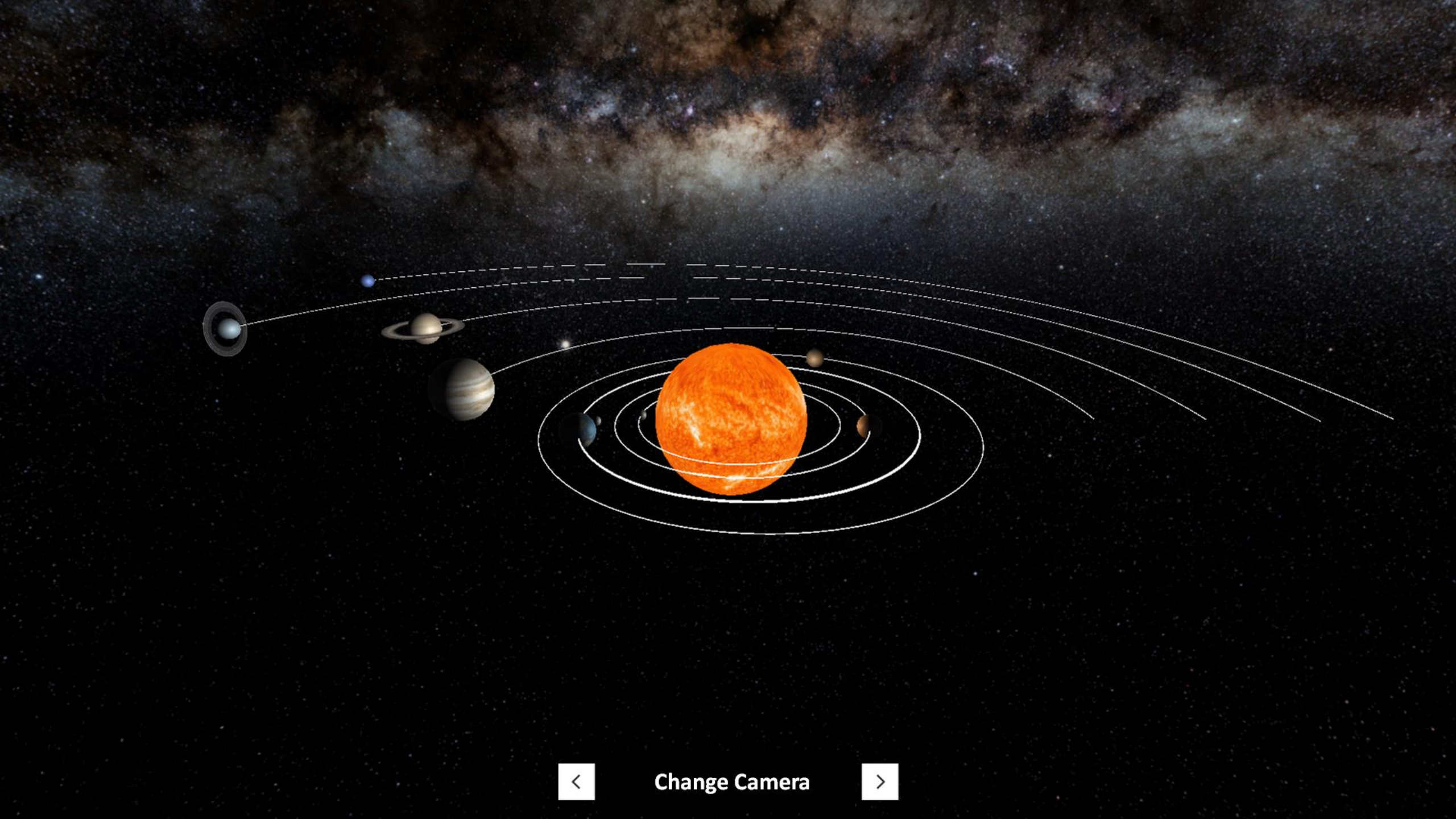
1. Which, out of the platonic solids on display, is the hexahedron?



Gradually formulate our Solar System, by choosing its planets *(out of the given list)* and placing them in the correct order, based on their distance from the Sun.

Jupiter | Mercury | Earth | Uranus | Neptune | Mars | Saturn | Venus

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Mars

Orbital period: 687 days
Distance from Sun: 227.9 million km
Gravity: 3.721 m/s²
Length of day: 1d 0h 37m
Radius: 3,389.5 km
Moons: Phobos, Deimos

< Change Camera >

Male athletes will, from now on, be identified with their respective gender identifier, within our sport facility:

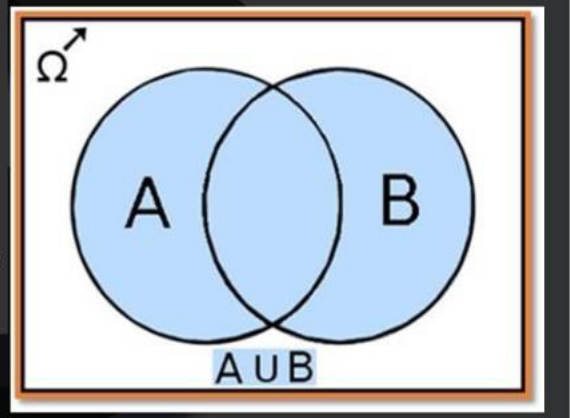
4. Which is the Union of women athletes playing basketball and women athletes playing football?

In set-builder notation

$$A \cup B = \{x : x \in A \text{ or } x \in B\}$$

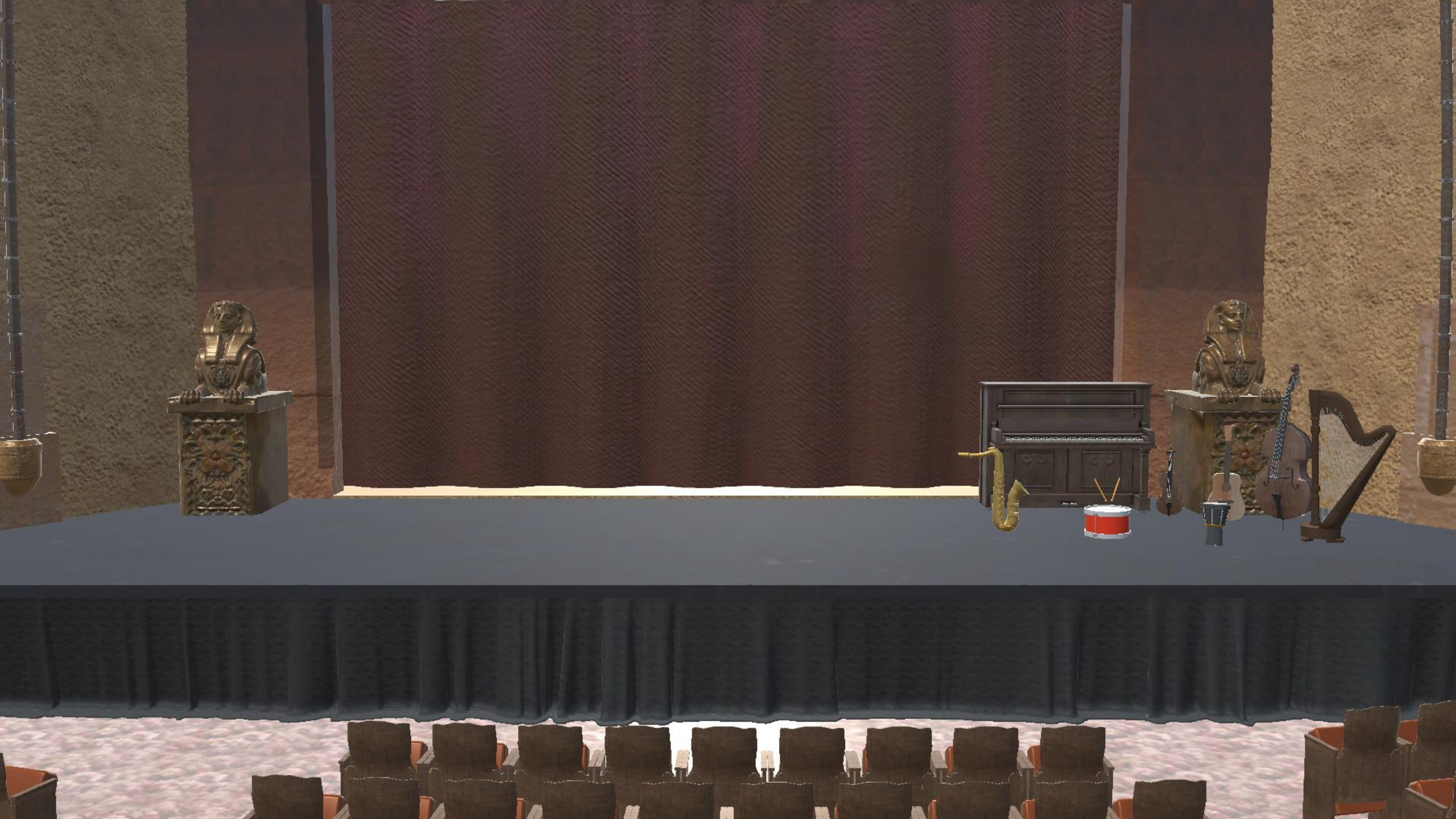
In set theory, the union (denoted by ∪) of a collection of sets is the set of all elements in the collection. It is one of the fundamental operations through which sets can be combined and related to each other.

The union of two sets *A* and *B* is the set of elements which are in *A*, in *B*, or in both *A* and *B*.



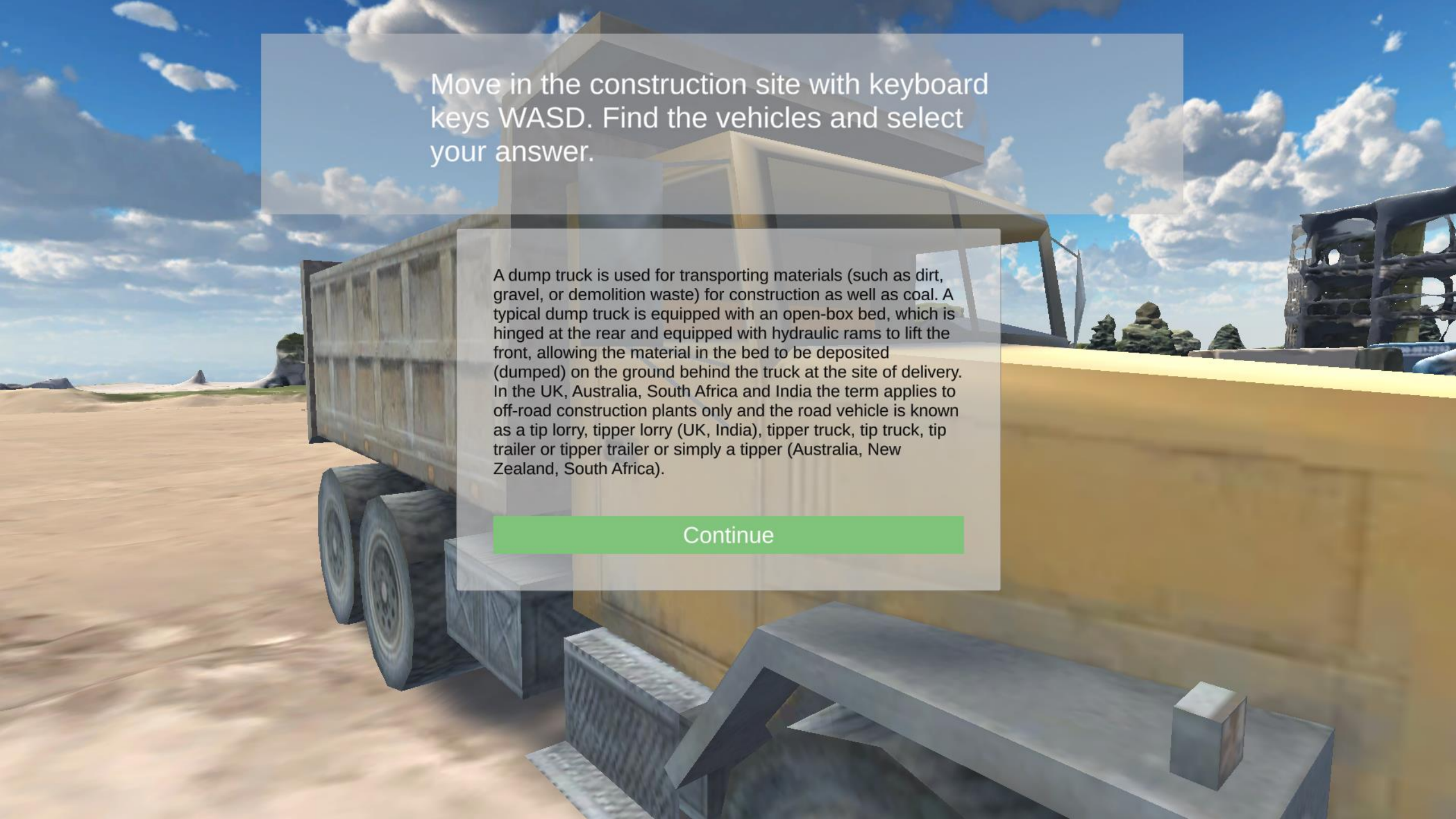
Ok


Which, in your opinion, are some of the most easily reusable utensils?
a. Plastic Straws
b. Plastic Cups
c. Plastic Plates




The kora is a stringed instrument used extensively in West Africa. A kora typically has 21 strings, which are played by plucking with the fingers. It combines features of the lute and harp.
Ok


Welcome to the Construction Site!
A construction site is an area or piece of land where construction work is taking place.
Sometimes construction sites are referred to as ‘building sites’. This usually implies that buildings or houses are being constructed, whereas ‘construction site’ covers a wider scope of work. This could refer to anything from a house extension to a landscaping project, road or bridge construction or a huge engineering project, such as the Crossrail development or the creation of a new power station.
Start


Move in the construction site with keyboard keys WASD. Find the vehicles and select your answer.
A dump truck is used for transporting materials (such as dirt, gravel, or demolition waste) for construction as well as coal. A typical dump truck is equipped with an open-box bed, which is hinged at the rear and equipped with hydraulic rams to lift the front, allowing the material in the bed to be deposited (dumped) on the ground behind the truck at the site of delivery. In the UK, Australia, South Africa and India the term applies to off-road construction plants only and the road vehicle is known as a tip lorry, tipper lorry (UK, India), tipper truck, tip truck, tip trailer or tipper trailer or simply a tipper (Australia, New Zealand, South Africa).
Continue

When it comes to the differences in British English and American English spellings even brits get caught out occasionally. The main difference is that British English keeps the spelling of words it has absorbed from other languages, mainly French and German. Whilst American English spellings are based mostly on how the word sounds when it is spoken.

English was introduced to what is modern day America in the 17th century by the British settlers. Since then the language has evolved and has been influenced by the many waves of immigration to the USA.

The spelling of British English words were cemented by Samuel Johnson in what is considered to be one of the most famous dictionaries in the world. It took Johnson, and six helpers, just over eight years to curate the 40,000 words that appeared in ‘A Dictionary of the English Language’, which was publihsed in 1755.

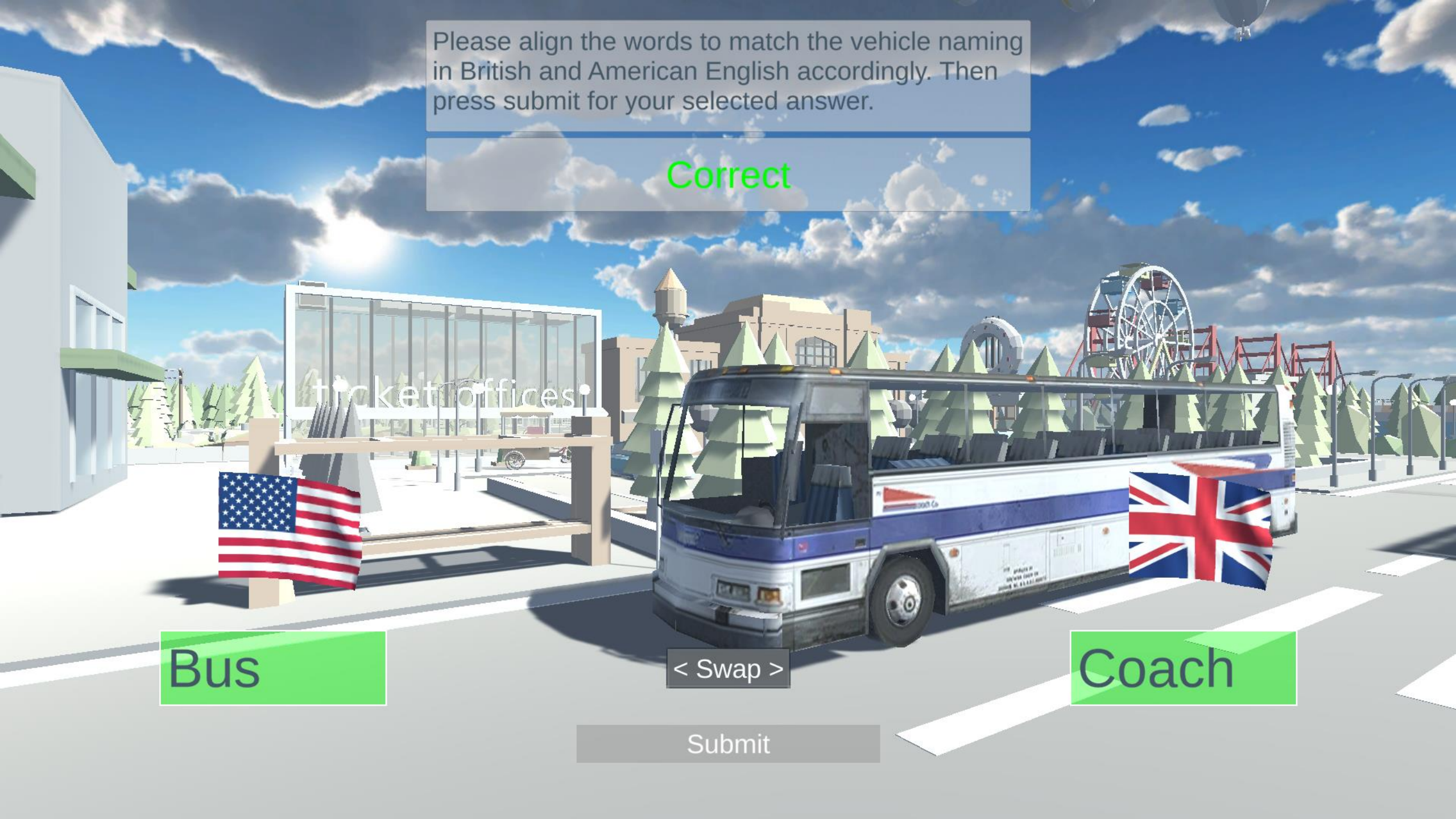
Similarly in America ‘A Compendious Dictionary of the English Language’ was first printed in 1806 and popularised the American English spellings that were being used instead of the British English spellings of words, such as color instead of colour.

The author was Noah Webster who followed up the original dictionary in 1828 with his ‘An American Dictionary of the English Language’ which had over 70,000 words.

- British English words ending in ‘our’ usually end in ‘or’ in American

Please align the words to match the vehicle naming in British and American English accordingly. Then press submit for your selected answer.

Correct



Bus

< Swap >

Coach

Submit

7. Conclusion

UXD of Innovative Gamified Educational Learning Systems

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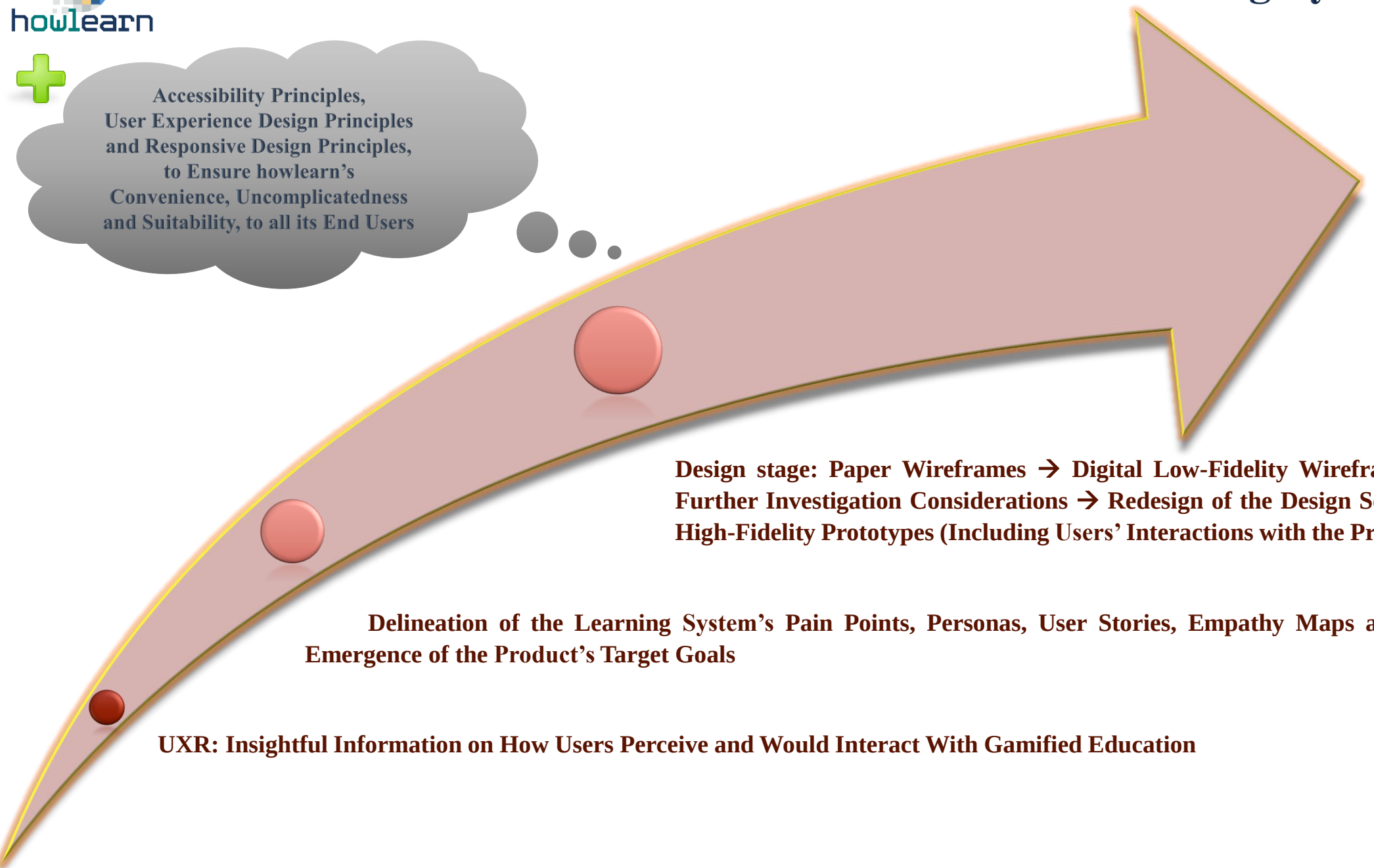
Accessibility Principles,
User Experience Design Principles
and Responsive Design Principles,
to Ensure howlearn's
Convenience, Uncomplicatedness
and Suitability, to all its End Users



Final Configuration of the System, Upon Multiple Design Revisions: Complex, Multifaceted User Experience Design, of an Innovative, Inclusive, User-Centered, Educational Learning System

Design stage: Paper Wireframes → Digital Low-Fidelity Wireframes → Usability Study → Further Investigation Considerations → Redesign of the Design Solution: Digital Mockups → High-Fidelity Prototypes (Including Users' Interactions with the Product)

Delineation of the Learning System's Pain Points, Personas, User Stories, Empathy Maps and Problem Statements: Emergence of the Product's Target Goals

UXR: Insightful Information on How Users Perceive and Would Interact With Gamified Education

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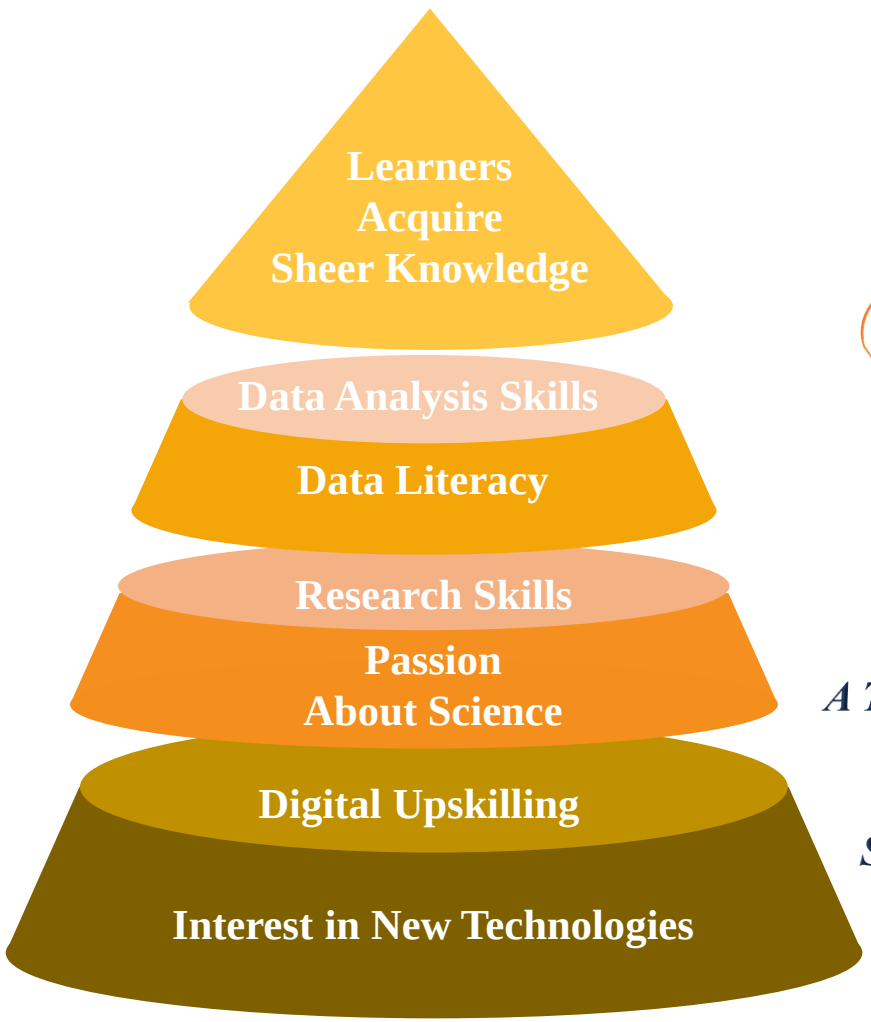
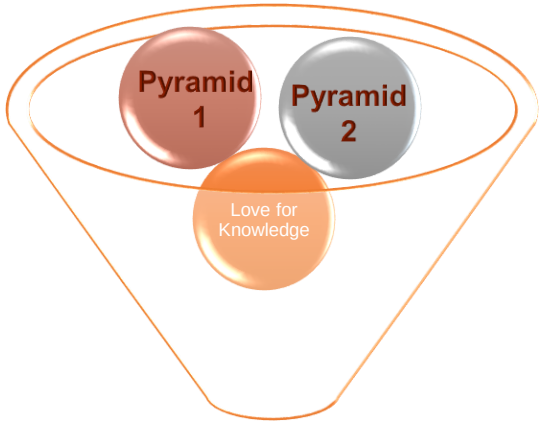
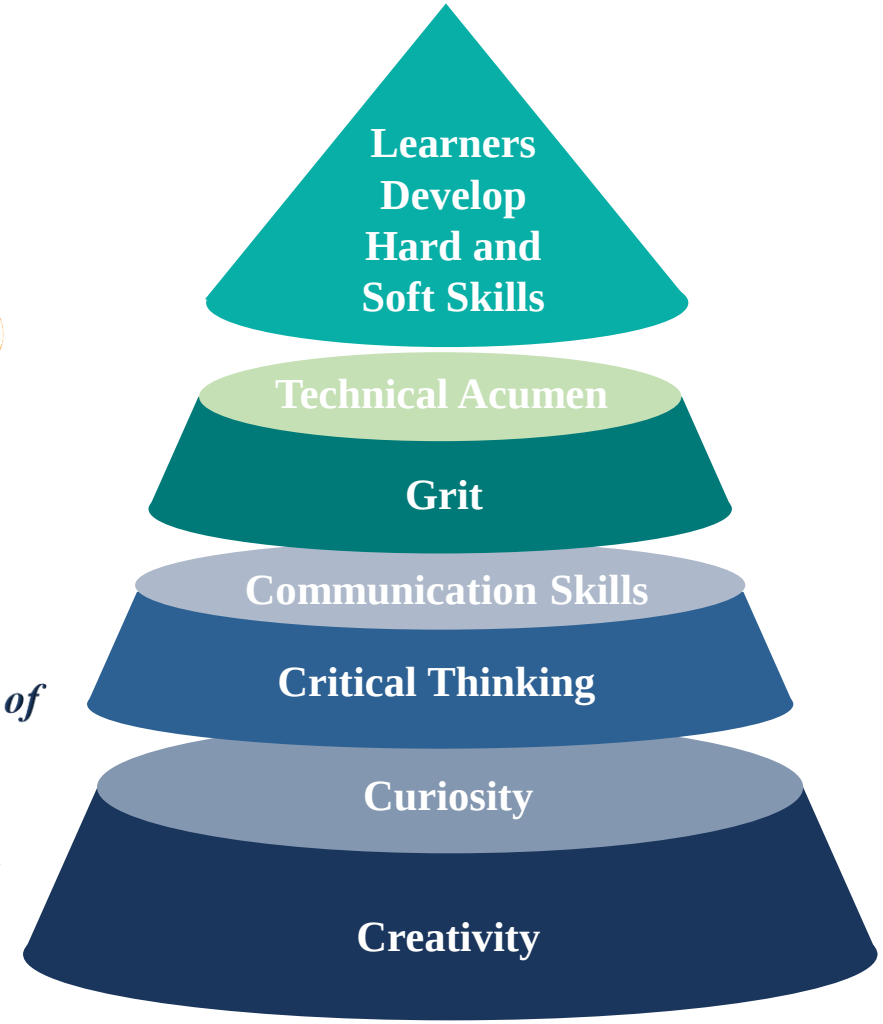
Cross-Platform Innovative Educational Gamified Learning Systems





A Thrilling Voyage to the World of Inclusive, Multidimensional {Cognitively, Emotionally, Socially and Technologically}, Sustainable Education



8. Let’s Connect

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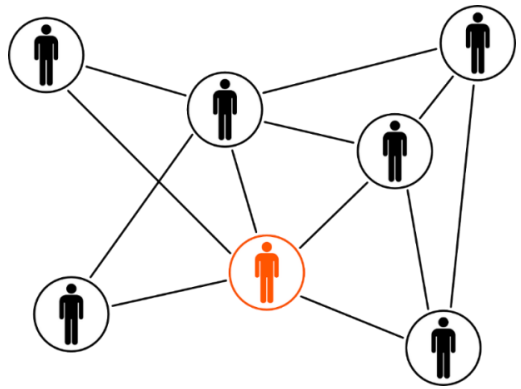
Exchange of Thoughts and Thoughtful Feedback Are the Only True Paths Towards Sheer Knowledge!



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Thank You!