Healthy Plates, Healthy Planet:

Developing Interactive Games about Food and The Environment in Thessaloniki

Julia Colucci, Jake Friend,
Sophia Kalavantis, Abby Stack

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By: **Julia Colucci, Jake Friend, Sophia Kalavantis, Abby Stack**
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Project Advisors: **Professors Melissa Butler** and **Michael Butler**

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MEET THE TEAM

Julia Colucci

Julia Colucci is a junior from Lynnfield, Massachusetts. She is pursuing a Bachelor of Science in Electrical and Computer Engineering

Jake Friend

Jake Friend is a junior from Lunenburg, Massachusetts. He is pursuing a Bachelor of Science in Data Science and a Bachelor of Arts in Environmental and Sustainability Studies.

Sophia Kalavantis

Sophia Kalavantis is a junior from Belmont, Massachusetts. She is pursuing a Bachelor of Science in Computer Science.

Abby Stack

Abby Stack is a junior from Bridgewater, Massachusetts. She is pursuing a Bachelor of Science in Industrial Engineering and a Master's in Management.

ABSTRACT

Active learning offers a promising alternative to traditional teaching approaches by fostering practical understanding and encouraging the application of knowledge. Education games, in particular, have been shown to enhance motivation, engagement, and contextualization of information. The goal of our project was to develop non-digital games for the Centre of Environmental Education of Eleftherio-Kordelio's (KPE) "Food for Thought'' program. To better understand active learning along with the process of game development, our team conducted observations, interviews, and assessed sponsor and participant feedback. In all, our team created ten successful games, which are outlined in both a booklet and a website to be used by the KPE and other educational institutions.

EXECUTIVE SUMMARY

Introduction

Educators in Greece are looking toward active learning approaches to increase the effectiveness and consistency of food and environmental education. This shift in approach is prompted by a decline in youth adherence to the Mediterranean diet, which is characterized by health benefits and foods of low environmental impact.

Youth preference for a globalized diet includes greater meat consumption, fewer plant-based foods, and foods of greater convenience. This preference contributes to 40% of youth being overweight or obese in Greece and to negative environmental externalities: higher carbon footprint, increased plastic and food waste, and exacerbation of unsustainable food production practices.

Education plays a pivotal role in shaping youth's awareness of their choices, impacting both health and the environment. Through food education, students learn about the relationship between diet and health, while environmental education fosters sustainability awareness. These programs empower youth to make informed decisions and adopt more healthy and environmentally friendly practices.

However, traditional teaching methods often prioritize knowledge transmission over critical thinking skills, particularly in food and environmental education. Research suggests that passive approaches, such as lecture-based classes, can hinder youth's understanding of how their dietary choices impact the environment. Active learning, an approach that involves students in the learning process, is a more effective tool for fostering critical thinking and practical understanding among youth. Game-based learning, in particular, has been highlighted for its ability to enhance motivation, engagement, and contextualization of information, bridging the gap between youth food behaviors and environmental impact.

The Centre of Environmental Education of Eleftherio-Kordelio (KPE) is one of 58 centers in Greece that educates students about the environment, sustainability, and resilience planning through active learning. Their programs aim to foster critical thinking, reflection, application, and autonomy to encourage youth to make conscious decisions and actively care for the environment.

Research Design

The goal of this project was to apply active learning strategies in the development of educational games to assist the KPE in increasing youth awareness of healthy and environmentally conscious decisions in Thessaloniki. Our team first had to understand how the KPE philosophy guides their educational approach. Concurrently, we determined best practices for effective and engaging game-based learning, which led to the development of 10 games that center on various diet and environmental topics. Finally, we evaluated the success of our games in fostering active learning criteria and enhancing the student experience, and we refined them as needed.

To inform our game development process, we observed three of the KPE programs and conducted informal interviews. This helped us understand the KPE approach to education and the benefits of active learning approaches. To refine and evaluate our games, we analyzed physical and verbal student feedback in relation to success criteria to assess the most effective active learning strategies. In doing so, our team created games that made learning about food and the environment an interactive and enjoyable experience, thereby increasing engagement while encouraging students to think critically.

Game Development

We utilized a game design blueprint that emphasizes improvement through an iterative cycle of revision and feedback. Our team began the “Capture” process by identifying areas within the “Food for Thought” program that were not consistently effective or engaging for students. To address the need, we brainstormed how to connect specific topics with specific games. We gained inspiration from educational games that we enjoyed as children and the Red Cross Red Crescent Climate Centre, a forum for game inspiration. From there, we developed initial prototypes and created outlines, which we presented to the KPE for playtesting. Playtesting allowed our team to receive feedback from educators with experience in successful gaming to help us improve the games before implementation. The “Iterate” phase immediately followed playtesting and allowed our team to revise games as necessary and incorporate guidance on designing a more engaging, efficient, and interesting game. Post-gameplay, we received both written and verbal feedback from students at the KPE, where we then improved our games further before re-implementation the following week.

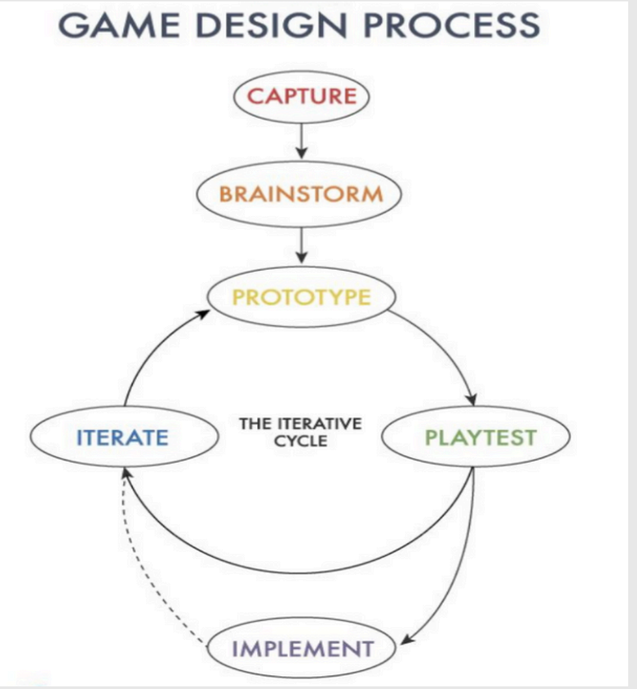

Figure E2: The game design process by Timothy Klanderud of Game Career Guide

Success Criteria

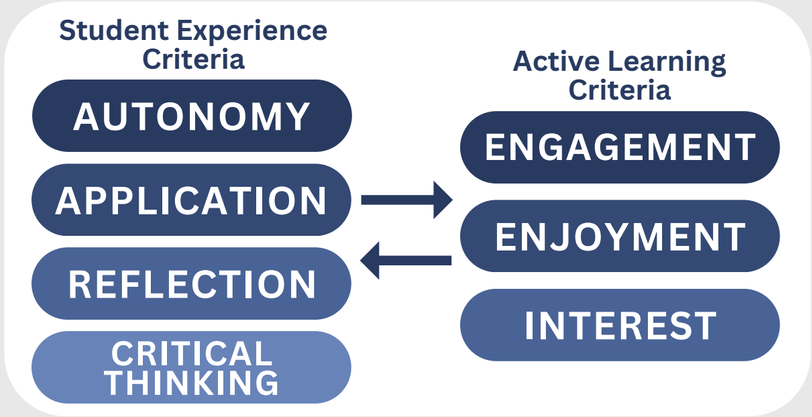

Figure E1: The Criteria for Successful Games

To assess our games, we developed criteria for evaluating success based on existing literature in active learning education. With success being defined as the “favorable or desired outcome,” we determined the success of our games was twofold; it depended on how the game enhanced the student experience and promoted the active learning criteria.

The criteria for student experience was based on behaviors including participation, focus, and physical and verbal reactions. The criteria for active learning were based on how the game fosters deeper analysis and synthesis of complex topics among students.

Observing and Applying Educational Approaches

The KPE Approach:

KPE values letting students think independently and openly share their opinions.

The KPE staff prioritizes critical thinking and independent learning, guiding students to draw their own conclusions rather than offering direct answers. Through active games and discussions, students are prompted to engage deeply with topics and express their opinions freely. This philosophy extends to the program's structure, fostering an environment where students feel comfortable voicing their thoughts and feelings openly.

The KPE implements active learning.

Our observations of games within the “Food for Thought” program demonstrate how the KPE utilizes various active learning strategies that align with specific criteria for assessing active learning. The KPE programs incorporate games that embody experiential, collaborative, discussion-based, physical activity, and peer-teaching strategies. Most KPE games intersect, covering multiple active learning styles. This multi-faceted approach enhances student engagement and learning compared to traditional teaching methods.

The KPE discourages competition as an effective learning strategy.

Through collaboration with the KPE and insights from educational psychologists, we explored the impact of competition in educational games. Initially incorporating competitive elements in our designs, such as determining a "winner" and "loser," we encountered resistance from the KPE staff, who advocated against competition due to its potential to demotivate students. We noticed that many of the games in KPE programs include collaboration and teamwork at the forefront, as opposed to competition.

The KPE aims to bridge the gap between student understanding of diet and its environmental impact.

Our research highlights a gap in students' understanding of the relationship between nutrition and sustainability. While they recognize the impact of diet on personal health, fewer grasp its environmental implications. Educators also note this gap in teaching, with a focus on isolated topics like recycling rather than holistic discussions or topic synthesis. To address this, KPE employs interactive methods to increase environmental education.

Games That We Implemented:

Pyramid Pairs (Active Learning Objectives: Collaboration and Discussion-based)

Pyramid Pairs is a memory game for small groups. Players flip over cards, aiming to match food pairs. One card is placed on the food pyramid, while the second is positioned on a scale representing environmental impact. Group discussion aids self-correction.

Label Dash (Active Learning Objectives: Physical Activity, Collaboration, Experiential)

Label Dash is a relay race where student teams sort nutrition labels into three bins: green for healthy, yellow for moderate, and red for unhealthy amounts. Teams collaborate to place labels into the correct bins.

Label Line (Active Learning Objectives: Physical Activity, Collaboration, Experiential)

In Label Line, the class is split into two groups where one focuses on sugar and the other on salt. Each student is handed a food label. In each group, the students work together to order themselves from the lowest content to the highest. They are encouraged to make connections between foods that are commonly high up the line or lower.

Food Corners (Active Learning Objectives: Discussion-based and Physical Activity)

Food Corners can be played in small or large groups. Each corner of the room represents a season, and students hold notes with various fruits or vegetables, choosing the corresponding season it is produced. After self-correction through discussion, students reveal their choices and discuss the importance of seasonal produce.

Mind Map (Active Learning Objectives: Collaboration and Discussion-based)

In Mind Map, students are divided into groups and given large posters labeled "Environmental Problems" and "Nutrition" to brainstorm associated words or phrases. After 15 minutes, one member from each group writes their ideas on the whiteboard. Another member then highlights common themes with circles.

Waste Walk (Active Learning Objectives: Physical Activity, Discussion-based)

Students are presented with plastic, paper, food, and reusable waste items on the floor. The instructor calls out a category and motion, and students move to the corresponding waste item while performing the motion. Once everyone is on an item, they discuss their choices and share if they've encountered similar items in daily life.

Common Traits of Successful Games

Effective education emphasizes experience over information retention.

The transition from traditional lessons to game-based learning markedly improved student engagement and learning outcomes. Feedback from students, teachers, and staff emphasized the effectiveness of experiential learning and game-based approaches, highlighting the preference for hands-on activities over passive instruction. Educators noted that active learning methods fostered greater student involvement and understanding, leading to increased motivation and application of knowledge. This firsthand experience aligns with research findings on the benefits of game-based learning, indicating its potential to enhance learning in educational settings.

Collaboration, discussion, and/or physical activity are effective in increasing engagement, enjoyment, and interest for the KPE students.

The development of discussion-based and collaborative games proved highly effective in engaging students and fostering critical thinking. By integrating elements that encourage group participation and interaction, such as post-game discussions and cooperative tasks, our team observed increased engagement and enthusiasm among students. Additionally, incorporating physical activity into games further enhanced student involvement and enjoyment, highlighting the importance of interactive and dynamic approaches in educational gaming.

Students prefer games that are short, simple, and easy to understand.

Evaluation of longer and more complex games revealed shortcomings in meeting active learning criteria. This resulted in student disengagement and limited reflection on educational material. Conversely, simpler games consistently met active learning objectives by allowing for greater autonomy and encouraging critical thinking. Students responded positively to these games, actively participating and demonstrating creativity and collaboration. This aligns with existing research indicating that successful gaming enhances problem-solving skills and overall learning effectiveness.

Deliverables and Future Research

Two deliverables will be provided for the KPE: first, this study to aid in game development with active learning criteria, and second, a WordPress website serving as a "Food For Thought" game repository. The game booklet, hosted on the website, provides instructions and materials, designed with a playful, green theme. Games are downloadable in PDF format, facilitating accessibility. Translation and integration with the KPE website are planned for broader use among Greek educators.

Future research should broaden its focus beyond assessing enjoyment, engagement, and interest in educational games to explore how these factors vary across demographics such as age, location, socioeconomic status, and gender ratio. Investigating these variables can help uncover potential barriers different groups face in accessing and benefiting from these games, leading to more inclusive delivery methods. Understanding which games resonate better with various youth groups could enable the KPE to tailor activities accordingly, ensuring effective utilization and creating a more enjoyable experience for all participants.

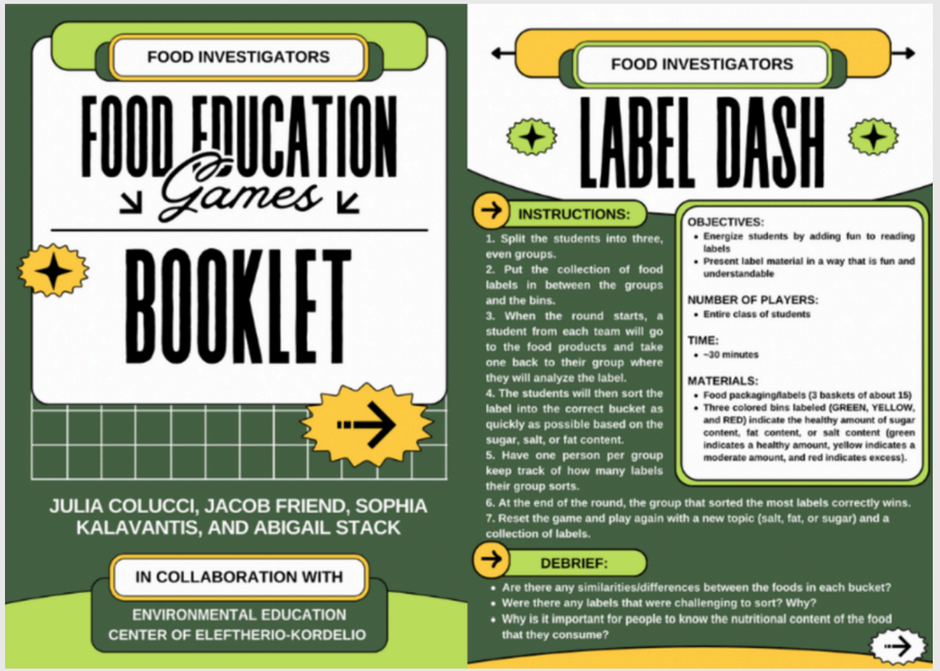

Figure E3: Food Education Games Booklet

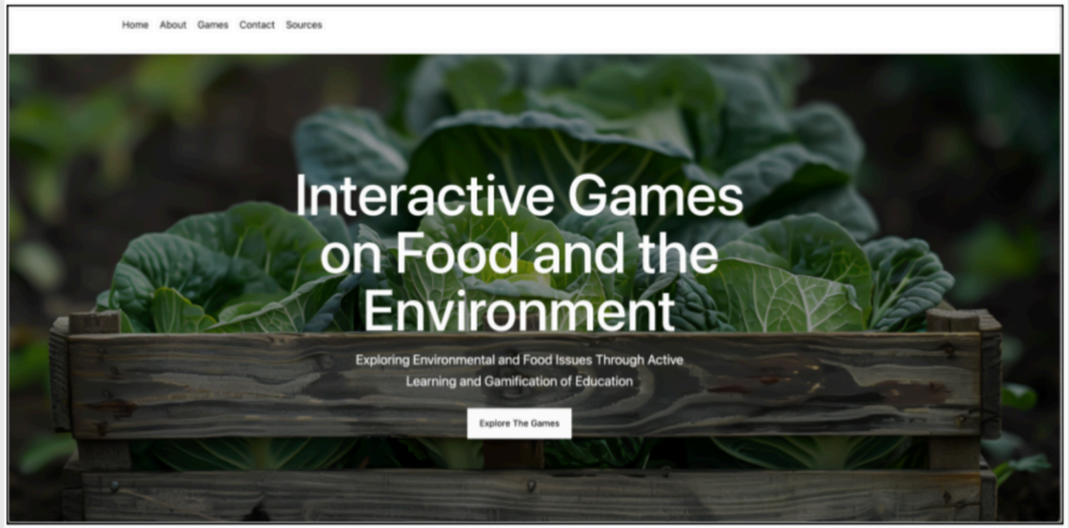

Figure E4: “Home” page on the “Food for Thought” website

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AUTHORSHIP

All members contributed equally to the writing of this report.

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Introduction

The passive transmission of knowledge from teacher to student is inconsistently effective for youth because it primarily focuses on knowledge-based development rather than addressing critical thinking skills (Schrader and Lawless, 2004). Passive approaches are emphasized in traditional teaching styles through the use of lecture-based classes. When used in food and environmental education, these approaches disrupt youth's understanding of how their diet impacts the environment (Environmental Education Centre Staff, personal communication, March 26, 2024).

Active learning—defined as engaged learning through activities—is an effective tool for fostering critical thinking and engagement, which can increase practical understanding among youth. (Abdul Razak and Connolly, 2013). This practice acknowledges the relationship between knowledge, attitudes, and behaviors, and provides valuable opportunities to apply effective education (Howell, 2021). One active learning approach is game-based learning, which increases motivation, provides better engagement in learning, and helps students contextualize the information being taught (Klabbers, 2003). As such, educational games are one method of bridging the disconnect between youth food behaviors and environmental impact.

The Environmental Education Center of Eleftherio-Kordelio and Vertiskos (KPE) is an organization that educates students on topics pertaining to the environment. The goal of the KPE is to push students to think actively and critically by engaging in educational activities. KPE's "Food for Thought," launched in October 2023, aims to increase youth awareness of how diet impacts the environment, emphasizing engagement over information retention (Environmental Education Centre Staff, personal communication, March 26, 2024).

In this report, we discuss the importance of a healthy diet, sustainable food practices, and active learning through educational games for youth (13-18 years old). We utilized the Knowledge, Attitudes, and Behaviors (KAB) approach (Schrader and Lawless, 2004) in unison with active and game-based learning strategies to encourage conscious decisions concerning food and the environment. Through observations of the KPE's program, student feedback analysis, and implementation of new games, our team developed 10 games for the KPE "Food for Thought" program. Of the ten games, we were able to successfully implement seven games that incorporated various active learning strategies, thus promoting engagement, critical thinking, and reflection.

The Relationship Between Youth Diet and the Environment

Beginning in the early 2000s, there has been a gradual abandonment of the Mediterranean dietary pattern by youth in Greece (Kontogianni et al., 2008; Farajian et al., 2011). This shift is significant, given the Mediterranean diet's historical ties to Greece and the health benefits derived from the prevalence of plant-based meals and low levels of red meat intake (Adamidis et al., 2021; Angastinioti et al., 2020; Mayo Clinic, n.d.). This shift is marked by rising consumption of red meats and items high in saturated fat, alongside a decline in legume consumption. (Trichopoulou et al., 1993; Fernandez, 2006). Surveys of Greek youth revealed that fat accounted for 40% of daily energy intake, with 50% of a large sample of school-aged adolescents consuming soft drinks daily and 30% consuming confectionery daily. (Risvas et al., 2008; Hassapidou et al., 2006).

The accessibility of food within the global production system plays a pivotal role in shaping individuals' dietary choices. It is primarily through this system that youth in Greece gain access to various food options, influencing their consumption patterns. Evolving youth dietary preferences contribute to unsustainable environmental practices in various ways (Papadaki & Mavrikaki, 2015; Thyberg and Tonjes, 2016; Hamilton et al., 2005; Lyndhurst et al., 2007). Firstly, their preference for a globalized diet leads to food traveling long distances to reach local supermarkets, increasing carbon footprint (Partalidou, 2015). Moreover, research highlights that "carbon footprint" ranks lowest in consideration during food choice decisions, with a preference for convenience (Panatsa & Malandrakis, 2024; Skeirytė et al., 2022). Additionally, youths significantly contribute to plastic and food waste, with nearly half of the solid waste in schools being food packaging waste due to a preference for pre-packaged foods (Heiges et al., 2022; Papakonstantinou et al., 2012). Furthermore, youths generate higher levels of food waste compared to older individuals (Thyberg and Tonjes, 2016; Hamilton et al., 2005; Lyndhurst et al., 2007), and their inclination towards meat, particularly pork, chicken, and beef, further exacerbates unsustainable food production (Papadaki & Mavrikaki, 2015; Piperakis et al., 2007). These behaviors result in significant environmental impacts such as deforestation, increased water use, biodiversity loss, and greenhouse gas emissions contributing to climate change (Litskas et al., 2020; Banos-González et al., 2021; Dilkes-Hoffman et al., 2018; Seberini 2020).

Importance of Education

Education is crucial for enabling youth to be conscious of their personal choices and behaviors. It goes beyond transmitting knowledge to students; it aims to guide their practical understanding in various situations, taking into account both personal health and environmental impact. (Biesta, 2015). Just by attending classes, engaging in assignments, and participating in school activities, students inadvertently boost their intelligence and social skills, fostering a mindset that steers them towards improved structural and social norms (Kingston et al., 2003). By both conforming to and enhancing their societal skills, education provides young people with an understanding of their potential impact on the world.

Food Education

Recent studies highlight the impact of food education on informed dietary choices. Food education programs are vital in enhancing student awareness and autonomy about food, facilitating positive decision-making (Mukhamedzhanov et al., 2023). Teaching children the relationship between diet and health fosters healthier attitudes toward nutrition, empowering them to make better food choices.

Understanding food labels is an important part of food education. Food labels significantly influence youth's dietary choices as they serve as a key information source and help guide purchasing decisions (Konstantoglou et al., 2020; Kumar and Kapoor, 2017). Research shows that adolescents who read nutrition labels are more likely to consume fruits and vegetables and fewer sweets per day (Haidar et al., 2017). However, a substantial portion of youth do not consistently use or understand these labels, with only 25% regularly checking them (Wojcicki and Heyman, 2012)

The correlation between education and health is evident in Greece, where rising childhood obesity rates underscore concerns about health and growing nutrition illiteracy among youth. Children with "low" health literacy show a 6.3% higher BMI than those with higher health literacy. Moreover, those with "high" health literacy scored 25% higher on the KIDMED index for healthier eating, showing a direct relationship between nutritional knowledge and diet quality (Kanellopolou et al., 2021).

Environmental Education

Education is considered to be the most “powerful transformative force to deepen sustainability”, emphasizing the critical role that awareness plays in shaping a more sustainable future (UNESCO, 2015). Environmental education teaches students that they are part of the natural world, allowing students to develop an understanding of their impact (Orr, 1990).

Without an understanding of how decision-making can impact the environment, there is less motivation among young people because they tend to prefer actions of minimal inconvenience (Banos-González et al., 2021). Individuals with higher environmental consciousness and education tend to waste less food and make more sustainable consumption choices (Barr, 2007; Panatsa and Malandrakis, 2024; Parfitt et al., 2010; Williams et al., 2012). Similarly, educational interventions have shown significant potential in reducing meat consumption among participants (Banos-González et al., 2021), indicating education's role in encouraging youth to adopt more sustainable dietary practices. Environmental education not only informs students about environmental issues but also equips them with the ethical framework necessary for making informed choices that positively impact the environment.

Innovative Approaches to Food Education

Active Learning

While knowledge is important to the learning process, it “is only a portion of the specified learning objectives” (Schrader and Lawless, 2004). Learning is more complex than the transmission of knowledge from teacher to student; it is a relationship between knowledge, attitudes, and behaviors (KABs). The KAB approach is based on an interdependent relationship: “What an individual knows may inform his or her attitude about that topic, and how he or she feels about that topic may influence behavior” (Schrader and Lawless, 2004). To combat the ineffectiveness of didactic approaches, and instead follow the KAB approach, educators can implement active learning. Active learning encourages students to be involved in the learning process, “[to] really think about it (analyzing, synthesizing, evaluating) rather than just passively receiving it” (Marin et al., 2021). Table 1 outlines five active learning strategies designed to engage students in dynamic and participatory educational experiences. From experiential learning to peer teaching, each method encourages students to be active participants in their own learning process.

Table 1: Active Learning Strategies

Active Learning Strategy	Description
Experiential Learning	The process by which students “learn by doing” and by reflecting on the experience. Promotes opportunities for students to take initiative, engage intellectually, creatively, emotionally, and socially, and learn from mistakes (BU Center for Teaching and Learning, 2024).
Collaboration	Encourages students to effectively work with peers, help each other learn, and feel a sense of belonging to a learning community that provides students with a shared purpose that can improve morale and increase motivation (Cornell University Center for Teaching Innovation, 2024).
Discussion/Debate	Teaches students how to express concepts and ideas in their own words, develop reasoning skills, examine diverse perspectives, and purposefully respond to others (Cornell University Center for Teaching Innovation, 2024).
Physical Activity	Incorporates movement to enhance engagement and retention of information (Nicksic et al., 2020).
Peer Teaching	To teach another, one must first fully understand a concept themselves. Verbalizing a concept and sharing the information with a peer reinforces knowledge gained (Hansen, 2022; Harter & Klemenčič, 2016).

As students are no longer engaged in the classroom through traditional styles such as lecture-based teaching and “traditional nutrition education interventions…are rarely effective past the short-term,” active learning can be used for food education, connecting nutrition to sustainability. (Prescott et al., 2019). The active learning styles detailed in Table 2 encompass criteria such as critical thinking, knowledge application, reflection, and autonomy, forming a rubric to guide active learning practices. Incorporating these components into teaching methods in food and sustainability education has been shown to enhance the experience for students.

One active learning approach in food education that utilizes the approach of experiential learning and emphasizes several active learning criteria is plate waste collection. Rather than solely relying on teacher instruction of a healthy diet and sustainability, two schools in the United States compared plate waste collections to one another, where one of the schools acted as a control or “baseline” (Prescott et al., 2019). This activity presented the students visually with their food consumption based on how much waste they produce and allowed them to think critically and reflect on the topics. Researchers found that the students who were actively engaged in “receiv[ing] a food systems education and promotion intervention increased their vegetable and fruit consumption relative to “baseline” and took particular interest in food waste (Prescott et al., 2019).

Table 2: Active Learning Criteria Rubric

Active Learning Criteria	Description
Critical Thinking	Describes forms of learning, thought, and analysis that go beyond memorization and recall of information and facts. Occurs when students analyze, evaluate, interpret, or synthesize information to form an argument, solve a problem, or reach a conclusion (Glossary of Education Reform, 2016).
Application	Refers to the practical implementation of acquired knowledge, skills, and understanding to deepen comprehension and enhance problem-solving abilities (Kolb, 1984).
Reflection	Critically analyzing one's learning experiences, thoughts, and actions fosters self-awareness, understanding, and continuous improvement (Brockbank & McGill, 2017).
Autonomy	Refers to the capacity and freedom of learners to take ownership of their learning process, make informed decisions, and set achievable goals (Gibbons, 2003).

Another food education approach that goes beyond the scope of traditional teaching styles is gardening. Gardening is a physical and experiential style of active learning that allows children to experiment with different fruits and vegetables, increasing their nutritional and environmental consciousness. As a result of real-world application emphasized in gardening, “researchers have found that youth gardeners expressed greater interest in eating fruits and vegetables as snacks” (Libman, 2007). Plate waste collection and gardening are not traditional learning approaches hat center on knowledge retention but are effective due to their respective active learning approaches.

An approach that encompasses different active learning styles while promoting the active learning criteria is game-based learning. Game-based learning, “has been shown to increase students’ motivation and provides opportunities to gain new knowledge and skills” (Legaki et al., 2020).

Effectiveness of Gaming Approaches

Over the last decade, different countries have implemented gaming approaches into food health education curricula, incorporating different types of educational games. Game-based learning through a non-digital approach “can improve a student’s engagement, motivation, and learning performance” (Legaki et al., 2020). For example, a school in Beijing created a board game for students that focuses on nutrition knowledge, dietary attitudes, and behaviors (Chiang et al., 2022). In this game, students roll dice to move along spaces on the board. The spaces contain tasks related to food health, and completing the task allows the student to select a healthy food card. However, if the task cannot be completed, the student must select an unhealthy food card. The goal is to obtain the healthiest food cards, so “students need to use strategies to acquire more healthy food cards and abandon unhelpful cards” (Chiang et al., 2022). The students were evaluated both before and after playing the game, showing “significant increases in two dimensions: food and nutrients and food safety and package,” proving the effectiveness of the game.

Serious games, games that involve storytelling, are also an effective learning approach when it comes to food education. In a serious game called Express Cooking Train, the player cooks healthy meal options disguised as junk food to fend off monsters (Mitsis et al., 2019). While the game has a non-serious concept, the core of the game is related to nutritional recipes and appropriate proportion sizes. Express Cooking Train builds upon “nutritional literacy and food literacy skills in adolescents and young adults,” promoting sustainable effective dietary changes (Mitsis et al., 2019).

Another game involving nutritional literacy, a Self-paced Nutrition Activity on Choices for Knowledge (S.N.A.C.K), elicits and reinforces healthier snack choices by providing educational knowledge on food labels. S.N.A.C.K. resulted in “significant improvements in knowledge and utilization of the Nutrition Facts Label” for the students, which in turn strengthens overall food knowledge (Fam et al., 2021). S.N.A.C.K. showed such improvements because of its effective gaming approach that kept the students engaged and thinking critically. Innovative approaches to food education, such as creating educational games, have proven to be effective and emphasize the relationship between food choices and environmental impact, which can be influential in Greek schools.

Methodology

The goal of this project was to apply active learning strategies in the development of educational games to assist the Centre of Environmental Education of Eleftherio-Kordelio and Vertiskos (KPE) in increasing youth awareness of healthy and environmentally conscious decisions in Thessaloniki. Our team accomplished this goal through the following objectives:

Our team worked to achieve these objectives while in Thessaloniki, Greece from March 11 to April 27, 2024. We used observations, informal interviews, and student feedback to understand the KPE approach and assess the most effective active learning strategies. Our team created and evaluated non-digitized games to make learning about food and the environment an interactive and enjoyable experience, thereby increasing engagement and encouraging students to think critically.

Objective 1: Understand how the KPE philosophy guides their educational approach.

Objective 2: Determine best practices for effective and engaging game-based learning.

Objective 3: Develop effective games that center around diet and the environment.

Objective 4: Evaluate the success of games in fostering active learning criteria and enhancing the student experience.

Observations of KPE Approach

We observed the “Learning About Climate Change by Playing”, “Food for Thought,” and “Thessaloniki – Sustainable City” programs at the KPE from March 13th to April 19th to identify their educational approach (Appendix A). We observed aspects of the program that explained their philosophical approach and coded these observations based on major themes. These observations informed our understanding of the KPE’s approach to delivering their program and how we could align our respective games.

Furthermore, our team aimed to identify what types of active learning strategies (Table 1) were used by the KPE, and how they promoted criteria of active learning (Table 2). To do this, we used an observation guide (Appendix B) to collect data on the objectives of each activity and student behaviors during them. We focused on behaviors that suggested these games were promoting criteria of active learning, and during the coding process, our team organized the information to identify and group data according to these criteria. We also used observations to determine how successful different games were at enhancing the student experience. To objectively analyze active learning outcomes, our team developed a rubric of student experience criteria (Appendix C) that ranked the level of success from “Very Successful” to “Very Unsuccessful,” with success being defined as the “favorable or desired outcome” (Merriam-Webster, 2024). In this case, the desired outcome was to develop games that promote high levels of engagement, enjoyment, and interest among students. We established the criteria based on student behaviors regarding participation, focus, and physical and verbal reactions, as these behaviors reflected the desired outcomes. All criteria were based on our background research, as well as recommendations from Dr. Brown, Ms. Krespani, and the KPE staff.

To assess our games, we developed criteria for evaluating success based on existing literature in active learning education. With success being defined as the “favorable or desired outcome,” we determined the success of our games was twofold; it depended on how the game enhanced the student experience and promoted the active learning criteria. The criteria for student experience was based on behaviors including participation, focus, and physical and verbal reactions.

The criteria for active learning were based on how the game fosters deeper analysis and synthesis of complex topics among students. The criteria for success, as shown in Figure 1, were used to analyze our games and those already conducted by the KPE.

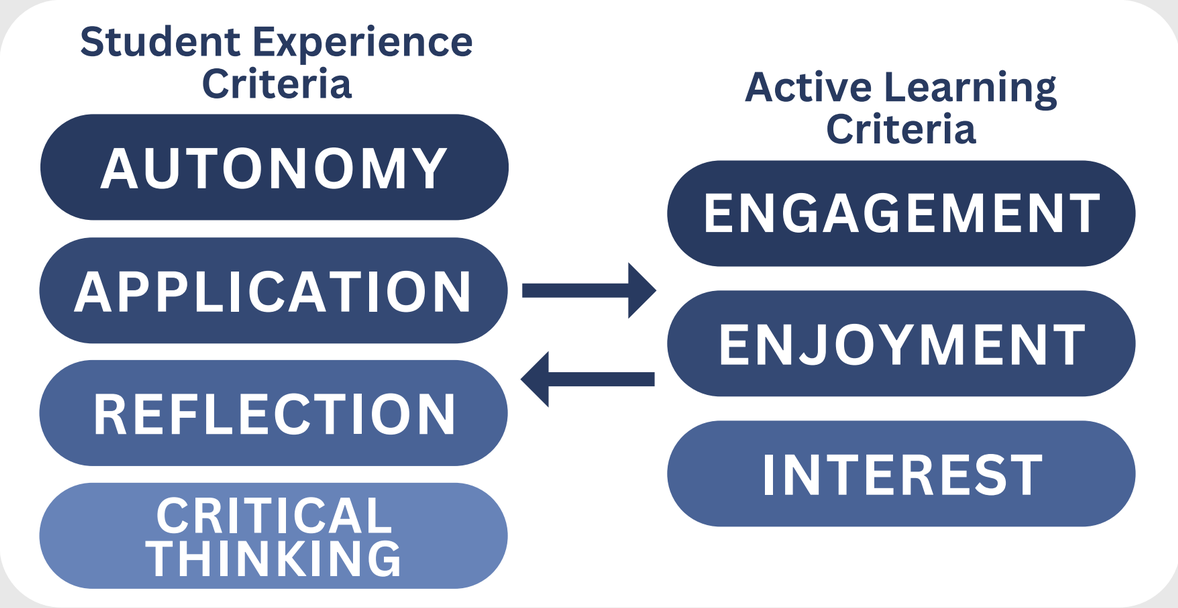


Figure 1: The Criteria for Successful Games

Conducting Interviews to Understand Game Development

For our interviews, we used consent forms (Appendix D) to obtain permission to use any data and ensure the interviewees understood their rights as participants. Our team conducted an informal interview with the KPE staff, Chrysoula Athanasiou, Giorgos Slafkidis, and Giorgos Yfantis on March 26th. During this meeting, we discussed their educational approach and how it is different and/or more effective than traditional teaching methods. On April 9th, we conducted a similar interview with teachers, who accompanied their students, to gauge their perspectives on how active learning can be more rewarding for students (Appendix E). Learning the benefits of different active learning strategies helped us understand the best approaches to include in our games.

On March 14th, we interviewed Scott Brown (Appendix F), a retired University of Connecticut professor, who is a leader in learning and cognitive processing and who taught how to effectively engage students (Korengay, 2019). We asked questions related to teaching approaches such as active problem-based learning and game-based learning as well as how to evaluate the effectiveness of these approaches. In addition, we also asked Dr. Brown about the psychology of food education, game recommendations, and common techniques to motivate students.

We informally interviewed Niki Krespani, a WPI co-researcher who recently earned her Master's in Educational Psychology. Krespani's focus is on primary education, where she has spent much of her academic career researching and developing engaging game-based activities for students. During this interview on March 26th, our team asked Ms. Krespani about her knowledge and opinions on competitive games along with games that involve a reward and punishment. From this interview, our team planned to adapt previously created games and develop future games that adhered to her advice.

Game Development

Our team modeled our game development process after the flow chart represented in Figure 2. While we adapted the process for each game, we utilized this general blueprint for a process that emphasizes improvement through an iterative cycle of revision and feedback. Our team began the “Capture” process by identifying specific areas within the “Food for Thought” program that were not consistently effective or engaging for students. To address the need, we then brainstormed how to connect specific topics with specific games. We gained inspiration from educational games that we enjoyed as children and the Red Cross Red Crescent Climate Centre, a website that details a multitude of active games relating to climate topics. From there, we developed initial prototypes and created outlines that detailed materials needed, estimated time, number of players, and rules for each game. Our team then scheduled time to do initial testing with KPE staff. Play testing was a vital stage in the process because our team received feedback from educators with experience in successful gaming and received advice on areas to improve. The “Iterate” phase immediately followed play testing and allowed our team to revise games as necessary and incorporate guidance on designing a more engaging, efficient, and interesting game. Reworking our games as necessary before execution was a successful strategy that made the “Implement” stage smoother.

Game Development Process

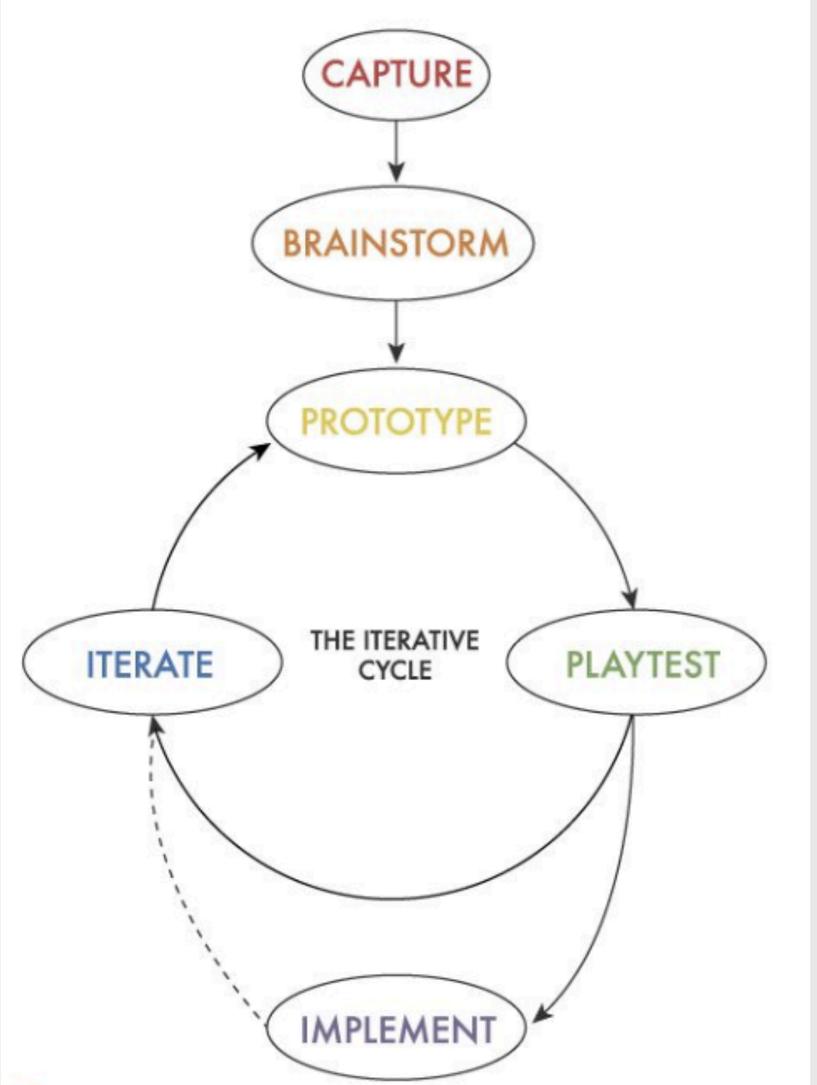


Figure 2: The game design process by Timothy Klanderud of Game Career Guide.

Post-gameplay, we received feedback from the KPE staff, as well as students at the KPE. We would debrief with the KPE staff about what went well and what could be improved, and they would give our team advice on what we could change. We also utilized written student feedback. The KPE ended each session by distributing small questionnaires (Appendix G) for the students to complete in order to receive feedback from students and to initiate reflection from the students, a criterion for active learning. Katerina Tsiri, an assistant researcher studying at the Aristotle University of Thessaloniki, then collected the data from these questionnaires and arranged it into an Excel document. We were given access to this document after every “Food for Thought” session, in which we analyzed the students’ thoughts on each activity to determine if the games were successful or if they needed to be improved upon.

Observing and Applying Educational Approaches

Our findings include insights obtained from interviews, observations, the game development process, student feedback, and our success criteria. We explore the broader educational approach of the KPE and their objectives with the "Food for Thought" program, while also delving into the details of our game development process, offering valuable lessons learned along the way.

In this section:

THE KPE APPROACH TO DIET AND THE ENVIRONMENT

- *KPE VALUES LETTING STUDENTS THINK INDEPENDENTLY AND OPENLY SHARE THEIR OPINIONS.*
- *THE KPE IMPLEMENTS ACTIVE LEARNING.*
- *THE KPE DISCOURAGES COMPETITION AS AN EFFECTIVE LEARNING STRATEGY.*
- *THE KPE AIMS TO BRIDGE THE GAP BETWEEN STUDENT UNDERSTANDING OF DIET AND ITS ENVIRONMENTAL IMPACT.*

OUR APPROACH TO GAME DEVELOPMENT

- *PYRAMID PAIRS*
- *LINE DASH*
- *LINE LABEL*
- *FOOD CORNERS*
- *MIND MAP*
- *WASTE WALK*

The KPE Approach to Diet and the Environment

KPE values letting students think independently and openly share their opinions.

KPE staff encourages students to critically assess the information given to them and to form their own conclusions. During the program on March 13th, 2024, Katerina Tsiri noted "You can see that we don't give students the answers…we just help them think about it." Furthermore, when we observed their program "Learning About Climate Change by Playing," they played an active game called "Survivor," where students perform a physical action corresponding to different climate change weather events. The game did not explicitly "teach" students any information, but they were guided to draw their own conclusions about the deeper meanings and context of the game in a post-game discussion. Through this approach, they encourage students to think for themselves rather than being given a singular correct answer. Giorgos Slafkidis regards this as a more effective way of reaching students; "It also depends on how you serve the subject or task, for example, are you using games or not? Are you just talking to them? If you are just talking to them, maybe they don't listen so there's no change in attitude or things like that. But if you focus on their way of thinking about things, it may be more effective." Their philosophy of independent thinking is expanded even further, as they do not just want students to think for themselves, but to be able to convey their opinions about it freely and without judgment. As we observed their programs, the KPE staff explicitly stated their goal at the start of every program, saying, "Our goal is to listen to you more and let you voice your opinion." Whether introduced by Giorgos Yfantis or Giorgos Slafkidis, they followed this statement by asking the group how they felt about this goal, immediately implementing this sentiment into the program. The students responded in turn, voicing their

Figure 3: Students drawing their own conclusions

honest thoughts about learning autonomously using words like, “different”, “unique”, and even “weird.” While these words can have a negative or positive connotation, this simple question allowed each group to express themselves.

The opening games embody this belief, focusing on proposing questions to the class and providing them with different forms for their answers, whether it be physical, vocal, or written. For example, during the game, “Take Place” (Appendix G), the students were given two statements: “I think diet impacts our health” and “I think our diet impacts climate change.” They were then told to go to different sides of the room corresponding to “Agree,” “Unsure,” or “Disagree.” The utilization of physical activity as an active learning style encourages students to take a stance even if some feel uncomfortable vocally expressing themselves. While some students may be influenced by their peers, the game succeeds in giving students a platform to change their position throughout the game if they feel swayed by another. The actions of the KPE succeed in creating a comfortable environment for the students to voice questions or concerns that they may have, further ingraining the idea of student autonomy into the program.

The KPE implements active learning.

Our observations of games in the “Food for Thought” program (Appendix I) detail specific techniques (Table 1) the KPE implements that align with the criteria used to assess active learning (Table 2). Programs such as “Food for Thought”, “Learning about Climate Change by Playing,” and “Thessaloniki — Sustainable City” all include games that exemplify experiential, collaboration, discussion-based, physical activity, and peer-teaching active learning strategies. As seen in Figure 3, while not all games cover each strategy, the majority of KPE games are intersectional and therefore cover more than one active learning style.

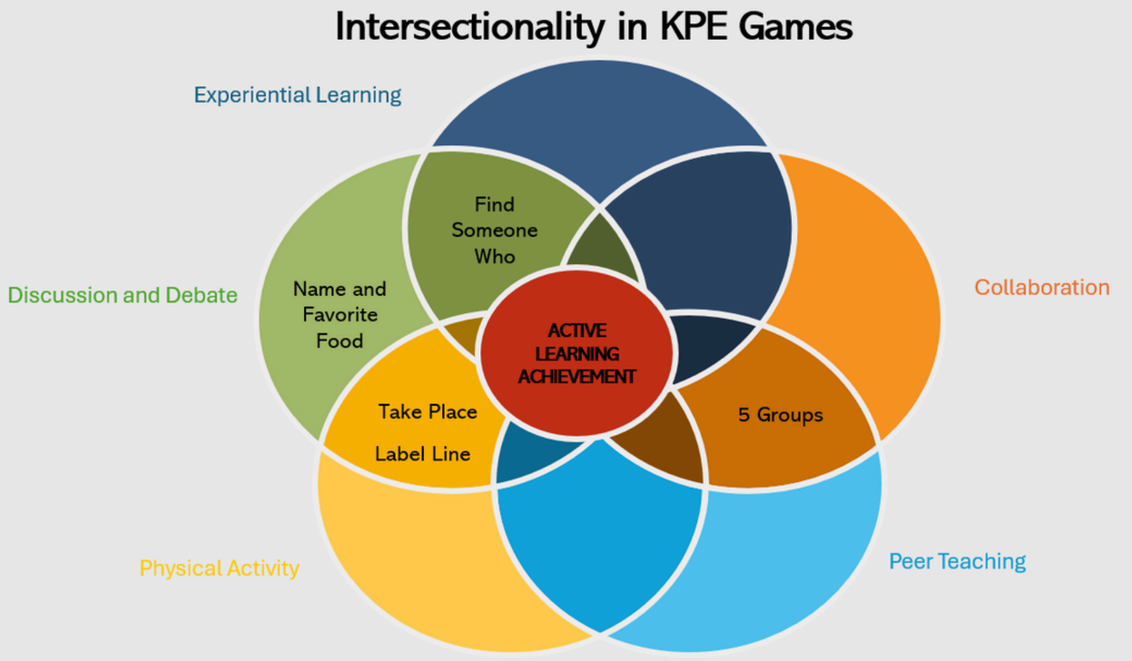


Figure 4: Variety of Active Learning Styles in KPE Games

In the activity “5 Groups,” students were tasked to collaborate in order to learn material about a topic and were tasked with preparing and presenting a presentation to their peers. The combination of active learning strategies, collaboration, and peer teaching, incorporated two active learning criteria, critical thinking, and autonomy. The students must be able to work together to verbalize the information they learned in a manner that they choose. In the game “Take Place”, the students went to different areas of the room that corresponded to their opinions regarding a given statement and then engaged in a discussion to defend their opinions. This activity incorporated the active learning criteria of reflection and application. By integrating games that involve active learning strategies, the program was more effective at reaching students than through a traditional teaching approach. This multi-faceted approach is corroborated by Dr. Brown, who noted the importance of motivation among students which can be reached through active learning. Stimulating motivation leads to better focus and achievement. By “creating a problem for students to solve,” we can improve the reach and impact of education through games.

The KPE discourages competition as an effective learning strategy.

By collaborating with the KPE and speaking with educational psychologists, we were able to gain insight into the effectiveness of competition in educational games. Some of our original game designs included a competitive aspect in which a game would have a “winner” and a “loser.” For example, the original outcome of “Pyramid Pairs” (Appendix H) was to have the student with the most matching pairs be the winner. When we presented this game to the KPE staff, they requested that we remove any competition because it goes against their philosophy, as they believe that losing can cause students to become unmotivated. This advice was corroborated by Niki Krespani, who has a Master’s in Educational Psychology. She noted that competition, “can lead to discouragement among students who are losing,” and explained that “competition and winners are not important, but instead that we are learning.” Furthermore, team-based games with neither reward nor punishment are common elements of the Greek education system and so students are used to them. Dr. Brown agreed with this approach, acknowledging that successful games “make the goal something where everyone can win,” so that students are motivated rather than discouraged.

The KPE aims to bridge the gap between student understanding of diet and its environmental impact.

Our research found that although students understand topics related to nutrition and environmental sustainability, independently, there has been no unanimous agreement regarding the relationship between the two. During the game “Take Place” on April 19th, 100% of students agreed that diet impacts their health, but when asked if diet impacts the environment, 18% of students disagreed and 64% were unsure, with only the remaining 18% agreeing. Similarly, during “Take Place” on March 19th, 100% of students agreed that diet affects health, but only 52% agreed that diet affects climate change. Giorgos Slafkidis corroborated this sentiment, saying that students don’t know the intersectionality between food and the environment and that “it’s something new to them.” Giorgos Yfantis agreed, saying that “[students] cannot tell in which way that food impacts the environment.” In their standard education, diet and environmental topics are not consistently taught effectively. For example, Chrysoula Athanasiou said that “kids deal with recycling… since kindergarten, and it’s a quite familiar subject” while “most of the issues that [we] raise during this project are issues that are not taught in any subject at school,” showcasing how educators mainly teach youth about singular topics such as recycling practices rather than discussing topic synthesis such as the relationship between diet and environment impact. Through active learning, gaming and peer-based discussion about their opinions on these topics, KPE aims to guide student perspectives on the connection between diet and the environment. This supports our initial research about the relationship between the two, with an increase in environmental education showing a simultaneous increase in awareness and motivation for youth to be conscious of their personal choices regarding food (Mukhamedzhanov et al., 2023, Panatsa and Malandrakis, 2024).

Our Approach to Game Development

Pyramid Pairs

(Active Learning Objectives: Collaboration and Discussion-based)

Pyramid Pairs is a game played in small groups consisting of 4-8 students. It mimics the card game "Memory" where students flip over two cards, searching for a matching pair of foods. When a match is found, the student places one of the cards on the food pyramid, keeping the second. After a group discussion on environmental impact, the students place the second card on a line signifying low to high environmental impact. Students are encouraged to self-correct with input from groupmates.

The creation of "Pyramid Pairs" (Appendix H) stemmed from a necessity for enhanced interaction during the "Five Groups" activities within the "Food for Thought" program. These hour-long sessions involved students dividing into five smaller groups, watching videos discussing different food and environmental topics, and presenting the information to the class afterward. Our observation of this session, as well as the student feedback forms, revealed that students lacked interest in this part with only 8% of students noting that it was their favorite activity. Students frequently looked away from the videos, indicating low interest and engagement in the material. Furthermore, the facilitator often needed to push students to think critically and make meaningful reflections, suggesting that the activity was not successful on its own in promoting the active learning criteria. By aligning these observations with our criteria for successful games (Figure 1), we deemed these group activities unsuccessful.

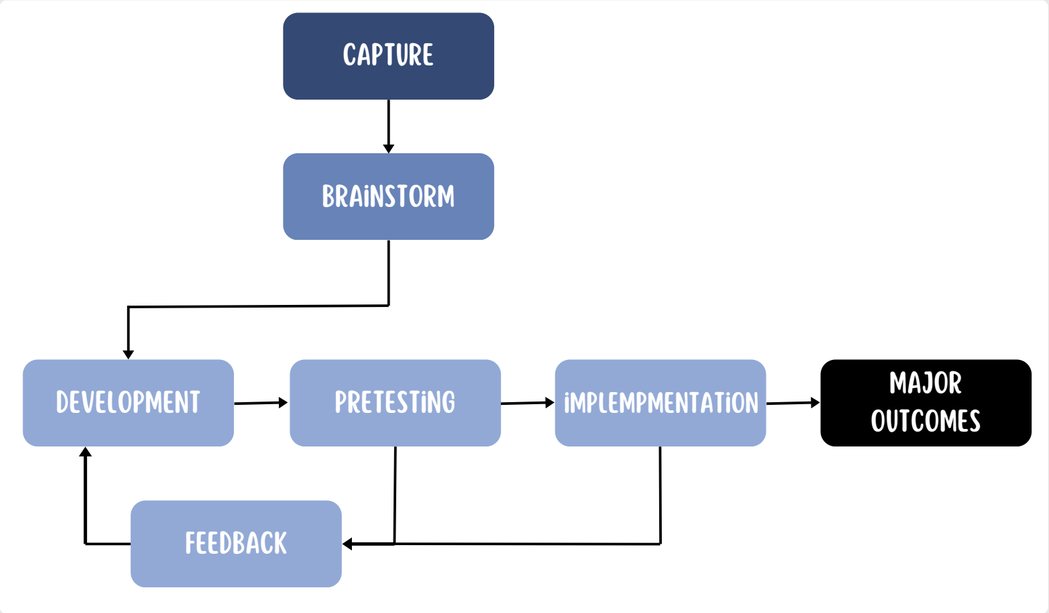


Figure 5: Adapted Game Design Process

To address the need for a better student experience in group activities, our team moved into the brainstorming and early development phase of our first game. Drawing inspiration from the

2023 WPI IQP project "Game On! Gamifying Thessaloniki, Sustainable City" (Tropeano et al., 2023), which featured a game called "Design a Square," we adapted its concept to suit our focus on nutrition. This led to our first version of the game, "Design a Plate." In this game, students constructed a plate from a range of food options they found appealing. Subsequently, they were introduced to a balanced plate, illustrating recommended portions of different food groups. Students then adjusted their plates accordingly and had a debrief to discuss key insights. Part of our game design was the incorporation of pre and post-game self-efficacy questions to gauge information retention. These questions were about their confidence in practical knowledge, such as "I am confident in my ability to construct a balanced meal," where students would respond on a scale of strongly disagree to strongly agree.

We implemented the game into the program on March 21st, which garnered negative feedback from both student reactions and insights from the KPE. The three students, aged 12-13, who played the game were confused and required repeated explanations while the facilitator had to frequently encourage student participation. Students' minimal positive emotional reactions also suggested low enjoyment, so we found it unsuccessful according to the student experience criteria (Appendix C). Additionally, while the students did have autonomy over their decisions in the game, it proved to be unsuccessful at prompting critical thinking, reflection, and application. The discussion was unfocused and mundane, and students did not relate it to their own lives. Thus, using our criteria for successful games (Figure 1), we deemed the game unsuccessful overall. In the post-game debrief, the KPE staff had similar observations and offered suggestions to improve the rules, context, and discussion of the game. The experience also highlighted the importance of pre-testing, as our team and the KPE both acknowledged feeling unprepared and disorganized during implementation.

Figure 6: Implementation "Design a Plate"

Based on all the feedback from “Design a Plate,” our team decided to scrap the game. Our team was determined to create a game for the same topic and part of the program, but aimed to make it more gamified. We also removed the self-efficacy questions, as we felt these focused too much on information retention, which did not align with the KPE approach. The students may have felt as if they were taking a test, instead of critically reflecting and being honest. Finally, we adjusted our game to be more tied back to the environment, as this is also one of the main goals of the “Food for Thought” program. All of these adjustments led to the creation of “Pyramid Pairs,” a brand-new game that incorporated all our new goals.

Prior to implementation, we tested the game with the KPE staff to gather feedback. Originally, the game involved competition in that the winner would be the one with the most pairs, but KPE advised against this, citing potential demotivation among losing students. They also recommended simplifying the rules for better comprehension. After incorporating their suggestions, we finalized the rules (Appendix H) and implemented the game on March 27th. Observations during gameplay indicated success according to our student experience criteria (Appendix C). Students displayed positive reactions, engaged voluntarily, and contributed actively to to discussions without prompting, which all suggested high levels

Figure 7: Implementation of “Pyramid Pairs”

of engagement, interest, and enjoyment. In terms of active learning criteria (Table 2), students were evaluating and synthesizing information on their own to determine the environmental impact of foods, which signified critical thinking, reflection, and autonomy. They also related the information to their own dietary choices, which suggested application. According to our observations and the criteria for successful games (Figure 1), we concluded the game was successful. The success of "Pyramid Pairs" underscores the efficacy of incorporating collaboration and and discussion as active learning strategies.

Furthermore, the coexistence of positive emotional reactions with the active learning criteria suggests that these aspects of active learning can effectively enhance the student's experience.

Label Dash/Label Line

Label Dash (Active Learning Objectives: Physical Activity, Collaboration, Experiential)

Label Dash is best played with more than 15 students, and less than 30. It is a relay race where student teams sort nutrition labels into three different bins based on the health content found on the label. There are three bins: green, yellow, and red which correspond to healthy, moderate, and unhealthy amounts, respectively. The students work with their team to place labels into the correct bins.

Label Line (Active Learning Objectives: Physical Activity, Collaboration, Experiential)

Label Line is played best with a class of 20 students. The class is split into two groups where one focuses on sugar and the other on salt. Each student is handed a food label. In each group, the students work together to order themselves from the lowest content to the highest. Once ordered, the students read their labels to see what type of foods belong to each end of the spectrum. They are encouraged to make connections between foods that are commonly high up the line or lower.

Previous to the creation of "Label Dash" (Appendix H), the program consisted of an hour-long lecture on nutrition labels, titled "Labels Under the Microscope." According to student feedback and observations of the activity in correspondence with our criteria for successful games (Figure 1), we deemed "Labels Under the Microscope" as strongly unsuccessful. Of the 12 students (16-18 years old) that responded with written feedback on the first day of implementation (March 21st), 46% reported that they found this the "Most Tiresome Activity" and only 20% responded that it was their "Favorite Activity." During observation, most students displayed low engagement, as they frequently had side conversations and needed to be brought back to the presentation by the facilitator. Some students even played with labels instead of utilizing them as intended. Six students were slouched in their chairs, and several closed their eyes. Overall, students lacked consistent focus, showing disengagement and disinterest. Additionally, the activity fell short of meeting our active learning criteria, failing to foster critical thought, application, or autonomy among students. While they were assigned to read labels, they weren't prompted to evaluate them, deepen comprehension, or make informed decisions. This underscored the "Capture" phase, the necessity for a game that better aligned with active learning goals and enhanced the label lesson experience.

During our brainstorming, we decided to incorporate movement, one of the tenets of active learning, to break up the lecture. The idea of incorporating physical activity was inspired by "Survivor," a game we observed on March 19th during the KPE's "Learning about Climate Change by Playing" program. After observing significant enjoyment and engagement during "Survivor," we felt passionate about creating a similar game with an emphasis on physical movement. To do this, our team developed "Label Dash," a relay game that focuses on the same information that the KPE teaches on nutrition labels and a discussion on sugar, salt, and fat content. Our original idea was to play "Label Dash" three separate times, once each for the three contents. We presented and pre-tested "Label Dash" prior to conversations about competition, and proposed that each round would have one winner and that there would be a timer. Mr. Slafkidis first suggested that a timer may cause students to worry about "beating the clock" instead of correctly reading the labels. We also decided to break the class into smaller teams to collaborate on categorizing labels collectively, rather than having a single winner. Incorporating collaboration aligns with active learning achievement and aligns with our criteria. On March 27th, 2024, we implemented "Label Dash." During rounds one and two, students were excited to play the game. Despite the game not having a competitive nature, the students were voluntarily competitive, which was seen through their running, how they helped their teammates read the labels, and shouting at other teams. The students had positive reactions such as laughing, smiling, and clapping, indicating success according to the student experience criteria (Appendix C). However, by round three, student engagement, enjoyment, and interest

Figure 8: Implementation of "Label Dash"

declined as evidenced by several students groaning when they were prompted to begin and the instructors having to force them to begin the round. The students no longer found “Label Dash” to be a game, but rather a task to complete, and they were relieved when the game was completed. While “Label Dash” was more successful than the original lecture, it was an activity of mixed success, exemplified by post-gameplay student feedback, as answers varied from thumbs up to thumbs down (Appendix C). Therefore, our team and the KPE discussed how to address the problem of repetition, which led to disengagement. Subsequently, we created a game that would be played in addition to “Label Dash,” called “Label Line” (Appendix H), which focused on the active learning styles of physical movement and collaboration. “Label Line” would now supplement the sugar and salt lessons, while “Label Dash” would focus on fats. Due to the simplicity of the game, our team was able to share our idea with the KPE and implement it without any changes having to be made. We implemented the finalized versions of “Label Dash” and “Label Line” together on April 16th. This time when played, student engagement, enjoyment, and interest stayed strong throughout the lesson. Unlike the previous time, students did not groan during the lesson but instead showed positive reactions of laughing and smiling in both games. Every student voluntarily participated and many joined in the discussion. In addition to our own assessment of the games, student feedback showed that now 20% responded that it was the “Most Tiresome Activity” and 57% responded that it was their “Favorite Activity.” The change in percentage proves the addition of gamified physical activity and collaboration improves student engagement, enjoyment, and interest. Furthermore, the

Figure 9: Students collaborating during “Label Dash”

game encouraged critical thinking, application, and reflection as students had the opportunity to analyze foods that are healthy and unhealthy based on sugar, salt, and fat content in a creative way (Table 2). Therefore, given the observations and feedback in comparison with the criteria for successful games (Figure 1), we determined that “Label Dash” and “Label Line” were successful games, and they evidence the benefit of game-based learning. When gaming is used as a strategy for teaching, and there is an emphasis on experience over information retention, student engagement also increases. Consistent with (Legaki et al., 2020), game-based learning has been shown to improve student “engagement, motivation, and learning performance.” Also, we found that competition is not needed in order to create a successful game. In fact, the lack of competition can add to success because it motivates the students to work together to reach one goal.

Food Corners

(Active Learning Objectives: Discussion-based and Physical Activity)

Food Corners is a game that can be played in small groups, of 4-8 students, or as a class of 20-30 students. Each corner represents a different season: spring, summer, fall, winter. Each student is given a note with a different fruit or vegetable and must go to the corner of the room (the season) they believe their food is produced during. Students are given time to self-correct after discussing with their classmates. Once everyone is settled, each student reveals which food they are and the class discusses the importance of purchasing in-season fruits and vegetables. The facilitator groups the students in the center of the room and yells a fruit or vegetable to which students must run to the correct corner.

After improving the “Labels Under the Microscope,” our team switched our focus back to “Five Groups.” As discussed in the development of “Pyramid Pairs,” active learning strategies were lacking in these small group activities, and we determined they were unsuccessful based on the criteria for successful games (Figure 1). Since there were still four other topics during the “Five Groups” section, our team decided it could benefit from more games. During the brainstorming phase, we took inspiration from the game “Four Corners” and related it to the KPE’s teachings on

seasonal fruits and vegetables that occurred during “Five Groups.” From this, we came up with “Food Corners” (Appendix H), a game that kept with the active learning approach of the KPE by incorporating physical movement and discussion.

During the pre-testing stage, our team played the game for our sponsors. They made no suggestions about the rules of the game, but recommended that it be played twice: once in a small group during the “Five Groups” section, and a second time as a class, during the student presentations. We implemented the game on April 3rd, and it was successful according to our student experience criteria. Observations showed that students were focused on the goal of the game. When given their respective fruit or vegetable, all students moved around the corners discussing with their classmates what season they thought they were. Students were laughing with others and shouting across the room to peers about placement. Here, we emphasized trying our best and having no punishment for being wrong. The ensuing discussion, which began with hand-raising, turned into shouting out ideas due to excitement. The discussion promoted active learning criteria by encouraging students to engage in all four criteria: critical thinking, application, reflection, and autonomy. Students were able to relate the lesson to foods they eat in their own lives, reflect and self-correct, make their own decisions, and think about why they were learning the information. In all, “Food Corners” was successful according to the criteria of successful games (Figure 1). This was also supported by student feedback, as a majority of students gave this section of the program a thumbs up. Finally, we were pleased to hear that the KPE staff was very pleased with the success of “Food Corners” and had no recommendations.

Overall, the inclusion of a game during “Five Groups” worked well to break up the presentations and to keep student engagement, enjoyment, and interest high, along with promoting active learning criteria. Getting students up and moving during a stretch of lecturing emphasizes experience rather than information retention. During this process, our team was also learning about teaching approaches and and applying our knowledge to our process, streamlining it and requiring less help from our sponsors.

Figure 10: Implementation of “Food Corners”

Mind Map

(Active Learning Objectives: Collaboration and Discussion-based)

Mind Map is best played as a full class split into 4 groups. Each group is given a blank poster-size paper with the words " Environmental Problems" and "Nutrition" written on top. The groups are asked to write as many words or phrases associated with those words as they can. After 15 minutes, a representative is selected from each group to write the words and phrases on a whiteboard to share with the class. A different team member from each group then denotes common themes with a circle.

Inspired by the success of our small group games, we continued to focus our efforts there, while also continuing to address our goal of creating versatile games adaptable to the KPE's programs. We wanted to develop a game that centered around the environmental impact of food from a broader, more general lens. This sparked the development of our game "Mind Map" (Appendix H). Drawing inspiration from a brainstorming exercise in a WPI social science research class, where groups generated ideas and made based on a single item, we tailored the concept to explore the relationship between food and the environment, while keeping the active learning strategies of collaboration and discussion at the forefront.

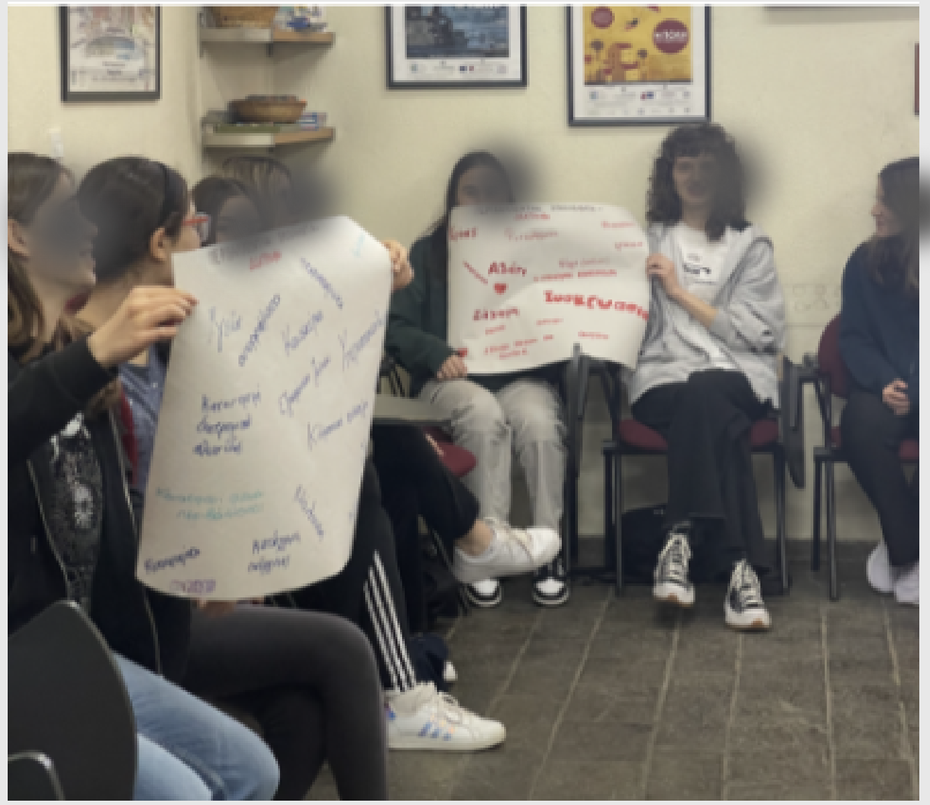


Figure 11: Implementation of "Mind Map"

Once the rules of "Mind Map" were finalized, the game was brought to the KPE staff on April 8th for the pre-testing phase. While the game's intuitive nature minimized the need for a full trial, we thoroughly discussed its logistical details with the KPE team. Although they had minimal feedback on the game itself, the in-person discussion ensured that both our team and theirs felt organized, prepared, and ready for implementation on April 9th.

The implementation of “Mind Map” was resoundingly successful, evidenced by our team's observations of student behaviors during the game and our established criteria for evaluating success. Students displayed remarkable enthusiasm, eagerly participating by running up to the board and contributing ideas. Moreover, the game facilitator extended the game by welcoming additional student participation when writing their connections, showcasing the game's capacity to inspire active involvement. Students took the initiative to enhance the experience, embellishing posters with drawings and colors, thereby transforming it into a more immersive and interactive activity. These behaviors showcased the game's effectiveness in fostering engagement, interest, and enjoyment, as evidenced further by the abundance of positive expressions such as laughter and smiles. Furthermore, students were given an opportunity to critically think on their own about connections between food and the environment and include their own creativity, which promoted autonomy. The game also encouraged them to apply what they were talking about to their own behaviors and reflect on that. All of the observations proved the game’s success according to the criteria of successful games (Figure 1). The overwhelming success of this game reinforces the consistent finding that collaboration and discussion significantly enhance student engagement, interest, and enjoyment.

Furthermore, the outcomes of implementing this game emphasize the benefit of promoting critical thinking, engagement, and reflection through interactive activities. Such aspects of active learning not only enrich the student experience but also foster a more effective learning process.

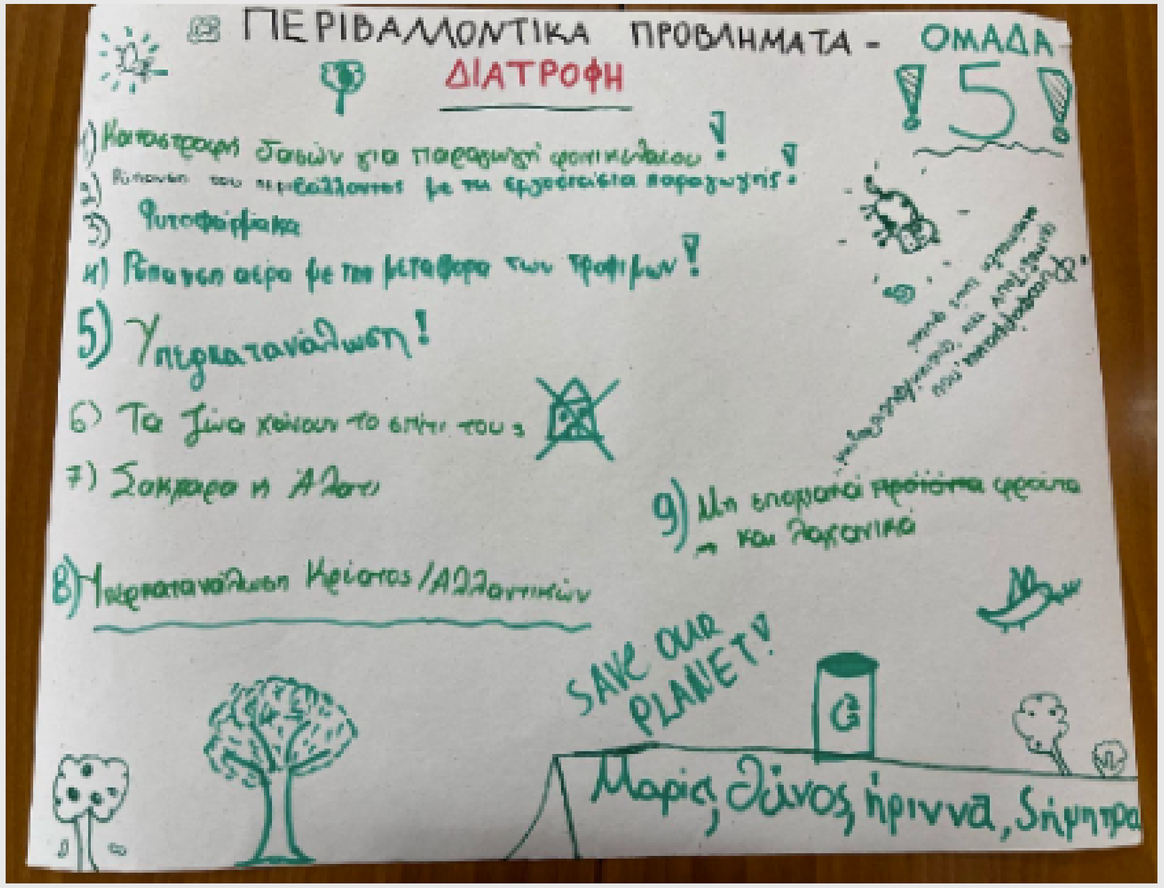


Figure 12: Student poster from “Mind Map”

Waste Walk

(Active Learning Objectives: Physical Activity, Discussion-based)

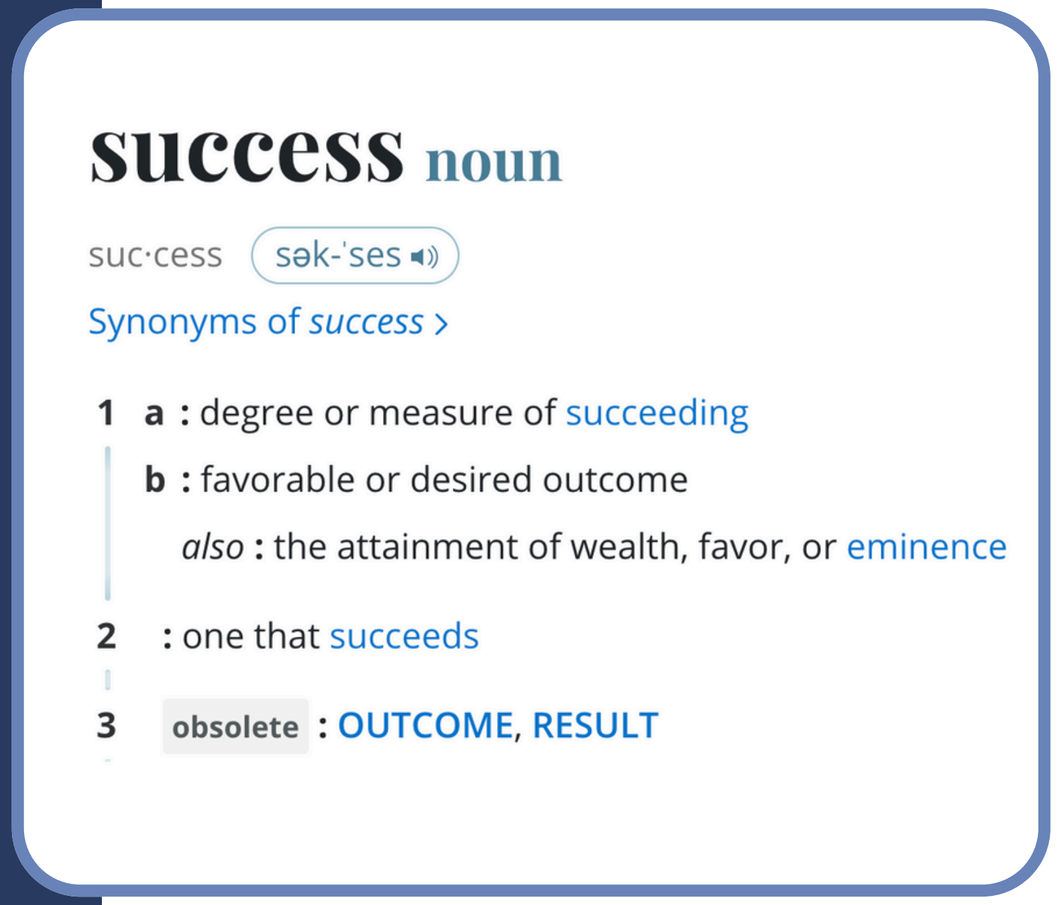
Waste Walk is best played with a group of 5-10 students. Different waste items from the categories of plastic, paper, food, and reusable options are scattered out on the floor in front of the students. The instructor announces a category and a type of motion and the students must go to an example of waste that would belong to that category by doing the specified movement. After all students are on an item, a discussion about what items they are standing on and whether they have seen that item in their everyday lives.

Given that many of our games were developed with older students as the intended audience, we felt challenged to make a game that would better adhere to younger students. To this end, we decided to focus on a section within "Five Groups," as student feedback showed that "Food Corners" and "Pyramid Pairs" improved the success of this section, and we wanted to continue to improve. Our team took inspiration from the children's game "Hullaballoo" to create an active game that incorporated physical movement and discussion. In the game "Hullabaloo," pictures from a variety of categories are scattered out across the floor and players are tasked with moving to these pictures by completing silly actions, such as hopping, marching, or slow-motion. To adapt "Hullabaloo" to fit into the KPE lesson about waste, we categorized waste into four sections; plastic, paper, food, and reusable options. Each category had five representative pictures of different waste items that were laid out on the floor. Before implementation, our team played the game for our sponsor. They enjoyed the silly movements and overall concept of the game and had no recommendations. They agreed with us that the game would work better with younger children and suggested it was ready for implementation.

Figure 13: Implementation of "Waste Walk"

Through observations, it was clear that students were engaged and interested in “Waste Walk.” All students willingly participated and many were eager to contribute during the discussion. Students stopped raising their hands and began shouting out answers because they could not contain their excitement. Their excitement coincided with their enjoyment and was also evidenced by their laughing and smiling. This all indicated success according to the student experience criteria (Appendix C). In addition, students were engaged in critical thinking, reflection, and autonomy. After interpreting the different waste items and categorizing them, students were asked where they had seen these items, relating the lesson back to the real world. Also, if standing on an incorrect item students were allowed to self-correct. According to our criteria for successful games (Figure 1), “Waste Walk” was successful, and our sponsors agreed. Because our team was able to streamline our game development process and focused heavily on upstream preparation, we found it common to receive fewer recommendations from the KPE post-implementation.

Figure 14: Sophia and Abby teaching the students how to play “Waste Walk”



Common Traits of Successful Games

Effective education emphasizes experience over information retention.

Collaboration, discussion, and/or physical activity are effective in increasing engagement, enjoyment, and interest for the KPE students.

Students prefer games that are short, simple, and easy to understand.

Effective education emphasizes experience over information retention.

Game-based learning in education, as evidenced by the transition from the game "Design a Plate" to "Pyramid Pairs" as well as the original lesson on Labels to the implementation of "Label Dash" and "Label Line", significantly enhances the student experience, focusing on engagement and learning outcomes rather than information retention. "Design a Plate" was similar to the original lesson on labels in that they showed comparable patterns in student feedback responses, both by observation and on their feedback forms. We observed a noticeable disinterest and lack of engagement among the students, who found it challenging to stay focused on the material. This was in sharp contrast to the games that replaced them, "Pyramid Pairs" and "Label Dash"/"Label Line." Both games emphasized the gamification of the educational experience rather than simply presenting educational material to the students, and both proved to be more successful than their predecessors, supporting the research that gamified learning can increase student motivation and engagement (Legaki et al., 2020).

This sentiment is seen not only in the games developed but also in the feedback from students, teachers, and staff themselves. Food education effectiveness in Greece is contingent on the type of school a student attends and how enthusiastic their teachers are (Environmental Education Centre Staff, personal communication, March 26, 2024). This greatly affects the impact of food and environmental education that students receive. These education practices can be often ineffective as teachers use passive methods of instruction rather than innovative approaches such as active and game-based learning (Environmental Education Centre Staff, personal communication, March 26, 2024). Student feedback revealed that experiential learning was preferred as it is a more hands-on approach that keeps students involved. One student commented during the session that he "liked doing activities instead of being talked at," supporting the success of experiential learning.

"I liked doing activities instead of being talked at" -15-year old student

Similarly, statements from educators further support the benefits of game-based learning in enhancing the learning experience. During an interview on April 9th, one teacher expressed, “experiential [learning] is the most important…I think the experiential part of this will help them understand more and feel inspired to apply it to their own lives.” She also noted the difference in engagement during active learning compared to lecture-style learning, saying that her students were more engaged during the “Food for Thought” program because “they are involved,” and this “lets them find their own answers.” This first-hand account conveys the same idea as our research on game-based learning and discusses how gamification results in increased engagement due to its stimulation of the players’ psyches (Marin et al., 2021). On March 13th, a different teacher expressed that this type of approach is a “great way of communicating the message and schools need to do more of it.”

“experiential [learning] is the most important…I think the experiential part of this will help them understand more and feel inspired to apply it to their own lives.” -Teacher

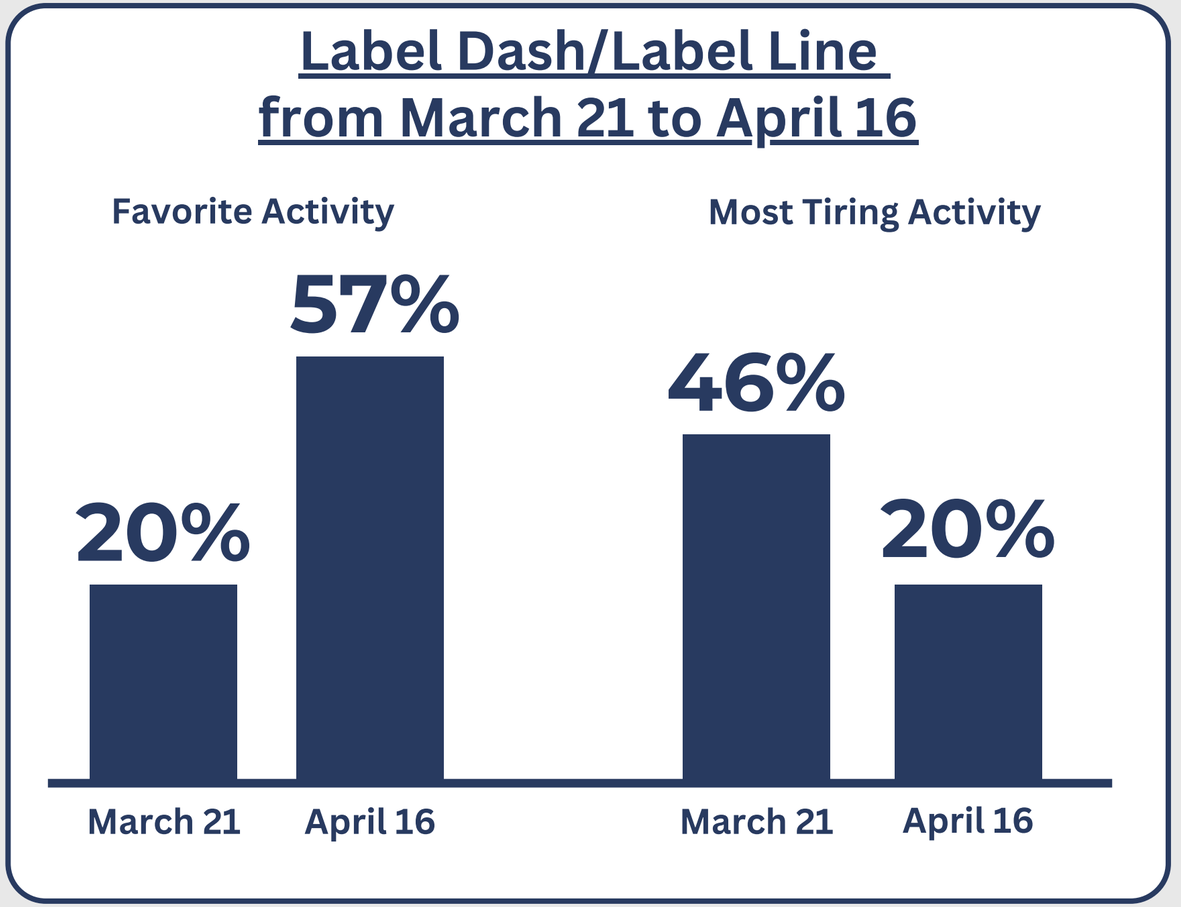


Figure 15: Change in success due to “Label Dash”/”Label Line”

Collaboration, discussion, and/or physical activity are effective in increasing engagement, enjoyment, and interest for the KPE students.

Every game that we developed included a discussion component, urging students to reflect on their experience and think critically about the information. Discussion-based games proved to be an effective active learning strategy, which is reflected by the success of our games as analyzed in *Our Approach to Game Development*. Many games that the KPE implemented included either a physical or collaborative aspect first, followed by a post-game discussion. The conversations maintained their natural flow as many students shouted out comments and were excited to share. Students often got carried away when discussions occurred, having to be continually brought back by the facilitator. However, this is a positive aspect of discussion because it stimulates engagement and interest. Student behaviors were also consistent with their feedback on different discussion-based games in the "Food for Thought" program. For example, "Take Place" (73%) and "Find Someone Who" (80%) (Appendix I) consistently had positive feedback from students, giving a thumbs up for each. When the students were asked how they felt about hearing their peers talk about their habits during "Find Someone Who", they used the words "surprised", "interested", and "excited," indicating interest and enjoyment. Furthermore, over four weeks, students expressed an appreciation for being able to share their opinions, and they found confidence in themselves from hearing others share theirs. Our team found this way of teaching very powerful, which was emulated throughout our own game development process to create successful games based on discussion as an active learning strategy.

> *"surprised" "interested" "excited" - Three students ages 15-16*

Based on the lessons that our team learned from the development of our own games, collaboration is a successful active learning strategy. This was evidenced by the results of implementing several of our games, such as "Pyramid Pairs," "Label Dash," "Label Line," and "Mind Map." These games all stemmed from our team wanting to address a lack of active learning strategies in various areas of the "Food for Thought" program. For example, in "Labels Under the Microscope," and "Five Groups,"

there was little to no collaboration, and student behaviors consistently suggested that these activities were unsuccessful, according to our criteria. Our games in these sections brought collaboration to the forefront of the experience, prompting a significant shift in behaviors to those that indicate success. Student preference for collaboration was also emphasized through their voluntary collaboration even when unprompted. When students were given individual tasks, their desire to help their classmates often took over and students worked together to complete a common goal. This theme occurred regularly throughout our games and KPE games, as collaboration allowed for cooperative critical thinking, and reflection, which is more beneficial than individual. This aligns with Giorgos Slafkidis' thought that "Playing all together is more productive, it is more engaging for the students." In all, collaboration can be proven a successful active learning strategy that is incorporated into our approach and the KPE approach.

"Playing all together is more productive, it is more engaging for the students."- Giorgos Slafkidis

As detailed in *Our Approach to Game Development*, our games that incorporated physical activity continued to foster engagement and enjoyment among students, as evidenced by their behaviors. We developed three successful games that involved physical activity: "Waste Walk," "Food Corners," and "Label Dash." Preference for physical activity was also reflected through the game "Survivor" during the KPE program "Learning About Climate Change by Playing" on March 19th. During "Survivor," students were willingly running around and wanted to be involved in the activity, as they expressed verbal and physical disappointment when they got out. Students also expressed a desire for physical activity during the "Food for Thought" program. Throughout four weeks of observations, our team consistently heard students convey in their feedback that they liked that they could move. Movement helps keep students involved in the learning process, which Giorgos Yfantis reiterated, saying "including games that make them move around helps students learn more efficiently." We found consistent success by aligning our approach to gaming with the approach of the KPE, through the inclusion of physical movement.

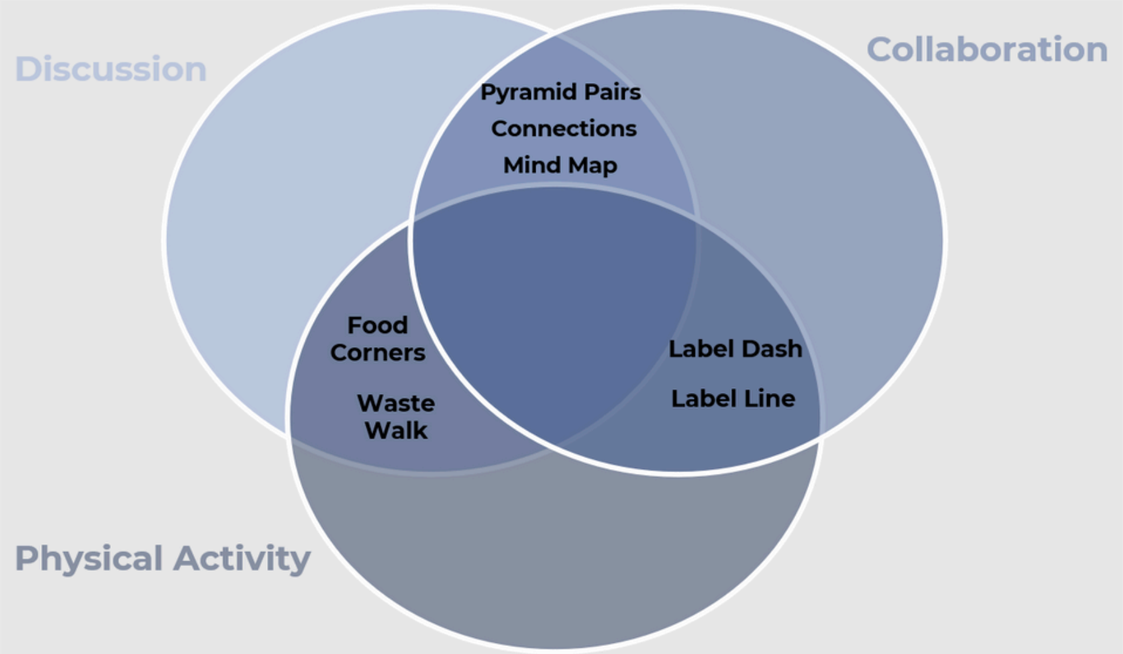


Figure 16: Intersectionality of active learning for our games

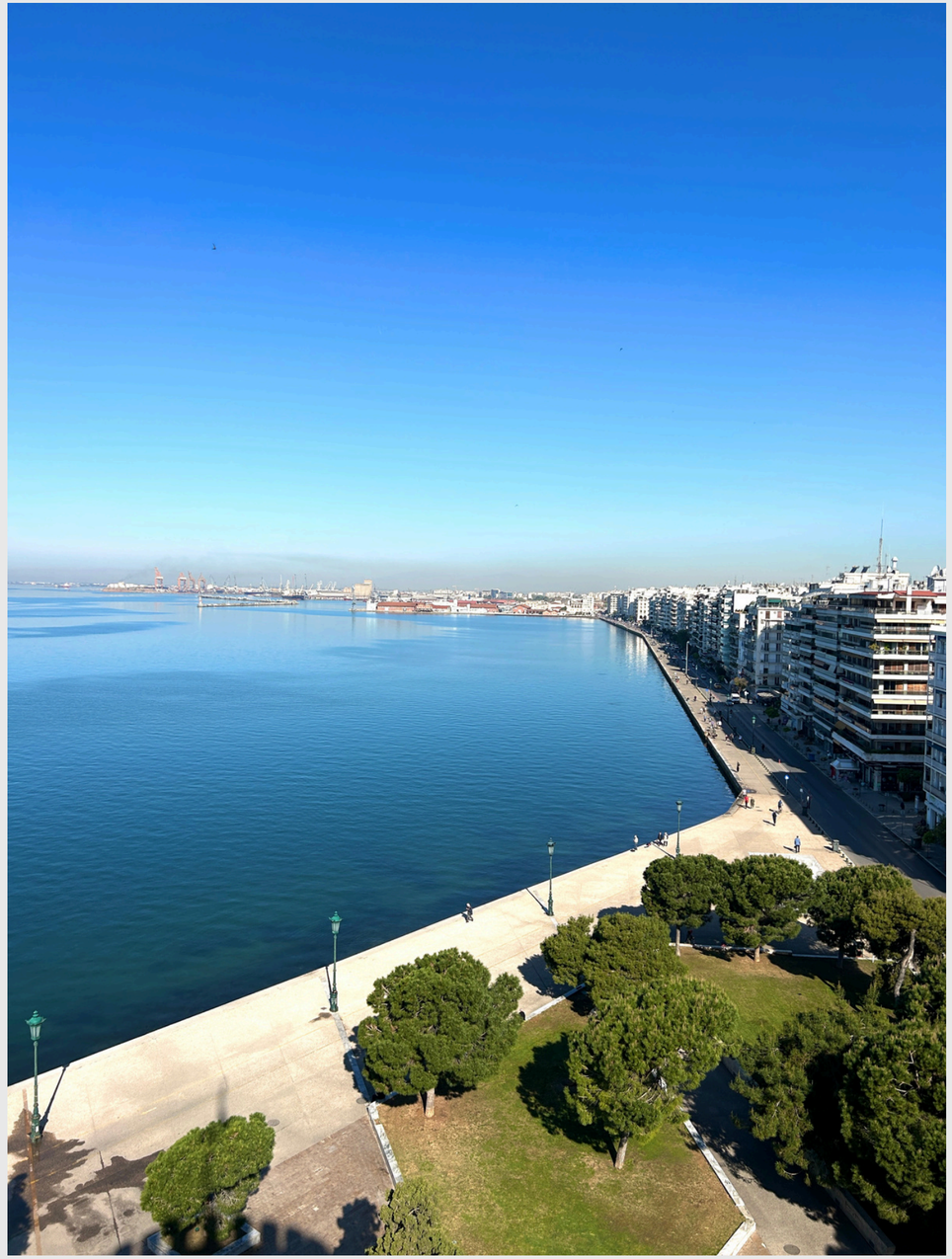
Students prefer games that are short, simple, and easy to understand.

Synthesizing results from longer and more complicated games, we found that they did not consistently meet active learning strategies or active learning criteria. This is exemplified in "Design a Plate," "Labels Under the Microscope," "Label Dash," and "5 Groups." In these games, students were disengaged with the games themselves and the educational material altogether. For example, in the first session, we observed "Labels Under the Microscope," and noticed the long-form passive-learning presentation style that was implemented. When students were asked about what they learned, 24% wrote vague and unclear statements about healthy eating and the impact of nutrition on the environment, 12% simply wrote "Yes," and one student even said, "No, I've heard them many times." Students were not reflecting on the information, they were not thinking critically about the information they were receiving, and they were simply hearing it. They were not making analysis or synthesis between topics. Their disengagement was further reflected in the feedback forms. On March 21, 20% of students voted it their "Favorite Activity" and 57% voted it as their "Most Tiring Activity." In our game "Label Dash," students became bored after the second round played. They became frustrated with the repetition of having to play the same game for three rounds. Again, we limited autonomy in their learning since they were forced to participate. Similarly, in "5 Groups," students in the audience were disinterested after several

Students were not reflecting on the information, they were not thinking critically about the information they were receiving, and they were simply hearing it

long presentations in a row. Facilitators often had to remind students to re-engage with the material. Here, students were not given the opportunity to reflect or apply information because they were subjected to one-way dissemination of information in a passive presentation. Given this, our team found that combating this by creating simpler games was a successful strategy that resulted in higher interest, consistent engagement, and increased enjoyment of our games.

Simpler games, with fewer rules, more consistently met active learning objectives and were observed well by our team. This is evidenced by our games “Waste Walk,” and “Mind Map.” Both of these games have minimal rules and instead, let the students participate in their own way. By emphasizing autonomy and critical thinking, students had a more positive experience which is reflected in the verbal and physical feedback that we received. During “Mind Map,” students made textual connections between their posters and their peers, as well as connections between their posters and real-world contexts. This success was further reflected in visual observations where students were laughing, collaborating, and being creative during their poster creation. This discovery supports existing literature on education practices for youth. Successful gaming helps students process and solve problems which increases the effectiveness of the learning experience (Surattana et al., 2021).



Deliverables and Future Research

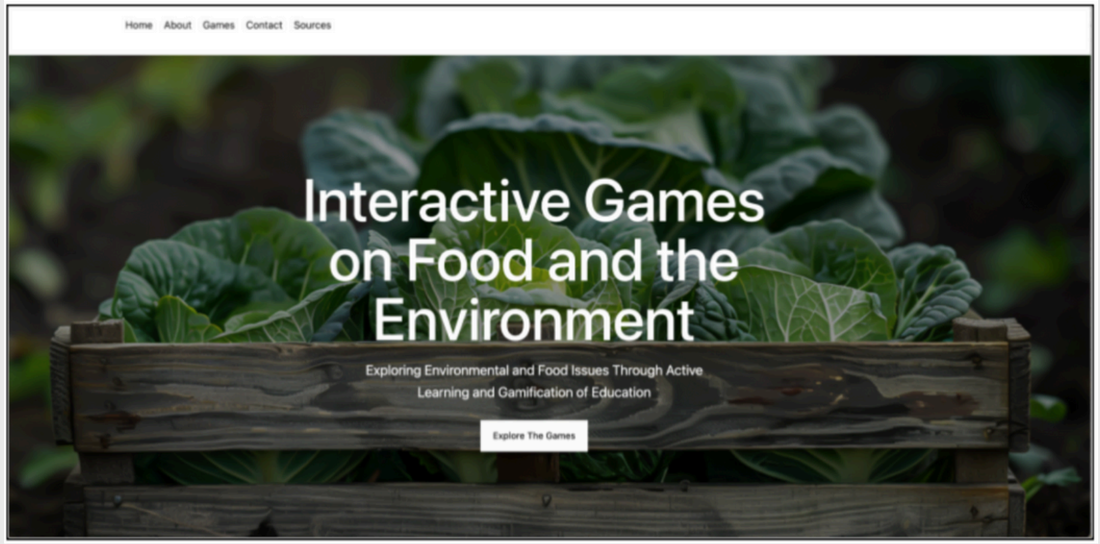


Figure 17: “Home” page on the “Food for Thought” website

There are two deliverables that were submitted for the KPE to utilize. The first deliverable was this study to aid in their efforts to further develop games with active learning criteria. The second deliverable was the website that we developed which served as a “Food For Thought” game repository. We chose WordPress to create the website due to the KPE's preference for a user-friendly platform that they could edit as needed. This allowed for the transfer of admin access to ensure that the website can be updated as necessary, including translations for Greek users and teachers.

As seen in Figure 7, the website has several pages. The “Home” page introduces the central theme of the project and provides quick access to the games. The “About” page details information about our team and the KPE, showing the collaborative effort behind the games. The “Games” page serves as a repository of the games that we created. The “Contact” page facilitates future research, allowing users to email the KPE or our team to share any feedback or ideas. The “Sources” page contains the sources that our team used to develop the website and booklet.

The “Games” page also showcases the game booklet (Appendix G) that we have created to house instructions, materials needed, and other necessary information. This booklet was created using Canva, using a playful and green-centered theme to highlight the focus on the environment and its youth-centered educational purpose. On the “Games” page, all games are available for download in PDF format, either in its entirety or by individual game.

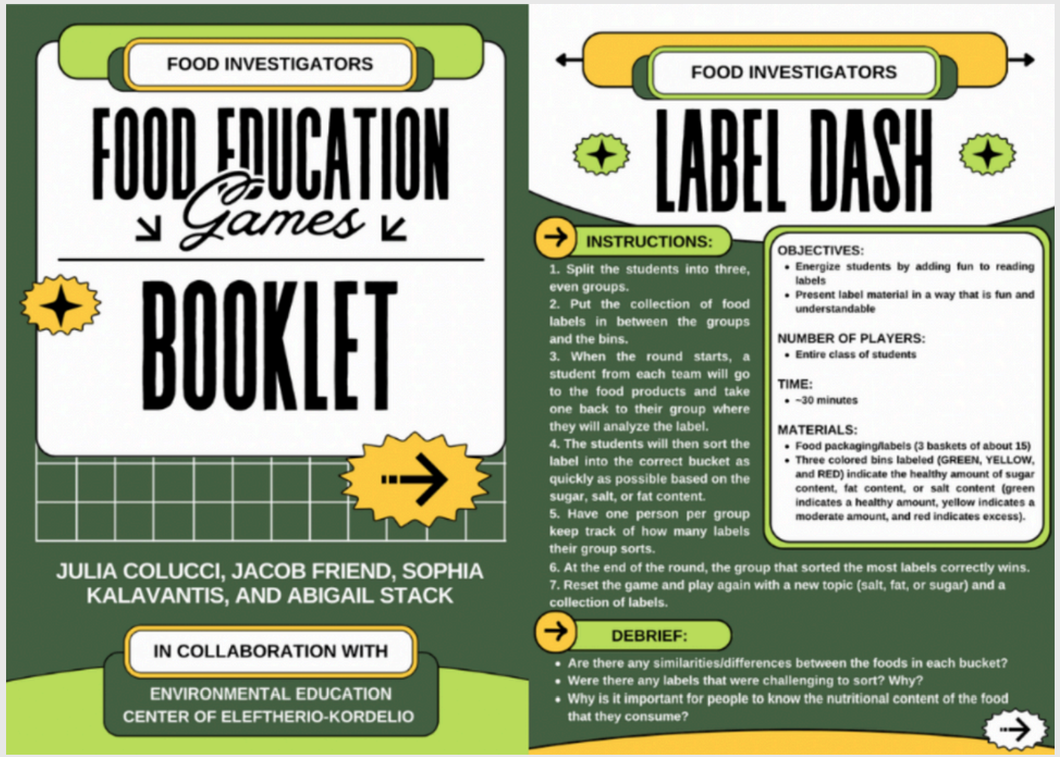


Figure 18: Food education games booklet

To ensure further access and understandability for Greek educators, the KPE will have to translate the booklet/website and link it to their own website. After the conclusion of our time here, we hope that this website will not only serve as a collection of our games but also have a lasting impact on food and environmental education at the KPE.

Future research should not only assess enjoyment, engagement, and interest and the active learning criteria in the educational games developed but also explore how these elements vary with factors such as age, location, socioeconomic status, and gender ratio. Research on these variables could explore the potential barriers that different groups may face in accessing and benefiting from these games, leading to more inclusive delivery. Understanding which games resonate better with different groups of youth could allow the KPE to target the activities based on the findings, ensuring that the games are utilized effectively and creating a more enjoyable experience for the youth.

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Appendices

Appendix A: KPE Program Attendance

Date	Time	Focus	Age Group	Class Size	School Type
March 13, 2024	10 am - 1 pm	Food For Thought	17 -18 years old	28 students	Technical High School
March 19, 2024	11 am - 1 pm	Climate Change	17-18 years old	25 students	Rural High School
March 21, 2024	9 am - 1 pm	Food For Thought	12-13 years old	15 students	Environmental School
March 27, 2024	9 am - 1 pm	Food For Thought	13-15 years old	23 students	Standard Junior High School
April 3, 2024	10 am - 1 pm	Food For Thought	15-16 years old	18 students	Standard High School
April 9, 2024	9 am - 1 pm	Food For Thought	14-15 years old	22 students	Environmental Elective Class
April 12, 2024	9 am - 11 am	Sustainable City	16-18 years old	28 students	Standard High School
April 17, 2024	9 am - 1 pm	Food For Thought	11-12 years old	30 students	Standard Junior High
April 19, 2024	9 am - 1 pm	Food For Thought	16-18 years old	24 students	Standard High School

Appendix B: Observation Guide

Header: Time, Place, Observer	
Descriptive Notes:	Reflective Notes:
Activity What activity are the children doing? What topic of food education does this activity fall under? Small group focused or entire class? How long did the activity take?	Evaluation of Activity: <u>Engagement</u> Notes on engagement throughout activity: <u>Enjoyment</u> Notes on enjoyment throughout the activity <u>Interest:</u> Notes on interest throughout the activity: <u>Problems or Confusion</u> Notes on any problems or confusion that arose during the activity: Add any questions the children had during/after the activity: <u>Positive Takeaways:</u> Did the children seem to get something out of the activity:

Appendix C: Student Experience Criteria

Very Successful	- All students are voluntarily participating (raising hands, asking questions, playing through the entire activity) - All students are paying attention to the game (all students focus on the facilitator or game being played) - All students have positive reactions (smiling and laughing, thumbs up during post-gameplay feedback) - Students do not want to stop playing the game (facilitator has to continuously prompt students to stop playing)
Successful	- The majority of the students are voluntarily participating - The majority of the students are paying attention to the game - The majority of the students have positive reactions - Students stop playing after prompting
Mixed Success	- Some of the students are voluntarily participating - Some of the students are paying attention to the game - Some of the students have positive reactions (answers vary from thumbs up to thumbs down during post-gameplay feedback) - Students are content with ending the game
Unsuccessful	- Minimal students are voluntarily participating - Minimal students are paying attention to the game - Minimal students have positive reactions (most students give thumbs side or down during post-gameplay feedback) - Students are mentally done with the game before the facilitator ends the game
Very Unsuccessful	- Forced or no class participation - The majority of students are not paying attention (side-conversations, wandering eyes, their focus is primarily not on the facilitator or the game being played) - The majority of students have negative reactions (most students give thumbs side or down during post-gameplay feedback) - Students are physically done with the game before the facilitator ends the game (students completely stop the game)

Appendix D: Observation Guide

We are a team of students from Worcester Polytechnic Institute in Worcester, Massachusetts, USA, collaborating with the Center of Environmental Education of Eleftherio Kordelio & Vertiskos. Our project aims to improve nutritional literacy and promote sustainable food practices among youth in Thessaloniki. To achieve this, we are conducting interviews and focus group discussions to assist us in understanding the current level of food education among youth, as well as the current curriculum and its effectiveness.

This discussion is expected to last about 30 minutes. Please remember, that your participation is entirely voluntary—you are free to decline to answer any question or stop the interview at any point. We assure you of the confidentiality of your responses; no personal information will be disclosed in our reports or publications without your explicit consent.

With your permission, this interview will be recorded for the purpose of accurate transcription. The recording itself will not be included in any further project materials.

If you have any questions or concerns regarding this interview, we can be reached at gr-thess-food-investigators-d24@wpi.edu, or through our advisors Melissa Butler (mbutler@wpi.edu) and Michael Butler (mbutler1@wpi.edu). For more information about this research or the rights of research participants, please contact Ruth McKeogh (irb@wpi.edu).

Appendix E: Teacher Interview

1) Do you do any activities like this to teach about food/environment topics during regular school hours? If so, could you talk a little about it.
2) Do you notice a difference in engagement, interest, or enjoyment during active learning like this vs. lecture-style learning?
3) How well do your students seem to understand environmental topics from your perspective? Do you think they recognize how much diet impacts the environment?

Appendix F: Scott Brown Interview

1) We understand that you are an advocate of problem-based learning for students, how does this relate to your background as an educational psychologist?
    a) Can you elaborate on the benefits of active problem-based learning?
    b) Have you seen other teaching approaches that are as effective as active problem-based learning?
    c) If yes, can you elaborate on those approaches? If not, can you explain why other approaches aren't as effective?
2) We also understand you have researched how gaming can be incorporated into learning, what makes gaming effective for students?
    a) How can gaming be used to implement social behavior?
    b) How can gaming be incorporated into learning to make it engaging and fun for students?
    c) How does gaming influence student behavior?
    d) Do you have any game recommendations about food education specifically?
3) Based on your recommendations for games we should implement, how should our team measure the effectiveness of our games? (How have you determined the effectiveness of games in the past?)
    a) Do you have any tips for observing effectiveness during game implementation?

Appendix G: Student Feedback Form

FEED BACK in two minutes

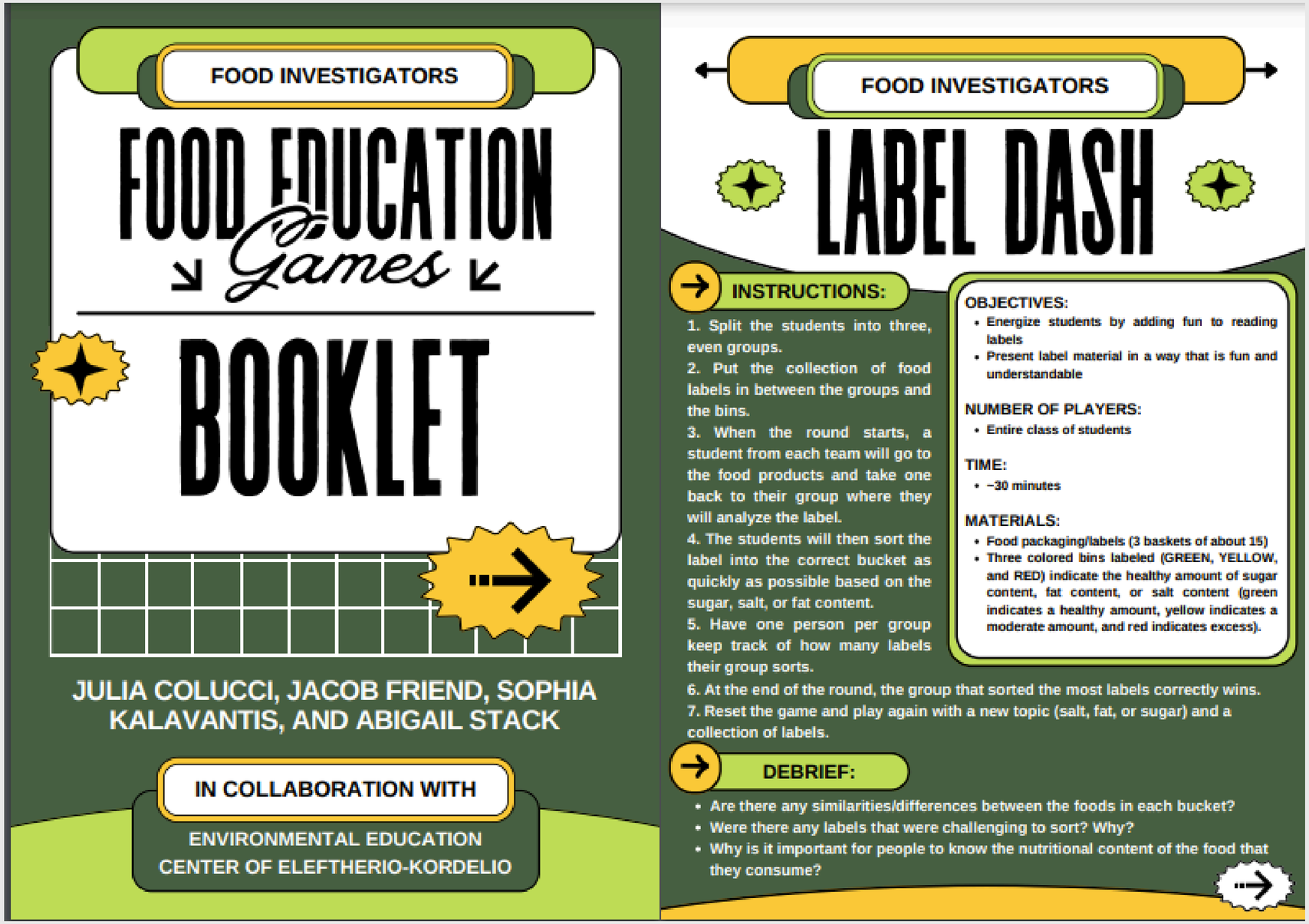
- (circle which one applies): GENERALLY I liked/disliked the program.
- How would you describe this program in one word: .....
- What or which activity seemed most interesting to me?.. .....
- What or what activity tired me the most? .....
- Did you learn something new today? YES NO

What: .....

- What else would I like to know? .....

(circle which one applies): Boy / Girl

Appendix H: Food Education Games Booklet



FOOD INVESTIGATORS

PYRAMID PAIRS

INSTRUCTIONS:

1. The cards are shuffled and placed face down on the table.
2. In turns, each player flips two cards at a time.
   a. If they have different foods, they have to place them back on the table.
   b. If two cards with foods within the same food group are chosen, they place one card on the food pyramid and the other one on the corresponding level of the environmental pyramid. Once the player places the cards on the correct levels, they keep the cards with each pair symbolizing one point.
3. The game is over when the facilitator decides to end the game or when no card remains on the table. The winner is the player who has the most pairs.

OBJECTIVES:
- Label foods to the food pyramid and the environmental pyramid
- Think actively about how diet impacts the environment

NUMBER OF PLAYERS:
- Group of 3-6 students

TIME:
- ~20 minutes

MATERIALS:
- Cutout of food and environmental pyramid
- 20 labeled cards with foods on them

DEBRIEF:

- What did you observe about the food and environmental pyramids?
  - Are there any similarities or differences?
- Why is the food/environmental pyramid important?

FOOD INVESTIGATORS

SUSTAINA-BALL

INSTRUCTIONS:

1. Before you play, check that all the players are comfortable with having something thrown at them. Ask those who are not comfortable with this to move outside the circle and observe the process. 2. Gather everyone into a circle, yourself included.
3. Introducing the context of the game, "The goal is to have a healthy and sustainable diet".
4. Start with a practice round with one ball to get used in the game. Throw the first ball to a group member. Participants must keep the ball in motion by continously throwing it around the circle, not letting it touch the ground or stay in any one participant's hands for more than 2 seconds if possible.
5. When a player drops the ball, they have to put one hand behind their back. If they drop it again, they step out of the circle.
6. Reset the game as needed and have everyone rejoin the circle. Introduce a "stressor" (one ball), and announce their entrance into the game ("You are dealing with".... deforestation due to meat production, disruption of the ecosystem due to overfishing, an increase in greenhouse gas emissions due to food waste and greater food miles, depleting water supply due to water usage in food production, increased plastic waste from food packaging). Keep adding balls until the play becomes chaotic, with balls being dropped very often and people losing the use of their hands.
   a. Players have the opportunity to take a ball out of the game if they suggest a solution to the stated problem
7. The game ends when there is one person left.

OBJECTIVES:
- Allow the group to actively think about how our diet can be influenced by sustainability

NUMBER OF PLAYERS:
- Entire class of students

TIME:
- ~20 minutes

MATERIALS:
- 6 balls differing in size and material (Meat production, overfishing, food waste/food miles, plastic waste, water usage) that indicate stressors

DEBRIEF:

- Were there any "stressors" that surprised you?

Adapted from "SP Juggle" on https://www.climatecentre.org

FOOD INVESTIGATORS

FOOD CORNERS

INSTRUCTIONS:

1. Assign each corner of a room a different season (4 corners for the 4 seasons)
2. The instructor stands in the center and tells the students a type of food, then begins to count down from 10
3. The students go to the season (corner) that they believe that food belongs to
4. After the 10 seconds are up the instructor will reveal which categories are correct and those students will remain standing
5. If a student is incorrect they sit down but can help their classmates pick the correct season to stand in
6. Play until there is only one student remaining or if 10 foods have been asked

OBJECTIVES:

- Energize the group
- Allow the group to actively think about seasonal foods

NUMBER OF PLAYERS:

- Entire class of students

TIME:

- ~15 minutes

MATERIALS:

- Create signs that depict what season is a put them in each corner

DEBRIEF:

- What fruit did you have? Did you know what season it belonged to?
- Do you try to eat foods when they are in season? Why or why not?

FOOD INVESTIGATORS

MENU & MILES

INSTRUCTIONS:

1. Give students a "menu" with a variety of meals on it.
2. Have each student pick a meal from the menu.
3. Once each student has selected their meal, they will have to research how many food miles each ingredient is on the "foodmiles" website.
4. After researching each ingredient, each student will add up their total food mileage for their meal.
5. The students will then line up horizontally facing the instructor.
6. The instructor will call out distances in increasing increments and the students will take a step forward if their meal's food mileage is over these distances.

OBJECTIVES:

- Energize the group
- Allow students to think about the amount of miles their food travels

NUMBER OF PLAYERS:

- Group of 3-6 students

TIME:

- ~10 minutes

MATERIALS:

- Menus
- Access to https://www.foodmiles.com/

DEBRIEF:

- What do you think the term "Food Miles" means?
- What was your total food mileage?
  - Was it more or less than you expected?

FOOD INVESTIGATORS

LABEL LINE

INSTRUCTIONS:

1. Give each student in the class a label
2. Instruct them to make a line from least healthy to healthiest label based on a specific part of their label (i.e. sugar content, salt content, fat content)
a. Note: make sure the students are standing shoulder to shoulder, not back to front
3. After the students have finished, have the students read out their labels to check if the line is correct

OBJECTIVES:
- Energize the group
- Encourage the students to collaborate with each other
- Allow students to see more than just their own food label

NUMBER OF PLAYERS:
- Entire class of students

TIME:
- ~10 minutes

MATERIALS:
- Food labels

DEBRIEF:

- Were you in the right spot in line?
- Was your label high or low in line?
  - Did the information on your label shock you?

FOOD INVESTIGATORS

MIND MAP

INSTRUCTIONS:

1. Each student (or group of students) is given a piece of paper with the same word (or words) written on top
2. The task is to write as many words or phrases associated with the word as they can
3. The students are given a certain amount of time to complete this task
a. The amount of time is up to the teacher's discretion
4. After time is up, the students will come together as a class and share what words they have written and how they connect to each other
5. The goal is to have the most unique connections
a. This will inspire students to think further on what connections they can make between food and sustainability topics

OBJECTIVES:
- Activate people's brain power
- To learn from each other what topics they associate with a certain topic

NUMBER OF PLAYERS:
- Entire class

TIME:
- ~30 minutes

MATERIALS:
- Paper and pencils

DEBRIEF:

- How many connections did you come up with?
- Did any connections surprise you?
- What's the most unique connection that you/your group made?

FOOD INVESTIGATORS

SCRAP SORT

INSTRUCTIONS:

1. Laid out in front of the students are the Waste Tokens face down.
2. One by one the students take turns selecting a Waste Token.
3. The students then "feed" the bin by putting the tokens into bin that they believe is the correct match.
4. Students can help each other during this process.
5. The game is continued until all tokens are gone.
6. After the game a discussion is held.

OBJECTIVES:
- Strengthen ability to categorize different types of waste
- Allow students to collaborate

NUMBER OF PLAYERS:
- Group of 2-4 students

TIME:
- ~30 minutes

MATERIALS:
- Different waste items printed out and cut into the shape of tokens
- Bins with a slit that the tokens can fit into that represent each waste category

DEBRIEF:

- What types of waste belong to each category
- Do you see/use these items in your everyday lives

Adapted from "Hungry Bins" by Adventerra Games

FOOD INVESTIGATORS

FOOD CONNECTIONS

INSTRUCTIONS:

1. Gather students either around a computer or projector screen.
2. Explain to students the premise of the game is to select four words that would belong to the same category for each of the four categories and that they are allowed three mistakes.
3. Allow students to work together to figure out the which words they believe belong together.
4. When in agreement, select the four words and hit submit.
a. If correct, continue with this process for the next category.
b. If incorrect, have the students try again to either replace one of the words or go for a different category.
6. Play until the students get all the four categories or they use all their mistakes
7. Have a discussion about each category and their words after the game.

OBJECTIVES:
- Activate people's brain power
- Get students to work together to think about different food and environmental connections

NUMBER OF PLAYERS:
- Entire class or small groups

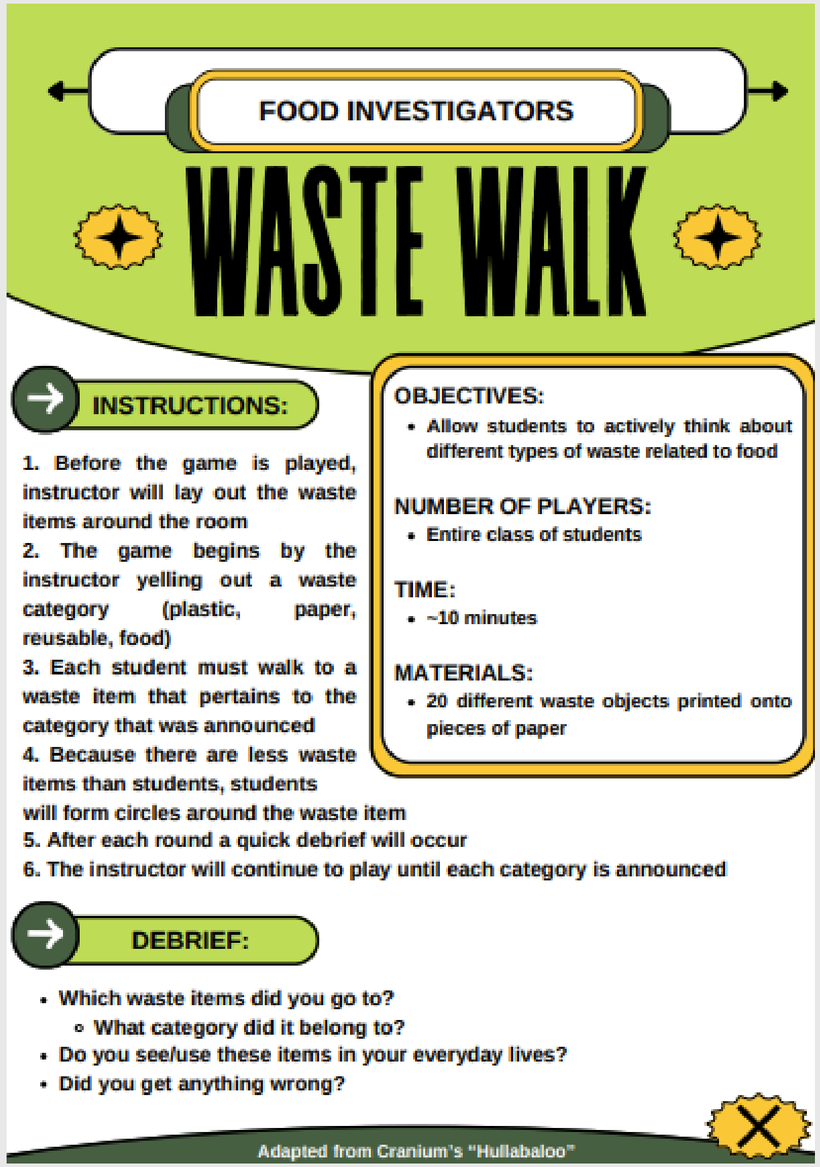
TIME:
- ~10 minutes

MATERIALS:
- Electronic device
- Game links

DEBRIEF:

- What does each category mean?
- Why do these words belong in each category?
- How many mistakes did you make?

Adapted from the New York Times game "Connections"



Appendix I: Student Feedback Form

Name	Description	Active Learning Strategy (Table 1)	Meets Active Learning Criteria (Table 2)
Name and Favorite Food	An introductory game that is played by the whole class, where each student states their name and favorite food.	Discussion-based: The students are all required to participate by speaking about themselves.	Reflection: The students synthesize information they heard from their classmates and present it in broad themes.
Take Place	The facilitator reads a prompt and students must move to the side of the room corresponding to "Agree," "Disagree," or "Unsure."	Physical Activity: The students have to show their opinions through movement. Discussion-based: The students are tasked to defend their positions.	Critical Thinking and Application: The students use their real-world knowledge and experiences to make conclusions about the relationship between climate change, diet, and health.
Find Someone Who	The students interview other students based on statements regarding various food or environmental choices.	Experiential: The students learn about the dietary habits of others by performing interviews themselves. Physical Activity: The students have to walk around the room and interact with their classmates	Engagement and Autonomy: Students do not need to be under supervision or facilitated in order to find answers to the questions they were given.

Labels Under the Microscope	PowerPoint presentation on nutrition labels, ingredients, sugar content, fat content, salt content, and food miles.	N/A: The KPE's original labels presentation had a traditional lecture format	N/A
Five Groups	Groups watch a video and read a presentation regarding a different food or environmental topic and present what they learned to the class.	Peer-teaching: the students are tasked to present the information that they have learned to their classmates Collaboration: the students have to work as a team to prepare their presentations	Reflection: students reflect on the videos they watched or the activity they did. They then share this with the class in their presentation