# Apply Augmented Reality on Constructing Children's Cognition of Foods and Agriculture -A Case of Seafood

## Yu-Chin Hsiao

Abstract—As the issues of nature conservation and environmental protection are spiraling, it seems necessary to take root in children for the cognition of ecological chain and food chain. Recently, Food and Agriculture Education are promoted to increase and strengthen conceptions of foods, ecology, production etc. Different from traditional instruction for marine organism, for example, narrators explain in the maritime museum, Food and Agriculture Education emphasizes the experiences. This study attempts to create a market seafood based augmented reality application which can be used in smart phone and template. Via the camera to capture the seafood image user wants to explore, the seafood models, its related information will be presented. The seafood models are created by Fish Database of Taiwan, Academia Sinica.

*Index Terms*—Augmented Reality, Food and Agriculture Education, Marine Organisms, Marine Ecology

#### I. INTRODUCTION

#### 1.1 Background and motivation

Whereas the climate, ecology, agricultural food, and diet have become global issues, accompanied with the long-term problem of food safety, the requirement of food health has gradually increased. More and more people turn to promoting the implementation of friendly environmental farming, sustainable food and even food and farming education, so people may set up awareness of food and community, agriculture, land and ecology. However, "food and farming education" is not a new educational idea, but a thought and concept that has already existed in our life but has not been integrated and implemented. It is an experience process of interacting with food, animals, plants, the natural environment, farmers, food workers, and related actors, understanding local agriculture, proper diet, the culture of both, and the relevance of agriculture, diet and the ecological environment [1].

In recent years, food and farming education has gradually been germinated in the curriculum of elementary and junior high schools, and the idea transmission has been performed by the form of experience, implementation and course presentation. The current information shows that the teaching content still mainly focuses on the teaching of planting and farming experience, but the food of animals is not emphasized; and due to the difficulty of keeping fresh of the marine animals, it is more difficult to teach the related food and ecological knowledge by experiencing firsthand in the teaching field. At present, the trend of action learning has expanded to the various levels; this Research provides an application, which may allow children to operate by themselves through the teacher's off-campus teaching or the guide of family senior members. Children may learn by parent-child learning to lead them into traditional markets or supermarkets to learn directly about the identification and related ecological knowledge of marine animals such as seafood. By photographic scanning of a tablet (or smart phone), the application corresponds to the image of the vendor or the seafood on the shelf, the related knowledge of marine life and ecology may be shown on the screen in augmented reality. In addition, it also supplements by the text description provided in the interface, and the game options, which allows children to learn more about the habits of the creature.

This Research is expected to set up a Taiwanese "Seafood Guide"[2] in the Taiwan Fish Database through the Academia Sinica, constructs a map storage of the marine organisms provided, designs an interactive script for the ecological knowledge related to the project, and stores all the data in a database for learners to use. Users may take a complete image of the marine organisms by a smart phone or a tablet camera, and compares the image with the image database set up previously for identification. Finally, activate the information of the augmented reality to the device held by the users based on the image taken by the users and the comparison result, which may effectively enhancing the learning intention and effect of the learners.

#### 1.2 Purpose

The main purpose of this research is to construct an application program for the augmented reality of merchant seafood ingredients, thereby enhancing the students' awareness of seafood ingredients, natural environment and ecology, and eating methods.

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Overall, the objectives of this research include:

- 1) the discussion of the general situation of students' cognition of marine in food and farming education.
- 2) an interactive learning application which uses augmented reality technology to construct merchant seafood ingredients.
- the discussion of the cognitive and effectiveness of the students after experiencing augmented reality interactive learning.

II. RESEARCH DESIGN

## The research flow of the study is shown as below (Fig. 1).



Fig. 1. Research and development process chart

## 2.1 Application, Research and Development of Technology

Through the AndroidStudio development system, we designed a complete set of apps, combining image recognition, seafood database and small games to allow users to know seafood and then enhance the awareness by recognition and small games. The application development of the application Vuforia is to create a system with identification technology. In the process of experience, the learners would be interested and immersed in the joy of learning.

#### 2.2 Development process

- 1) In Phrase 1, we took the Taiwan " Seafood Guide" set up by the Academia Sinica in the Taiwan Fish Database as the database content to construct drawing patterns of the marine organisms provided, and design to plan the interactive scripts for the related ecological knowledge, and store all the data in a database for learners to use. Users may take a complete image of the marine organisms with a smart phone or a tablet camera, and compare the image with the image database established previously for identification. At last, activate the information of augmented reality to the user's device according to the comparison results of the image taken by the users to enhance the learner's willingness and learning effect effectively. Meanwhile, the application development and production shall be started, and test the identification function by sample production.
- 2) Phrase 2 "Interactive Content Project": Conduct the interactive script writing, story board and interactive game design according to Phrase 1 content information collection analysis results.
- 3) Phrase 3 "Production and Development of Application ": Perform the film and game production of interactive content, UI/UX design, importing text images and integrated development for the story content developed in Phrase 2.

4) Phase 4 "Testing, Modification and Optimization of Application ":

Perform the application use assessment for children in the intermediate grade.

## 2.3 Development tools and software:

- Android Studio—Android Studio is an integrated development environment for Android platform development program. It integrates all the tools required to develop Android applications, allowing developers to use these functions specifically designed for Android to quickly develop and test Android applications. It may be executed on Windows, OS X and Linux platforms as well.
- 2) Visual Code—Visual Code is developed by Microsoft, supports Windows, Linux, and mac OS systems and open the code editor for source code.
- 3) Flask—Flask is a lightweight web application framework written in Python, which is based on the Werkzeug WSGI toolkit and the Jinja2 template engine.
- 4) ResNet—Residual Network [3] referred to as ResNet which is a network architecture jointly proposed by He, Kai-Ming, Chang, Xiang-Yu, Ren, Shao-Qing and Sun, Jian in 2015.
- 5) Image processing, sound production and recording, code writing - Photoshop, Illustrator, Premiere, Aftereffect, Audacity, Visual Studio Community.
- 6) Augmented Reality Development Software—Vuforia is a software providing good augmented reality development tool for mobile devices (Android/iOS). Besides supporting iOS and Android SDK, it also supports the game engine Unity editor.

#### III. RESEARCH RESULT

This research produces augmented reality application of Taiwan Seafood Fish-eating culture, and there are some snapshots of its interface as tabbelow (Fig. 2 and 3):



Fig. 2. Taiwan Seafood Fish-eating culture-Application Interface

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Fig. 3. Taiwan Seafood Fish-eating culture-Application Interface

#### 3.1 APP Usability Assessment

#### 1) Application Interface Criteria Assessment

There are 14 questions in the questionnaire. The evaluation criteria is based on the four-point scale, which mainly expected that the students in the intermediate grade would be able to check the answering options more easily. It is evaluated by score 1 point (strongly disagree)  $\sim$  4 points (strongly agree), and the descriptive statistics results are shown in Table I.

No.	Question	Number of	Average	Standard Deviation
		Samples		
Q1.	The information displayed by the app is easy to read.	40	3.875	0.334932
Q 2.	The buttons inside the app are easy to understand.	40	3.6	0.7779
Q 3.	The content presented in the app is easy to browse.	40	3.8	0.464095
Q 4.	The visual experience of the app interface is aesthetic.	40	3.6	0.744208
Q 5.	The overall system feedback and recognition of the app is fast.	40	3.475	0.986771
Q 6.	The interface operation of the app is easy to learn.	40	3.675	0.525625

Q 7.	The overall use experience of the App is satisfactory.	40	3.75	0.493548
Q 8.	Through this app, I can increase the attention of your learning content.	40	3.825	0.384808
Q 9.	Through this app, I can learn more knowledge related to fish.	40	3.575	0.635993
Q 10.	Through this app, I will enhance my impression of the edible classification of fish (how to eat fish correctly).	40	3.775	0.576795
Q 11.	Through this app, I can deepen the related knowledge about fish food culture (how fish is classified, how to cook, etc.).	40	3.6	0.632456
Q 12.	Through this app, it makes me feel more responsible for marine environmental conservation.	40	3.275	1.109111
Q 13.	The game content of the app is interesting.	40	3.725	0.554122
Q 14.	If the APP is available for download, I am willing to share it with my friends.	40	3.55	0.845804

## 2) Independent sample t verification

In order to test whether the respondents of different background attributes may differ in the application interface usage scores, this research used independent sample t-test to discuss the difference in score in terms of their gender, grades(3 and 4) and the progress and regression of their grades before and after using the App. In order to understand further the influencing factors between the application and the respondents, the statistics and independent sample t-tests are shown respectively in Tables II and III. The description of the significant variables is as follows:

In Question 5 of the questionnaire "The overall system feedback and recognition of the app is fast", which is significant-significance (0.024>) in the male-female grouping. However, the score of the boys is 3.9 on this question and the girls still scores 3.5 points on the question. The scores are all close to satisfactory, but there is still significant difference between the two. In the classroom, we observed that the boys are braver to try in the operating program, and actively or easily click the various button

functions, so they may be faster than the girl in the recognition of the system feedback. (Table II)

Tuble II Statistics on gender and valuetes							
NT.	Question	Variables	Number of	Average	Standard		
INO.			Samples		Deviation		
05	The game content of the app is interesting.	Male	21	3.8571	.35857		
C.		Female	19	3.4737	.61178		

Table II Statistics on gender and variables

No.	Levene -test		t-test	
	F-test	Significance	Degree of freedom	Two-Tailed Test
Q5	16.337	.000	28.454	.024

In Question 11 of the questionnaire "Through this app, I can deepen the related knowledge about fish food culture (how fish is classified, how to cook, etc.", it is significant-significance (0.021>) in the 3rd and 4th grades, 3.7 for the 4th grade, and 3.0 for the 3rd grade. In accordance with the classroom observations and interviews, we may know that the difference may be related to the difference between their literacy and comprehension abilities. Students in the third grade still need some phonetic symbol to assist, and their literacy rate is lower than that of the fourth-grade students as well. The same situation happens in the comprehension and expression abilities of the words and sentences. In addition, In the group of progress and regression of their grades before and after using the App, it also contains a high significance (0.006>) in this question, the progress group got 3.8, and the regression group got 3.0. The absorption of the knowledge related to the fish food culture is positively correlated with their performance. (Table III)

			0		
NT	Question	Variables	Number of	Average	Standard
NO.			Samples	-	Deviation
Q11.	Through this app, I can deepen the related knowledge about fish	3rd grades,	23	2.9565	1.26053
	food culture (how fish is classified, how to cook, etc.).	4th grade	17	3.7059	.68599
Q13	The game content of the app is interesting.	3rd grades,	23	3.3043	1.01957
		4th grade	17	3.8824	.33211

Table III Statistics on the criteria and grade variables

No.	Levene -test		t-test		
	F-test	Significance	Degree of freedom	Two-Tailed	
		-	-	Test	
Q11	13.216	.001	35.357	.021	
Q13	20.497	.000	27.977	.017	

In Question 13 of the questionnaire "The game content of the APP is interesting" the significance is (0.017>), the grade 4 got 3.9, the grade 3 got 3.3. Since the scores are close to satisfaction, we observed and interviewed the two groups of respondents and found that they were mostly interested in the game. We speculated from the interview feedback that the students in the 4th grade may get into the game part more, and most of them agree with the games in their learning. For some of the students in the third grade have insufficient time

allocation for the game, and expect more plural content, so there is a gap. (Table  $\mathrm{IV})$ 

Table IV Statistics on criteria and score variables

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Na	Question	Variables	Number of	Average	Standard	
INO.			Samples		Deviation	
Q11.	Through this app, I can	Progress	25	2.9600	1.24097	
	deepen the related	group				
	knowledge about fish					
	food culture (how fish	Regression	15	3.8000	.56061	
	is classified, how to	group				
	cook. etc.).					

No.	Leven	e -test	t-test	
	F-test	Significance	Degree of freedom	Two-Tailed
				Test
Q11	20.173	.000	35.969	.006

## 3) Satisfaction assessment of application interface criteria assessment

In the satisfaction assessment of Interface criteria assessment, Efficacy, Learnability and Satisfaction of this application obtained higher scores. The details are shown as Table V.

Table V Satisfaction of	f Application	Interface	Criteria .	Assessment
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	atistaction	ог дррп	cation interface efficita Assess	ment
Range	Themes	No.	Question	Satisfac
	number			tion
Interaction	4	Q1.	The information displayed	100
Interface			by the app is easy to read.	
Charisma		Q 2.	The buttons inside the app	90.24
			are easy to understand.	
		Q 3.	The content presented in the	95.12
			app is easy to browse.	
		Q 4.	The visual experience of the	87.80
			app interface is aesthetic.	
Efficacy	1	Q 5.	The overall system	95.12
			feedback and recognition of	
			the app is fast.	
Learnability	1	Q 6.	The interface operation of	95.12
			the app is easy to learn.	
Satisfaction	1	Q 7.	The overall use experience	97.56
			of the App is satisfactory.	
Effectiveness	5	Q 8.	Through this app, I can	90.24
			increase the attention of	
			your learning content.	
		Q 9.	Through this app, I can	95.12
			learn more knowledge	
			related to fish.	
		Q10.	Through this app, I will	90.24
			enhance my impression of	
			the edible classification of	
			fish (how to eat fish	
			correctly).	
		Q11.	Through this app, I can	73.17
			deepen the related	
			knowledge about fish food	
			culture (how fish is	
			classified, how to cook,	
			etc.).	
		Q12.	Through this app, it makes	92.68
			me feel more responsible	
			for marine environmental	
			conservation.	
Sharing	2	Q13.	The game content of the app	85.37
			is interesting.	
		Q14.	If the APP is available for	85.37
			download, I am willing to	
			share it with my friends.	

#### 3.2 Result of Interview Analysis

In the interview feedback, we got some ideas from the students, which may be summarized as follows:

1) The assistance of application in teaching

Many respondents thought that teaching using APP is more interesting, fun and clear. They found that the classification and description of seafood in the APP is clearer, and the content is more complete and more aesthetic. Further, they understand the image and appearance of the sea fish and whether some fish is recommended to eat carefully while avoiding eating some other fish and they have more time to read and observe, which enhances the understanding of fish, and makes stronger impressions and deeper memories. Some of the respondents even expressed that they have a sense of duty to protect the ocean.

2) The help of game in teaching

Many respondents have higher interest in games. They said that it is relaxing when playing games, and it is a good learning way to understand fish by games. Moreover, there are some respondents think that the game makes them learn the most, and the most impressive was to earn a lot of new knowledge in a short time.

3) Improving learning attention

The respondents presented highly attention when using the app in in the tablet, and they expressed that it is easier to focus on learning through the app.

#### IV. CONCLUSION

The research results may be discussed in two levels of technological development and education grounded; in the part of technology development, there are not many related augmented reality applications in marine organisms or merchant seafood. The augmented reality application developed by this research institute shall be able to fill this gap effectively. In terms of the application content, besides the relevant knowledge and software technology, whereas the fact that most of the academic application technology level in the past is obviously more important than the interface and visual design, this research focuses more on the interactive aesthetic design and expects to improve users' willingness to use and learning results more effectively. According to the research results, in order to improve the description of the text content, this research add more graphic descriptions on the classification of fish food culture, cooking and other knowledge descriptions, so the students with different reading levels may be able to understand more easily. In addition, we will also develop games related to the theme of seafood consumption and conservation for the students to have corresponding learning meaning for different teaching objectives and enhance their interest in learning.

Overall, there is still a lack of effective integration and implementation in the education system. We have to enhance the learning willingness of elementary school students by the lively augmented reality application with innovative technology to make food and farming education implemented in lower grade and make the students become interested in and care about the topics such as ecology, environment and diet during their elementary school life. Therefore, this research provides a development process model of teaching-based augmented reality application for the future educational software developers as references.

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Date of modification: 2021/07/06

Brief description of the changes: A revision of format in "2.3 Development tools and software" point 5, 6 had been made.