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Effects of University Students' Perceived Food Literacy on Ecological Eating Behavior towards Sustainability

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Abstract: Due to the COVID-19 pandemic and industrialized food systems, people's eating behavior has become seriously restricted. Especially, university students have started to overly depend on processed foods and carnivorous diets, and it places a huge burden on society by inducing the deterioration of health and environmental sustainability. Therefore, this study was undertaken to examine the effects of university students' perceived food literacy on ecological eating behavior towards sustainability. A total of 395 university students in South Korea participated in this research. First, students' food literacy components, which are reading labels and budgeting, healthy snack styles, healthy food stockpiling and resilience and resistance, exert positive influences on ecological eating behavior; second, the other two components, which are food preparation skills and social and conscious eating, have no positive impact on ecological eating behavior. Finally, the influences of food literacy on ecological behavior are significantly moderated by gender differences. This suggests that strengthening university students' food literacy through education is necessary to promote ecological eating behaviors and advance the development of sustainable society.

Keywords: food literacy; ecological eating behavior; sustainability; university students

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1. Introduction

On account of the COVID-19 pandemic, people's lifestyles have changed to untact ways [1–3], and the constraint on outside activities, telecommuting and non-face-to-face education have disturbed opportunities for working out regularly [4,5]. Accordingly, activity levels drastically decreased compared with the pre-COVID-19 era, and obesity became an emerging social problem throughout the world [6,7]. Moreover, today's industrialized food system allows people only restricted access to fresh and natural foods by narrowing their range of food environment [8,9]. It consequently makes people become increasingly dependent on ultraprocessed foods, convenience foods and delivery foods, which are usually energy-dense and nutrient-poor [10–12]. Furthermore, under the profound effect of mass media, people are easily exposed to stimulating food advertisements and untrustworthy food information [13,14]. These lifestyle changes and negative external influences are hindering people from navigating the healthy food-scape in a time of crisis [15–17], and it places a huge burden on society by inducing the deterioration of personal health and high health care costs [18,19].

Moreover, people's huge dependences on processed foods and carnivorous eating habits have potentially negative consequences on both personal health and environmental sustainability [20–22]. These types of diet patterns eventually threaten the ecosystem of food chains by increasing carbohydrate emission levels and harming biological diversities [23,24]. In addition, huge amounts of food waste and hazardous waste, discharged from ready meals and packaged foods, have deteriorated environmental pollution for the past decades [25,26]. Thus, today's food consumption patterns, which are typically disconnected from the social and environmental values, are considered as major obstacles to the practice of ecological eating behaviors

such as eating fresh and healthy foods, buying local foods, lessening meat consumption and reducing food waste [27,28]. It is apparent that immediate efforts need to be made to find a solution for these problems and to promote peoples' ecological eating behavior at national levels [27,29]. Under these circumstances, food literacy is in the spotlight as a cornerstone to solve these problems and motivate food system thinking with ecological eating behaviors. In this context, the concept of food literacy has recently come into the spotlight as a cornerstone of possible solutions to these food-related problems [18,30,31]. Food literacy is comprehensively defined as "the scaffolding that empowers individuals, households, communities or nations to protect diet quality through change and strengthen dietary resilience over time" [32]. Recently, this notion of food literacy has expanded from nutrition knowledge and health information to include ethical and environmental values, and it is regarded as a remarkable concept to promote people's food system thinking [33,34]. It turns out that people who reach a high level of food literacy endeavor to develop healthy eating habits and to practice ecological eating behaviors in their daily lives [7,8,16,21,23].

According to the previous studies, it is particularly important for university students to have ideal food literacy capabilities [16,35]. University years are generally considered as the first transition point to becoming an adult [36] since students begin to have autonomy in managing their own lifestyles, including lifelong eating habits [37,38]. However, today's university students tend to overconsume fast foods, ready-to-eat meals and sweetened beverages because of several environmental factors such as financial constraints, time pressure, lack of family support and insufficient experience in cooking healthy food [16,39,40]. If university students have a lack of understanding of food literacy, and depend excessively on limited and nutritionally inadequate diets as they do now, they will be exposed to both various adult diseases and catastrophic environmental crises over their lifespan by causing deleterious impacts on the modern food system [20,41–43]. They must attain a high level of proficiency in food literacy because their food literacy capabilities reinforce the formation of healthy eating habits, and it will ultimately guide them to the maintenance of a sustainable life in an ecologically safe food environment [44–47]. However, there has not been a direct food literacy research focusing on university students in South Korea. In particular, in-depth research on the correlation between university students' food literacy level and their ecological eating behavior is very scarce. Moreover, most of the research into food literacy has focused on constructing conceptual frameworks of food literacy or defining components of food literacy using qualitative research methods. No empirical research studies have been undertaken so far, and it is time to execute a quantitative study to measure the potential effectiveness of food literacy on ecological eating behavior. In other words, this empirical research is expected to provide reliable and valuable information and ultimately give greater direction to food-related educational interventions for students' ecological eating habits.

Therefore, this study investigates the current level of food literacy among university students by examining their food-related knowledge, skills and behaviors. It also explores associations between their food literacy and ecological eating behavior, and seeks to confirm a significant moderating effect of gender differences. The results of this study contribute to understanding the present food literacy level and eating behaviors of university students and developing effective improvement plans for their ecological eating behavior for a healthy future and a better world.

We summarize the main purposes of this study as follows:

(1) To analyze the importance of food literacy on university students and ecological behaviors for achieving a sustainable society.
(2) To analyze the effects of university students' perceived food literacy on ecological eating behavior towards sustainability.
(3) To analyze the moderating effect of gender differences on the relationships among all variables.

2. Theoretical Background and Research Hypothesis

2.1. Food Literacy

Food literacy emerged from the process of conceptualizing health literacy [48]. Nutbeam [49] explained health literacy not only in terms of nutrition considered in daily life but also in terms of personal autonomy related to overall well-being. Health literacy is also interpreted in a comprehensive range, including the application of personal, cognitive and social skills [49,50]. Although the concept of food literacy was derived with a purpose of health promotion at first, it gradually has expanded the scope of various food-literacy contexts such as education, communication and social and environmental aspects of eating behaviors [11,51]. Food literacy was recently interpreted in different ways by each research discipline [52,53], and its dimensions appear at multilayered levels, depending on the contexts of studies [32,50]. Kolasa et al. [54] defined food literacy as "the ability to promote health as well as basic personal competencies to acquire, interpret, and understand food and nutritional information and services". Stinson [55] described it as "the ability to deeply understand the complex environmental and social factors of foods in daily life". In addition, Vidgen and Gallegos [33] described it as "a set of planning, management, selection, preparation, and intake and everyday practicalities associated with navigating the food system and using it to ensure regular food intake consistent with nutrition recommendations". Cullen et al. [20] described it as "the ability to develop into a positive interrelationship with food as well as individual food skills and behaviors within a complex food system", and 'the ability to make sustainable and correct decisions taking into account various factors of food system". All the above definitions imply that food literacy is effective at describing the nexus between various elements of the food system and people because it explains the interrelationship of food knowledge, skills and behaviors for the purpose of developing healthy eating at both the micro and macro levels.

Measurement methods of food literacy level also have developed in diverse ways over the time [50]. For example, Krause et al. [56] developed a short food literacy questionnaire (SFLQ), which is focused on exploring individual skills for choosing healthy food in a practical way. Na and Cho [42] tried to develop a food literacy measurement tool, customized for young Korean adults, and Park et al. [57] developed a food literacy scale, which particularly focuses on the concept of sustainability. In addition, Doustmohammadian et al. [58] developed a scale for measuring food and nutrition literacy levels, especially for elementary school children. Amuta-Jimenez [59] focused on the development of food label literacy to find out the potential relationship between food label use and food choice. Although many food literacy measurement tools have been used to determine reliable components and specific dimensions of the food literacy concept, the self-perceived food literacy (SPFL) scale, which was developed by Poelman et al. [11], is universally used in examining young adults' food literacy capabilities by including a wide range of food knowledge, practical skills and social behaviors of eating healthy and sustainable food. Accordingly, the SPFL scale, which incorporates various facets of food literacy, is considered as one of the most effective approaches in addressing the complex characteristics of people's food-related abilities and eating behavior. Therefore, this study applies the SPFL scale to measure the overall food literacy of university students in South Korea and explores the mechanism of their ecological eating behaviors from multiple viewpoints.

2.2. Ecological Eating Behavior

Ecological eating behavior is generally defined as "people's conscious eating habit or pattern that minimizes the destruction of natural resources and reduces the emissions of waste and pollutants" [27]. The main reasons why people practice ecological eating behavior are not only for protecting their own health and safe food systems but also for ultimately reaching global sustainability goals for the needs of future generations [60,61]. Therefore, the notion of ecological eating behavior is often compatible with proenvironmental or sustainable food consumption, and it is emerging as a significant topic since people have started to realize that environmental issues are directly related to human survival [62,63].

Major examples of ecological eating behavior include increasing consumption of fresh and natural foods such as plant-based and organic food, or preferring local and seasonal products, while reducing meat consumption and food waste [28,64]. In addition, participating food-related campaigns for environment protection or food sovereignty, proposing food security policies and actively encouraging others to practice sustainable food consumption are prime examples of ecological eating behavior from a macroscopic view [64,65]. As all these examples suggest, the concept of ecological eating behavior can be analyzed from comprehensive perspectives, beginning from the individual level, up to the community and global levels. According to Tobler et al. [28], people's eating behaviors are closely related with various internal and external factors in their daily lives. Especially, people's ethical and environmental motivations exert strong influences on their behavioral intentions of ecological food consumption. Moreover, Smith and Paladino [66] stated that sustainable food markets are constantly expanding throughout the world and people are showing greater interests in this type of food than ever before. They found out that the high levels of consumers' knowledge, subjective norms and environmental concerns lead to positive attitudes on sustainable food. Furthermore, Monroe et al. [27] discovered that the ecological eating intervention, which was the educational program for enhancing students' healthy and proenvironmental food consumption, was very effective in both broadening students' food knowledge and promoting their ecological eating behaviors in practical ways.

2.3. Relationships among the Constructs

The majority of previous studies argue that food literacy is positively related to healthy and sustainable eating practice and negatively related to unhealthy food intake [9,12,33,50]. This suggests that people who have a high level of food literacy are generally competent to practice ecological eating behaviors based on their extraordinary skills in handling food and extensive knowledge of food-related issues [22,23,32,44]. Accordingly, food literacy is expected to be a prime mover in cultivating people's power of understanding food and ultimately to be a powerful spur to make people practice ecological eating behaviors in the long run [9,20,21,23].

2.3.1. Relationship between Food Preparation Skills and Ecological Eating Behavior

Researchers in earlier studies have identified that there are intimate connections between various components of food literacy and ecological eating behaviors [7,13,16,21]. In particular, food preparation skills such as handling basic ingredients, managing kitchen equipment and following recipes are regarded as essential components of food literacy [31], and these skills have a lot of influences on sustainable healthy diets. Perry et al. [50] explained that the food skills of food purchasing, preparation and handling are closely related to healthy food intake. Thomas et al. [22] also noted that basic kitchen skills such as chopping, mixing and preparing meals increase accessibility to healthy food. In addition, Na and Cho [42] argued that food preparation skills should be emphasized as a vital element of food literacy because it enhances healthy eating habits and positive attitudes toward sustainable foods. Slater et al. [21] also confirmed the positive relationship between food preparation skills and sustainable eating behaviors for healthy food systems. Park et al. [57] argued that preparing delicious and safe meals through cooking skills is deeply tied up with other interactive and critical literacy dimensions, and the literacy mechanisms need to be carefully interpreted in sustainable aspects for healthy food systems. Based on these arguments, this study proposes the following hypothesis to examine the impact of food preparation skills on ecological eating behavior.

Hypothesis 1 (H1). *Food preparation skills positively influence ecological eating behavior*.

2.3.2. Relationship between Reading Labels and Budgeting and Ecological Eating Behavior

Food knowledge, regarding food origin, nutrition label, health information and budgeting, has been a necessary key component for food literacy among many researchers [12]. According to Colatruglio and Slater [67], basic food knowledge makes people interpret food labels and packaging information correctly, and efficient food expenditure skills also helps people select healthy foods within a budget. Perry et al. [50] explained that consumers can accept nutrition information by reading the nutrition facts label on foods, and it informs rational decisions for healthy food intake. Na and Cho [42] suggested that understanding nutrition labels and wise food budget planning are significant food literacy competencies for choosing sustainable healthy meals. All these previous studies suggest that people who read food labels correctly and plan proper food budgets can build healthy food environments into their lifestyles. Based on these previous studies' findings, this study assumed that students' preliminary food knowledge, which is reading labels and budgeting, would effectively increase their ecological eating behavior.

Hypothesis 2 (H2). *Reading labels and budgeting positively influence ecological eating behavior*.

2.3.3. Relationships between Healthy Snack Styles, Healthy Food Stockpiling and Ecological Eating Behavior

Understanding the benefits gained from healthier food choices, such as enjoying healthy snacks and stockpiling fresh ingredients, provides people with an opportunity to retain better health [12]. Truman et al. [68] and Vidgen and Gallegos [33] emphasized that not only people's food-related knowledge exerts a tremendous influence on their diet and health, but their real choice behavior and power of execution are also necessary requisites for achieving healthy eating habits. Perry et al. [50] and Rosas et al. [69] noted that selection and acquisition of healthy foods are two of the most primary dimensions of food literacy because these capabilities are intimately linked with people's daily diet patterns in a practical way. Vidgen [12] also confirmed that people who have enhanced food literacy tend to stockpile minimally processed and healthy foods, and this conscious choice of sustainable foods ultimately affects the physical and mental wellbeing in their daily routine. Based on these studies' results, this study presents the following hypotheses to examine the impact of food selection on ecological eating behavior.

Hypothesis 3 (H3). *Healthy snack styles positively influence ecological eating behavior*.

Hypothesis 4 (H4). *Healthy food stockpiling positively influences ecological eating behavior*.

2.3.4. Relationship between Resilience and Resistance and Ecological Eating Behavior

Meanwhile, resilience and resistance, another important food literacy value, has received great attention among scholars lately. Na and Cho [42] emphasized that it is important to recover resilience and self-regulation from emotional turbulence when people crave unhealthy junk food under pressure. Poelman et al. [11] argued that young adults, with higher levels of self-control and discipline in the aspect of food literacy, can resist food temptation easily and make the choice of healthy eating behaviors steadily. Perry et al. [50] and Thomas et al. [22] also explained that people who have a high level of self-efficacy are confident in achieving healthy and sustainable eating lifestyles, and they readily overcome various obstacles for the preservation of a healthy diet. In addition, Malan [16] and Brug [70] argued that people who are confident in their healthy eating ability are more active and supportive in protecting the environment. Based on these arguments, this study proposes the following hypothesis to examine the impact of resilience and resistance on ecological eating behavior.

Hypothesis 5 (H5). *Resilience and Resistance positively influence ecological eating behavior*.

2.3.5. Relationship between Social and Conscious Eating and Ecological Eating Behavior

According to Truman et al. [68] and Cullen et al. [20], social and conscious eating behavior is an important aspect of food literacy by reflecting one's culture and values toward sustainable food and eating practices. Thomas et al. [22] noted that people take a positive attitude toward healthy food by cooking fresh ingredients and enjoying tasting meals with their friends. Slater et al. [21] also noted that people are able to cultivate their relational capabilities through group dining with active communication, and this experience encourages people to recognize the importance of an interdependent world. Perry et al. [50] argued that people build intimacy and strengthen bonds with others by preparing the meal and experiencing various cultures through food. Furthermore, Colatruglio and Slater [67] and Vidgen and Gallegos [33] proposed frameworks which delineate close relationships between food literacy and food-related outcomes such as social connectedness and food security. It indicates that these aspects of food literacy exert powerful socio-cultural influence on eating behavior. Based on these previous studies, this study assumed that social and conscious eating would exert significant influence on ecological eating behavior.

Hypothesis 6 (H6). *Social and conscious eating positively influence ecological eating behavior*.

2.3.6. Moderating Role of Gender Differences

In much research related to health and food literacies, most women are interested in their appearance and weight control, and they have great interests in healthy diets to keep their weight down [71]. In addition, most food work in households are usually performed by women, and women are generally stereotyped as being "good with food" [12]. This socially constructed gender role makes women spend more time cooking nutritious meals to take care of their families' health [72,73]. These facts imply that women often tend to adhere to healthy eating plans and to have higher food literacy levels compared with men [12,74]. Krause et al. [56] argued that food literacy is expected to be higher among women and associated with higher levels of education. Sponslee et al. [74] also confirmed that women have higher self-perceived food literacy levels than men. Therefore, this study proposes the following hypothesis to examine the moderating effect of gender differences.

Hypothesis 7 (H7). *Gender moderates the effects of food literacy on ecological eating behavior*.

3. Research Methodology

3.1. Research Model

Based on the research hypotheses presented above, the research model for this study is developed as shown in Figure 1. The components of the self-perceived food literacy scale are the independent variables, and ecological eating behavior is a dependent variable. In addition, gender difference acts as a moderating variable in this study.

3.2. Sample and Data Collection

The population of this study was defined as university students in Seoul, South Korea. A preliminary survey was conducted one month before the main survey to correct unclear and ambiguous parts of the measurement items. The main survey was conducted in December 2021, and a total of 500 questionnaires were distributed through online survey websites and on-the-spot surveys at the universities. The researchers explained the purpose of study to the respondents and obtained consent from all the students. The survey was conducted by using a self-report method of the respondents by filling in the questionnaires themselves. Finally, 455 questionnaires were collected, and 395 were used for the final analysis by excluding the questionnaires not suitable for a double analysis.

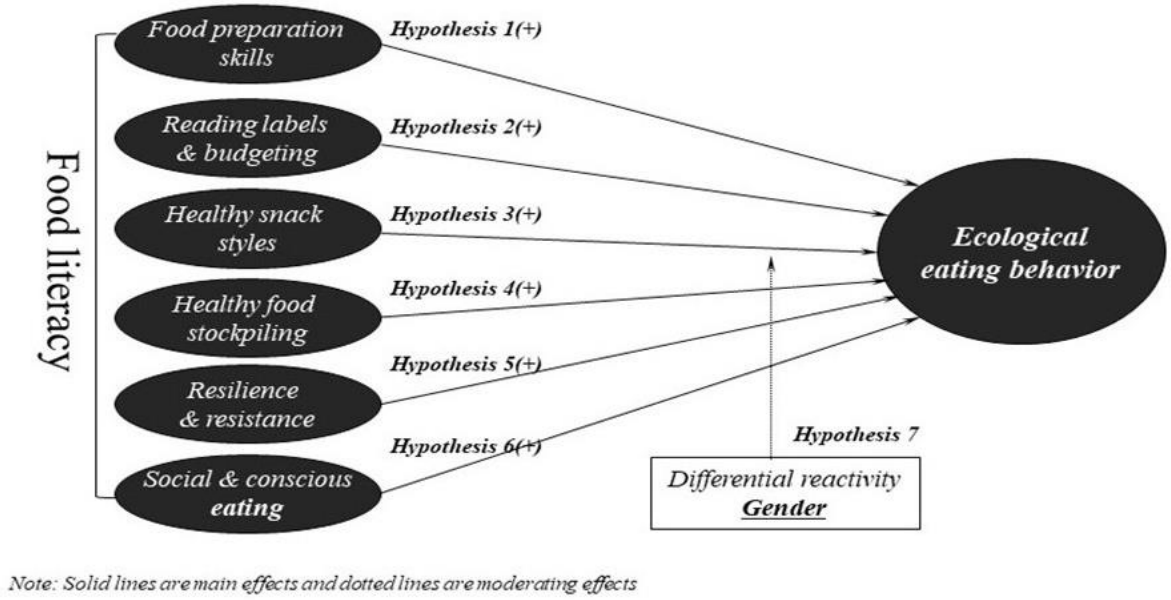

Figure 1. Research model.

3.3. Instrument Development

A survey questionnaire produced in English was translated into Korean as recommended by Brislin [75]. The items were rated on a 5-point Likert scale (1 = *strongly disagree*; 5 = *strongly agree*). The operational definition of each variable is provided in the Theoretical Background section, and the measurement items were as follows (See "The operational definition of each variable is provided in the Theoretical Background section"): The questionnaire was divided into three sections. The first part section measured the perceived food literacy levels based on the Self-Perceived Food Literacy scale (27 items) developed by Poelman et al. [11]. The second section about ecological eating included six items developed by Monroe et al. [27] and Tobler et al. [28]. The third section collected demographic information on gender, grade, education level and major. Male and female university students accounted for 41.8% and 52.8% of the participants, respectively. Senior students comprised the highest proportion (35.2%) and most participants (87.3%) were enrolled in four-year universities. Food and non-food-related majors accounted for 28.1% and 71.9%, respectively (Table 1).

Table 1. Profile of the sample (n = 395).

Characteristic	N	Percentage
Gender		
Male	165	41.8
Female	230	58.2
Grade		
Freshman	67	17.0
Sophomore	90	22.8
Junior	99	25.1
Senior	139	35.2
Education level		
Community college degree (2 years)	50	12.7
University degree (4 years)	345	87.3
Major		
Food-related major	111	28.1
Others	284	71.9

3.4. Data Analysis

The statistical analysis was performed using the SPSS 24.0 (IBM Corp., Armonk, NY, USA) and Amos 24.0 software (IBM Corp., Armonk, NY, USA). A frequency analysis was employed to investigate the sample's demographic characteristics, and confirmatory factor and reliability analyses were performed to assess the validity and reliability of the measurement variables. The study's hypotheses were tested by using a structural equation model, and the moderating effect of gender was assessed by using a multigroup analysis to examine gender-related differences.

4. Results

4.1. Measurement Model

A confirmatory factor analysis was performed to assess the validity of the collected variables before examining the developed theoretical model's causality, and Anderson and Gerbing's two-step approach was used [76]. As shown in Table 2, the standardized coefficients of all variables were at least 0.6, and composite construct reliability (0.795–0.888) and Cronbach's alpha (0.840–0.929) were at least 0.7. The chi-square value (1552.589), df (474), NFI (0.860), TLI (0.890), CFI (0.900) and RMSEA (0.080) also showed a good overall model fit [77]. The correlation analysis of the derived factors showed that both the hypotheses and the directions were consistent. The average variance extracted was 0.5 or higher, indicating discriminant validity (Table 3).

Table 2. Confirmatory factor analysis and reliability analysis.

Construct	Standardized Estimate	*t*-Value	CCR [a]	Cronbach's Alpha
Food Preparation Skills			0.888	0.924
FL_1 Are you able to prepare fresh vegetables in different ways? (cooking, steaming or stir frying, or in different dishes?)	0.816	fixed		
FL_2 Do you find it difficult to prepare a meal with more than five fresh ingredients?	0.851	20.106 ***		
FL_3 Are you able to alter a recipe yourself? For example, if you are missing one of the ingredients?	0.841	19.727 ***		
FL_4 Are you able to prepare fresh fish in different ways? (grilling, pan frying or stewing, or in different dishes?)	0.766	17.271 ***		
FL_5 Are you able to prepare a meal using fresh ingredients? So without pre-packed and processed foods?	0.880	21.128 ***		
FL_6 Are you able to see, smell or feel the quality of fresh foods? (meat, fish or fruit?)	0.781	17.755 ***		
Resilience and Resistance			0.856	0.894
FL_7 Are you able to say "no" to tasty snacks if you want to? (birthday treats or finger foods?)	0.739	fixed		
FL_8 Imagine that you are at a place where you see and smell tasty foods. Are you able to resist the temptation of buying them? (at the train station, the petrol station, or at the bakery?)	0.716	14.090 ***		
FL_9 Are you able to eat healthily when you feel stressed?	0.817	16.225 ***		
FL_{10} Do you choose foods that are in line with your mood? For example, if you are sad or annoyed?	0.693	13.604 ***		
FL_{11} Are you able to eat healthily if the situation deviates from a regular situation? For example, when you have unexpected guests or experience time pressure?	0.822	16.335 ***		
FL_{12} Do you eat the total contents of a bag or container of crisps, candies or cookies in one go?	0.797	15.805 ***		
Healthy Snack Styles			0.826	0.894
FL_{13} Do you take along healthy snacks for yourself when you are on the go? (fruit, cherry-tomatoes, nuts?)	0.844	fixed		
FL_{14} Do you eat vegetables as snacks?	0.891	22.717 ***		
FL_{15} Do you eat fruit as a snack?	0.747	17.235 ***		

Table 2. *Cont.*

Construct	Standardized Estimate	*t*-Value	CCR [a]	Cronbach's Alpha
FL_{16} Do you have healthy snacks for yourself in stock? (nuts, carrots, cherry tomatoes, or mini cucumbers?)	0.810	19.495 ***		
Social and Conscious Eating			0.795	0.840
FL_{17} Do you find it important to eat at the dinner table if you are eating with others?	0.901	fixed		
FL_{18} Do you find it important to eat dinner at the same time if you are with others?	0.916	23.520 ***		
FL_{19} Do you engage in any other activities while eating? (reading, working, or watching television?)	0.614	13.552 ***		
Healthy Food Stockpiling			0.858	0.929
FL_{20} Do you have 4 or more packages of crisps, pretzels or savory snacks in stock?	0.835	fixed		
FL_{21} Do you have 4 or more packages of candy, cookies or chocolate in stock?	0.869	21.711 ***		
FL_{22} Do you have 4 or more bottles of sugar sweetened beverages or lemonade with sugar in stock?	0.911	23.438 ***		
FL_{23} Do you have 4 or more cartons of fruit juice in stock?	0.880	22.167 ***		
Labels and Budgeting			0.820	0.880
FL_{24} Do you compare the calories, fat, sugar or salt content of different products?	0.752	fixed		
FL_{25} Do you check the nutritional labels of products for calories, fat, sugar or salt content?	0.782	15.693 ***		
FL_{26} Do you purchase healthy foods, even if they are a bit more expensive? (vegetables, fruit, or whole grain products?)	0.820	16.522 ***		
FL_{27} Do you purchase healthy food, even if you have limited money? (vegetables, fruit, or whole grain products?)	0.853	17.242 ***		
Ecological Eating Behavior			0.854	0.920
EEB_1 Buy regional food	0.857	fixed		
EEB_2 Buy organic food	0.887	23.558 ***		
EEB_3 Eat only seasonal fruits and vegetables	0.738	17.372 ***		
EEB_4 Eat less meat (maximum once or twice per week)	0.804	19.843 ***		
EEB_5 Avoid food products that were imported by airplane	0.860	22.288 ***		
EEB_6 Avoid food products with excessive packaging	0.711	16.430 ***		

Note: [a] CCR = composite construct reliability; standardized estimate = β-value; χ^2 = 1552.589 (df = 474) $p < 0.001$; χ^2/df = 3.276; normed fit index (NFI) = 0.860; Tucker–Lewis index (TLI) = 0.890; comparative fit index (CFI) = 0.900; root square error of approximation (RMSEA) = 0.080; *** $p < 0.001$.

Table 3. Means, standard deviations and correlation analyses.

Construct	1	2	3	4	5	6	7	AVE	Mean ± SD [a]
1. Food Preparation Skills	1							0.569	3.37 ± 1.07
2. Resilience and Resistance	0.619 **	1						0.500	3.72 ± 0.98
3. Healthy Snack Styles	0.508 **	0.738 **	1					0.545	2.95 ± 1.18
4. Social and Conscious Eating	0.455 **	0.596 **	0.567 **	1				0.571	3.45 ± 1.10
5. Healthy Food Stockpiling	0.357 **	0.561 **	0.764 **	0.536 **	1			0.602	2.73 ± 1.33
6. Label/Budgeting	0.560 **	0.756 **	0.783 **	0.666 **	0.625 **	1		0.533	3.38 ± 1.07
7. Ecological Eating Behavior	0.364 **	0.612 **	0.722 **	0.410 **	0.623 **	0.606 **	1	0.500	3.27 ± 1020

Note: [a] SD = standard deviation; AVE = average variance extracted; All variables were measured on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree), ** $p < 0.01$.

4.2. Research Hypothesis

Table 4 shows the results of the structural equation model analysis conducted to test the study's hypotheses. Given that chi-square is sensitive to the sample size, other fitness indices were also considered and found to be relatively reliable (chi-square = 2180.775, df = 486, TLI = 0.825, IFI = 0.840, CFI = 0.839 and RMSEA = 0.094) [76]. Among the

subfactors of food literacy, food preparation skills (beta = −0.059, *t*-value = −1.027 and $p > 0.05$) and social and conscious eating (beta = −0.088, *t*-value = −1.426 and $p > 0.05$) had no statistically significant positive effects on ecological eating behavior. Therefore, Hypotheses 1 and 6 were rejected. Conversely, label/budgeting (beta = 0.134, *t*-value = 2.213 and $p < 0.05$) had a positive effect. Therefore, Hypothesis 2 was accepted. This suggests that basic food knowledge obtained from labels or information about health increases the likelihood of healthy eating behavior. Likewise, healthy snack styles (beta = 0.477, *t*-value = 6.152 and $p < 0.001$) and healthy food stockpiling (beta = 0.198, *t*-value = 2.645 and $p < 0.01$) had significant positive effects on ecological eating behavior. Accordingly, Hypotheses 3 and 4 were accepted. This result suggests that enjoying healthy snacks and storing beneficial ingredients help to maintain good health, which eventually leads to ecological eating behavior. Resilience and resistance (beta = 0.232, *t*-value = 3.913 and $p < 0.001$) also positively influenced ecological eating behavior. Thus, Hypothesis 5 was accepted. This finding indicates that a higher level of self-control and resilience can lead to a stronger tendency to avoid harmful food, thereby reinforcing healthy diet behaviors. To test Hypothesis 7, according to which the positive effect of food literacy on ecological eating behavior is moderated by gender, a comparative analysis of unconstrained and constrained models was performed (Table 5) by dividing the respondents into two groups based on gender. The results show no significant gender-related differences in the effect of food literacy on ecological eating behavior. Thus, Hypothesis 7 was rejected. Nevertheless, women exhibited relatively greater resilience and resistance than men. This indicates that female university students with high self-control and resilience are more strongly inclined toward ecological eating behavior. This is partly consistent with previous studies [72,74] reporting that a higher level of food literacy is associated with a higher likelihood of healthy diet habits.

Table 4. Structural parameter estimates.

Hypothesized Path (Stated as Alternative Hypothesis)	Standardized Path Coefficients	*t*-Value	Results
H1: Food Preparation Skills → Ecological Eating Behavior	−0.059	−1.027 ^{ns}	Not supported
H2: Label/Budgeting → Ecological Eating Behavior	0.134	2.213 *	Supported
H3: Healthy Snack Styles → Ecological Eating Behavior	0.477	6.152 ***	Supported
H4: Healthy Food Stockpiling → Ecological Eating Behavior	0.198	2.645 **	Supported
H5: Resilience and Resistance → Ecological Eating Behavior	0.232	3.913 ***	Supported
H6: Social and Conscious Eating → Ecological Eating Behavior	−0.088	−1.426 ^{ns}	Not supported
Goodness-of-fit statistics	$\chi^2_{(486)} = 2180.775$ ($p < 0.001$) TLI = 0.825 IFI = 0.840 CFI = 0.839 RMSEA = 0.094		

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, ^{ns} not significant; TLI = Tucker–Lewis index; IFI = incremental fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation.

Table 5. Moderating effects on gender.

	Male (N = 165)		Female (N = 230)		Unconstrained Model Chi-Square (df = 972)	Constrained Model Chi-Square (df = 973)	$\Delta\chi^2$ (df = 1)
	Standardized Coefficients	*t*-Value	Standardized Coefficients	*t*-Value			
H7a: Food Preparation Skills → EEB	−0.103	−1.368 ^{ns}	−0.082	−1.014 ^{ns}	2772.847	2772.875	0.028
H7b: Resilience and Resistance → EEB	0.109	1.403 ^{ns}	0.358	4.212 ***	2772.847	2775.623	2.776
H7c: Healthy Snack Styles → EEB	0.581	5.802 ***	0.413	3.604 ***	2772.847	2774.688	1.841
H7d: Social and Conscious Eating → EEB	−0.113	−1.172 ^{ns}	−0.052	−0.664 ^{ns}	2772.847	2773.106	0.259
H7e: Healthy Food Stockpiling → EEB	0.069	0.703 ^{ns}	0.177	2.212 *	2772.847	2773.066	0.219
H7f: Label/Budgeting → EEB	0.237	2.606 **	0.139	1.240 ^{ns}	2772.847	2773.322	0.475

Note: CFI = 0.832; IFI = 0.833; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, ^{ns} not significant.

5. Discussion and Implications

5.1. Conclusions and Discussion

The growing interest in food as an important aspect of health has also increased the importance of food literacy on both individual well-being and a sustainable society. This study aimed to investigate the effects of university students' self-perceived food literacy on ecological eating behavior and to examine whether gender plays a moderating role in their possible relationship. The results show that the university students' food literacy positively affected their ecological eating behaviors. Healthy snack habits had the most powerful effect on increasing the ecological eating behavior and resilience and resistance also played a significant role in ecological eating habits. These results indicate that individuals' endurance for maintaining healthy eating habits and intrinsic motivations such as self-control and self-regulation are key elements in practicing ecological eating behavior in their daily lives [11,22,33,68]. Knowledge about the origin of food and label information was also closely related to sustainable eating behaviors [50,67]. These results confirm that providing exact food knowledge and transparency in food labeling play a pivotal role in making informed food decisions [78,79]. However, unlike the previous studies [21,22,31], university students' food preparation skills and social and conscious eating experiences are quite irrelevant to the ecological eating behaviors in this research. There are a variety of possible reasons which contribute to this result, the most notable being a lack of cooking experience and commensality for young generations. In the last decades, there has been rapid progress of food technological development, and people have become overly dependent on processed foods and eating out. Moreover, people are used to dining alone as single households and nuclear family units are becoming common. These socioeconomic and cultural transformations may cause the phenomenon that many university students underestimate the importance of practical food skills and commensality and are not aware of any relevance between these factors and their eating behaviors. In addition, gender differences also did not play a moderating role in the relationship between food literacy and ecological eating behavior.

5.2. Theoretical and Practical Implications

This study's findings have several theoretical implications. Although the positive effects of food literacy have previously been investigated, few studies have identified the connection between food literacy and ecological eating behavior from a sustainability perspective. In this context, this study covers a variety of areas related to food literacy with ecological eating behaviors, and it paves the way for facilitating and expanding future research on food literacy. Moreover, this study is the first to diagnose the current level of Korean university students' food literacy and revealed that their food literacy levels are not very high on the whole. In this regard, this study served as a warning to both government and the academic world that efficient food literacy education and programs are urgently needed to help students develop their food-related competencies by building sustainable healthy eating habits across their lifetime. In addition, although a clear moderating role according to gender has not been revealed, it is meaningful in that it explores the moderating role of a new variable beyond the simple causal relationship between food literacy and ecological eating behavior.

The results of this study have significant practical implications. First, in respect to health and education sectors, experts and educators should pay attention to the notion of food literacy which has great potential to elicit students' ecological eating behavior. As this study highlights that food literacy is the holistic understanding of the role of food in one's well-being, university students will be able to make responsible decisions in choosing what foods they eat and develop long-term sustainable eating habits if they receive proper food literacy education at the right time. In particular, the university period is an early stage of entering adulthood, and it is very necessary to develop ecological eating behavior in a positive direction by enhancing food literacy. Therefore, food literacy curriculum for students should be carefully systemized and concretized in order to encourage their

ecological eating patterns and to improve overall quality of life. Although it is not easy to change food preferences or eating habits, it is judged that it will be very meaningful to educate university students on the fact that eating habits are very important and to explain the advantages of ecological eating behavior from a long-term perspective. Moreover, government programs and institutional interventions related to the food literacy will be effective in enhancing people's understanding about food and even cultivating food citizenship. Consequently, all of the stakeholders related to food systems at both micro and macro levels need to work together in order to promote peoples' food literacy and sustainable eating lifestyles for the society as a whole. All these kinds of food literacy activities are expected to improve not only human well-being but also the stability of a society and the health of the planet. Meanwhile, it is an inescapable fact that today's young adults cook less and rely more on eating out or processed foods. This obesogenic environment has caused a rapid increase in obesity and various adult diseases, leading to a serious social problem in Korea. In this context, food companies ought to be conscious of their critical role in society and try to assist in the process of solving the problem that the nation faces. They may contribute to the improvement of consumers' food literacy by providing sustainable healthy food products and services through sustainable management processes. These concerted efforts by companies are expected to nudge customers toward healthier foods and, finally, boost their eating behaviors into a more sustainable direction. Moreover, as global consumers' demands for healthy and ethical food has risen recently, companies based on food literacy in the aspect of sustainability will gain much social support and, finally, achieve both high reputations and economic profits over the long run. Consequently, all of the stakeholders related to food systems at both micro and macro levels need to work together in order to promote peoples' food literacy and sustainable eating lifestyles for society as a whole.

5.3. Limitations and Future Research

There are some limitations in this study. First, the survey respondents were university students who live in Seoul, and the results may not be generalized beyond this specific consumer group. Moreover, the study failed to demonstrate the moderating role of gender in the relationship between food literacy and ecological eating behavior, possibly due to the nature of the specific group of university students. Therefore, it is necessary to conduct further research with more diverse samples. Variables other than gender, such as home environment factors that could moderate the relationship between food literacy and ecological eating behavior, also need to be explored. Finally, future research should consider individual variables that can strengthen the relationships among other various factors, such as sensitivity to food literacy and cultural differences.

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