ORIGINAL ARTICLE

The Correlation between Dimensions of Sustainability Literacy: The Case of British and Turkish Students

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***Abstract**: The acquisition of the competencies of sustainability literacy through education requires an understanding of how sustainability literacy is shaped. In this connection, in the current study, the interaction between the following dimensions of sustainability literacy was investigated; SA (sustainability attitude), SB (sustainability behavior) and SK (sustainability knowledge). The study was conducted as a survey study on university students in the UK and Turkey within the context of a project entitled "Ecological Literacy Education" and supported by TUBITAK (Turkish Scientific and Technological Research Organization). The participants (n:1023) of the study are students attending several departments of Plymouth University in the UK and Mugla Sitki Kocman University in Turkey. The data were collected by using the Scale of Sustainability Literacy and analyzed using AMOS version 24. Although it was understood that there were mutual and positive correlations between the dimensions of sustainability literacy, it was revealed that the correlations between some sub-dimensions of these dimensions showed variation. The results of the study are expected to contribute to revealing the interaction between the dimensions of sustainability literacy in more detail and accordingly to the effectiveness of sustainability education.*

Science Insights Education Frontiers 2024; 21(1):3309-3327.
DOI: 10.15354/sief.24.or535

How to Cite: Ozdemir, O. (2024). The correlation between dimensions of sustainability literacy: The case of British and Turkish students. Science Insights Education Frontiers, 21(1):3309-3327.

***Keywords:** Sustainability, Sustainability Literacy, Sustainability Education, Sustainability Attitude, Sustainability Behavior, Sustainability Knowledge*

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***Conflict of Interests**: None*

Introduction

TODAY, conventional environmental education, which focuses on a person's perspective on and behavior towards nature, is evolving into sustainability education aimed at fostering a more harmonious and equitable coexistence with nature. In this regard, the current study attempts to elucidate the interaction among the specified dimensions of sustainability literacy, which has become humanity's vision for the future.

The transition in light of sustainable development goals (SDGs) of the UN (UNESCO, 2017) requires an effective sustainability education which can enhance sustainability literacy of person (Sterling, 2004, p. 6). The scope and meaning of environmental literacy was extended to sustainability literacy due to transition from environmental education to sustainability education recently (Sterling, 2004, p50). Seen from this perspective, sustainability literacy also implies the ability for a sustainable future rather than environmental literacy. In this sense, sustainability literacy was defined as a broad competency for transition toward sustainability (Orr, 1992; Parkin et al., 2004, p. 9; Roth, 1992; Stibbe & Launa, 2014, p. 11; Winter & Cotton, 2012).

The acquisition of sustainability literacy is needed to understand the nature of sustainability literacy in more detail. However, there is also a gap in the literature in terms of examining the interaction between the dimensions such as sustainability attitude, sustainability behavior and sustainability knowledge. Thus, the current study focuses on the examination of the interaction of the dimensions of sustainability literacy such as SA (sustainability attitude), SB (sustainability behavior) and SK (sustainability knowledge).

Literature Review

Interrelationship between the dimensions such knowledge, attitude and behavior of sustainability education has been examined by several studies.

From the early 1970s, it was assumed that there was a linear relationship between knowledge, attitude and pro-environmental behavior (**Figure 1**) and the reason of the discrepancy between them was explained through the deficit model (Burgess et al., 1998, p. 1447)

However, this simplistic assumption was not confirmed by further studies because the change of pro-environmental behavior is influenced by different dynamics (Kollmus & Agyeman, 2002). Numerous studies have showed that there is a gap between attitude and pro-environmental behavior (Kollmus & Agyeman, 2002). Rajecki (1982) explains the discrepancy between attitude and pro-environmental behavior by factors such as direct versus indirect experience, normative influences, temporal discrepancy and attitude-behavior measurement.

Figure 1. Early Models of Pro-Environmental Behavior.

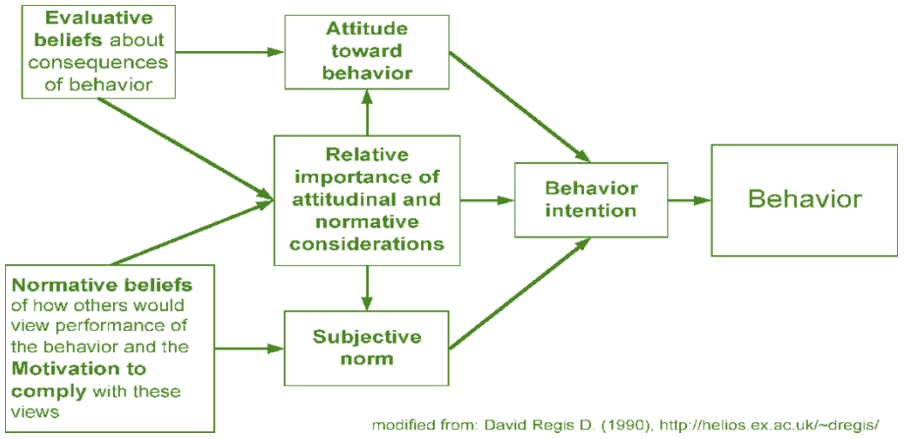

Figure 2. Theory of Reasoned Action (Ajzen & Fishbein, 1980).

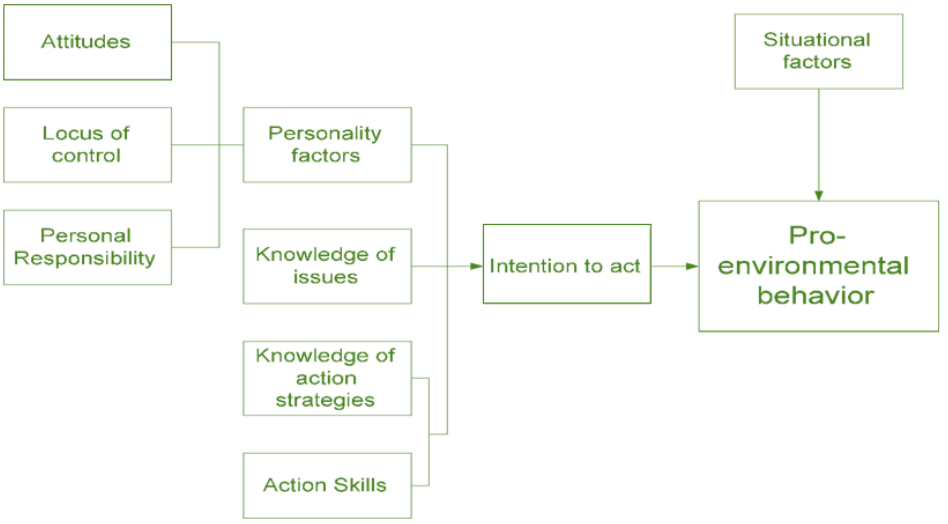

Figure 3. Models of Predictors of Environmental Behavior (Hines et al., 1986).

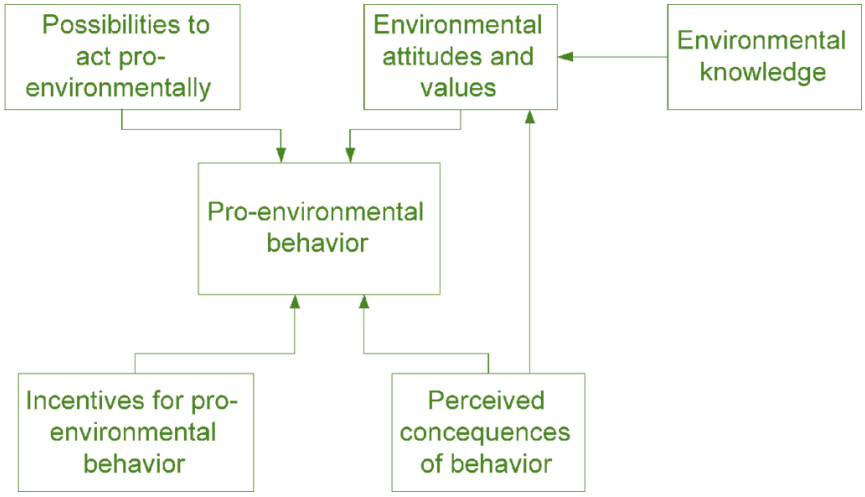

Figure 4. Model of Ecological Behavior (Fietkau & Kessel, 1981).

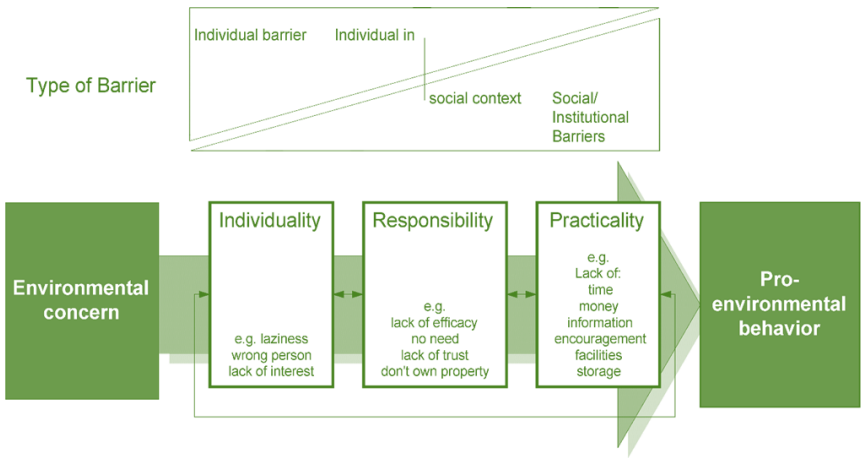

Figure 5. Barriers between Environmental Concern and Action (Blake, 2007).

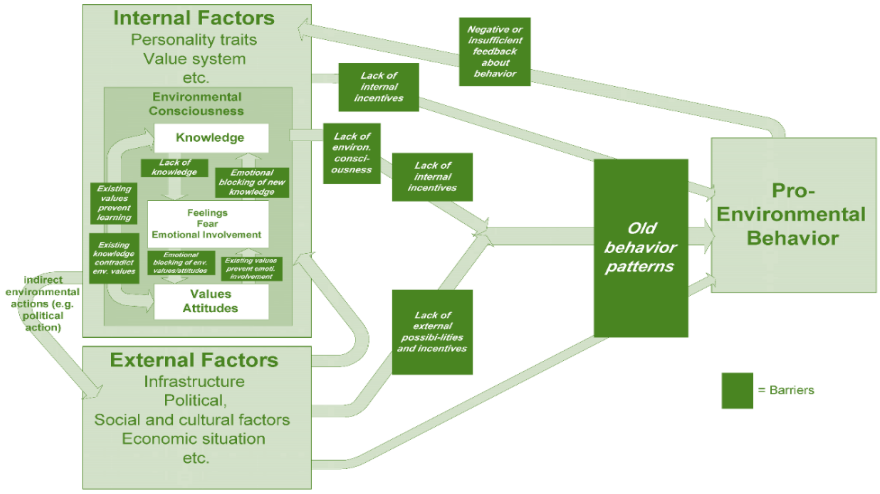

Figure 6. Model of Pro-Environmental Behavior (Kollmuss &Agyeman, 2002).

Numerous approaches have been employed to explain the influences on environmental behavior. In this regard, the dynamics of environmental behavior were tried to be explained through theories such as Reasoned Action (**Figure 2**) and Planned Behavior (Ajzen & Fishbein, 1980)

The approach of reasoned action has become one of the most influential models in social psychology due to its usefulness and has guided empirical studies to understand the nature of the behavior, particularly environmental behavior.

Furthermore, early in the 1990s, Hines et al. (1987) proposed the Model of Responsible Environmental Behavior (**Figure 3**) which shows the influence of the most common predictors on pro-responsible behavior such as knowledge, locus of control, attitude, verbal commitments and individual sense of responsibility. This model is the most common approach that has directed the studies and training on environmental education.

The nature of environmental behavior has also been tried to be explained through other approaches such as altruism, empathy and pro-social behavior models (Eisenberg & Miller, 1987; Lehmann, 1999, p. 34). These approaches are based on the following hypotheses (Kollmuss & Agyeman, 2002):

Fietkau & Kessel (1981) tried to explain the pro-environmental behavior with the model of ecological behaviour (**Figure 4**).

On the other hand, Blake (1999) tried to explain the nature of environmental behavior focused on value (**Figure 5**). According to him, the atti-

tude-behavior gap regarding environmental issues stems from the Value-Action Gap.

Lastly, Kollmuss & Agyeman (2002) developed a comprehensive model which explained the predictors of environmental behavior in light of internal and external factors as follows (**Figure 6**). According to this model, the internal and external factors influence each other and ultimately, pro-environmental behavior.

Furthermore, the interaction between the dimensions such as knowledge, attitude and behavior regarding to environmental literacy has been investigated by numerous studies. In this regard, it is seen that environmental knowledge is a significant predictor of responsible environmental behavior (Alkaher & Goldman, 2018; Amaoka, & Dzogbenuku, 2020; Chu et al., 2007; Hsu & Roth, 1998; Liu et al., 2020; Teksoz, et al., 2012). On the other hand, several studies have reported a significant correlation between environmental attitude and environmental behavior (Bomberg & Moser, 2007; Chu et al., 2007; Pa ϙo & Lavrodor, 2017; Shafiei & Maleksaeidi, 2020; Teksoz et al., 2012) and a significant correlation between knowledge and attitude (Amaoka & Dzogbenuku, 2020; Liu et al., 2020; Veisi et al, 2018).

Rationale, Purpose and Research Questions

As shown in the literature, numerous factors can predict the environmental behavior. In general, studies take into account the environmental behavior as a final outcome and investigate its predictors. On the other hand, the terminology dominating the literature involves the terms of environmental education and environmental literacy. Today, the evolution of environmental education into sustainability education requires the transformation of the terminology related literature towards sustainability.

From this point of view, this study investigated the interrelationship between the dimensions of sustainability literacy such as "sustainability attitude (SA)", "sustainability behavior (SB)", "sustainability knowledge (SK)" via a cross-national comparison between Turkish and British students.

The following questions were investigated in this study:

1. How do the dimensions of sustainability literacy including sustainability knowledge (SK), sustainability attitude (SA) and sustainability behavior (SB) interact with each other?
2. Which consistencies or discrepancies are there between the sub-dimensions of each dimension?

Table 1. Participants.

		f	%
Nationality	British (1)	522	51.0
	Turkish (2)	498	48.6
Gender	Female (1)	665	64.8
	Male (2)	351	34.2
Place of Residence	Urban (1)	629	61.4
	Rural (2)	392	38.3
Department	Health and Medicine (1)	218	21.3
	Social Sciences (2)	235	22.9
	Environmental Sciences (3)	186	18.1
	Education (4)	222.	21.7
	Sciences (5)	81	7.9
	Engineering and Computer (6)	81	7.9
Total		1,023	100

Materials and Methods

The study was designed as descriptive research that aims to investigate the interrelationship between the dimensions of SA, SB and SK of sustainability literacy via a cross-national comparison.

Participants

The study sample was drawn from British and Turkish students (n: 1023) who were studying in different departments at University of Plymouth in the UK and Mugla Sitki Kocman University in Turkey. Some demographic information of the participants is presented in the **Table 1**:

Instrument

The sustainability literacy scale used for data collection was developed in English as a part of TUBITAK project by Ozdemir (2021). The scale consists of the dimensions of "sustainability attitude (SA)", "sustainability behavior (SB)", "sustainability knowledge (SK)" and "sustainable perception (SP)". The current study was conducted considering the first three dimensions (SA, SB and SK) in the scale.

The scale of sustainability literacy limited to the dimensions of SA and SB has a Cronbach's alpha reliability coefficient of 0.839. The validity

of the dimension of sustainability knowledge (SK) was checked by taking the experts' recommendations into consideration. As a result, it was confirmed that the content of the items in the sub-dimensions of knowledge concurs with the relevant literature.

Sustainability Attitude (SA)

The dimension of sustainability attitude (SA) consists of a Likert-type scale items (n: 14) and includes sub-dimensions that are entitled as "concern/worried (SA1)", "social responsibility (SA2)" and "locus of control (SA3)". The items of SA in the scale assess the responses via self-report of participants in terms of the extent to which they agree with the related statements having five possible response options ('1' = strongly disagree, '2'=disagree, '3' = have no opinion, '4' = agree, '5' = strongly agree).

Sustainability Behavior (SB)

The dimension of sustainability behavior (SB) includes Likert-type items (n: 16) having the following response options; ('1'= never, '2' = very seldom, '3' = sometimes, '4' = often, '5' = almost always). The SB was designed to have the sub-dimensions of "consumption pattern (SB1)", "household use (SB2)" and "participation (SB3)".

Sustainability Knowledge (SK)

The dimension of sustainability knowledge (SK) consists of multiple-choice and close-ended questions (n: 11), which address fundamental ecological processes and principles (SK1, SK2, SK3, SK4, SK5), natural sources- human use (SK6, SK7, SK8) and environmental problems/issues (SK9, SK10). The correct response to each item was scored as "1" while the incorrect response was scored as "0".

Analyses

In order to answer the research questions, SEM (Structural Equation Modelling) was utilized in AMOS version 24. First, based on the previous research findings, a hypothesized model was created; then, the hypothesized model was tested to examine the harmony of the parameter estimates with previous research findings. In order to explore the strengths of the causal relationships among the components, the standardized estimates were examined.

Findings

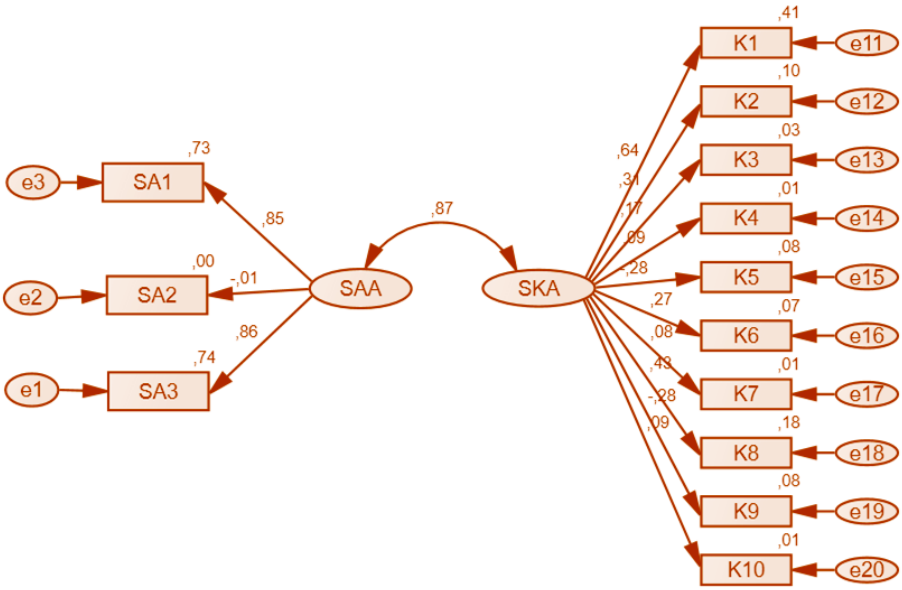

Figure 7. The Relationship between Sustainability Attitude (SA) and Sustainability Knowledge (SK).

Table 2. Correlation between the Dimensions of SA (Sustainability Attitude) and SK (Sustainability Knowledge).

			Estimate
SA1	<-->	SK	-0.046
SK	<-->	SA2	-0.012
SK	<-->	SA3	0.112
SK	<-->	SA	0.221

Table 3. Goodness of Fit Indices.

	χ^2/df	GFI	CFI	NFI	RMSEA
Acceptable fit	< 5	> 0.85	> 0.85	> 0.85	< 0.08
Model	4.021	0.957	0.887	0.856	0.054

The Interrelationship between Sustainability Attitude (SA) and Sustainability Knowledge (SK)

The first research question was "Is there any significant relationship between sustainability attitude (SA) and sustainability knowledge (SK)" of the participants. The proposed model is given in **Figure 7** below.

As indicated in **Figure 7** and **Table 2**, there is a positive and significant correlation between the SA and SK of the participants ($r = 0.87$; $p < 0.05$). To check the model fit, goodness of fit indices (GFI) were used. Goodness of fit indices can be seen in **Table 3**.

In this study, χ^2/df, GFI, comparative fit index (CFI), normed fit index, (NFI) and root mean square error of approximation (RMSEA) were used. To have a fit model, χ^2/df should be less than 5, GFI, CFI and NFI should be above .85, and RMSEA should be less than .08 (Schreiber et al., 2006). As **Table 3** shows, all the goodness of fit indices are within the acceptable range; therefore, the validity of the model is acceptable.

The Interrelationship between Sustainability Attitude (SA) and Sustainability Behavior (SB)

As indicated in **Figure 8** and **Table 4**, there is a positive and significant correlation between sustainability attitude and sustainability behavior of the participants ($r = 0.352$; $p < 0.05$). In addition, there is a positive and significant correlation between SA1 (*concern/worried*) and SB1 (*consumption pattern*) ($r = 0.352$; $p < 0.05$), between SA2 (*Social responsibility*) and SB1 (*consumption pattern*) ($r = 0.177$; $p < 0.05$), between SA2 (*social responsibility*) and SB2 (*household use*) ($r = 0.101$; $p < 0.05$), between SA2 (*social responsibility*) and SB3 (*participation*) ($r = 0{,}166$; $p < 0.05$), between SA3 (*locus of control*) and SB2 (*household use*) ($r = 0.102$; $p < 0.05$) and between SA3 (locus of control) and SB3 (*participation*) ($r = 0.462$; $p < 0.05$).

On the other hand there is a negative and significant correlation between SA1 (*concern/ worried*) and SB2 (*household use*) ($r = -0{,}067$; $p < 0.05$), between SA1 (*concern- worried*) and SB3 (*participation*) ($r = -0{,}076$; $p < 0.05$) and between SA3 (*locus of control*) and SB1 (*consumption pattern*) ($r = -0{,}317$; $p < 0.05$).

To check the model fit, goodness of fit indices (GFI) were used. Goodness of fit indices can be seen in **Table 5**.

In this study, χ^2/df, GFI, comparative fit index (CFI), normed fit index (NFI) and root mean square error of approximation (RMSEA) were used. To have a fit model, χ^2/df should be less than 5, GFI, CFI and NFI should be above 0.85, and RMSEA should be less than 0.08 (Schreiber et al.,

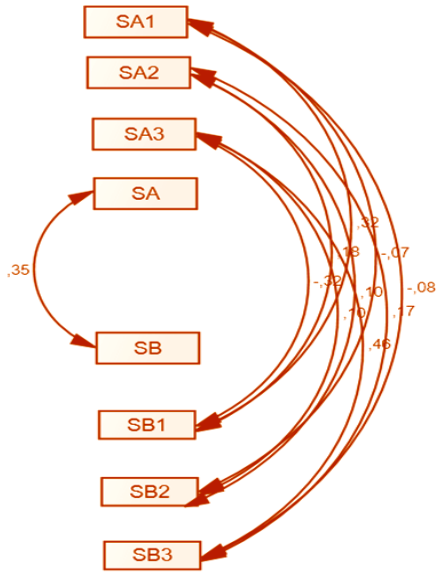

Figure 8. The Relationship between Sustainability Attitude and Sustainability Behavior.

Table 4. Correlation between the Dimensions of SA (Sustainability Attitude) and SB (Sustainability Behavior).

Variables	SA1	SA2	SA3
SB1	0.323	0.177	-0.317
SB2	-0.067	0.101	0.102
SB3	-0.076	0.166	0.462

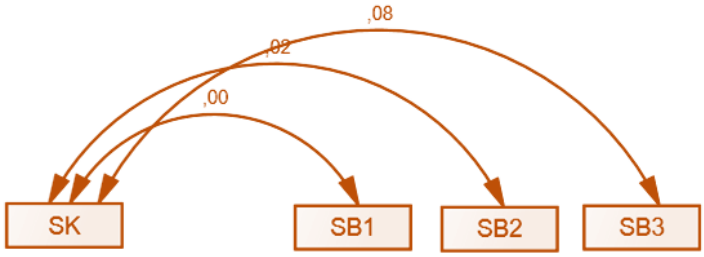

Figure 9. The Relationship between Sustainability Behavior and Sustainability Knowledge.

Table 6. Correlation between the Dimensions of SK (Sustainability Knowledge) and SB (Sustainability Behavior).

			Estimate
SB1	<-->	SK	-0.003
SK	<-->	SB2	0.018
SK	<-->	SB3	0.084

Table 7. Goodness of Fit Indices.

	χ^2 / df	GFI	CFI	NFI	RMSEA
Acceptable fit	< 5	> 0,85	> 0.85	> 0.85	< 0.08
Model	4.250	0.958	0.796	0.878	0.056

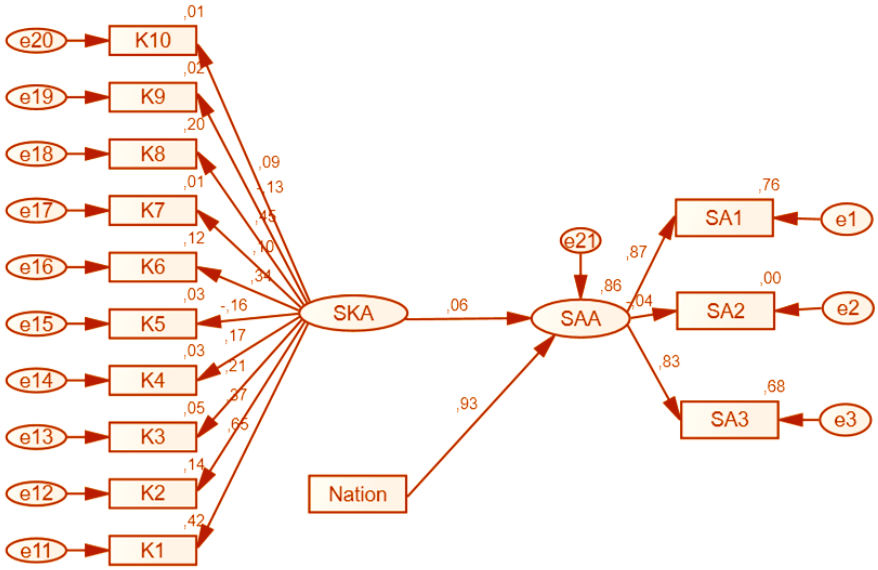

Figure 10. The Model of the Interrelationships between Sustainability Knowledge, Sustainability Attitude and Nation.

2006). As **Table 5** shows, all the goodness of fit indices are within the acceptable range; therefore, the validity of the model is acceptable.

The Relationship between Sustainability Knowledge (SK) and Sustainability Behavior (SB)

As indicated in **Figure 9** and **Table 6**, there is a positive and significant correlation between sustainability behavior (SB) and sustainability knowledge (SK) of the participants ($r = 0.084$; $p < 0.05$). On the other hand, there is no significant correlation between sustainability knowledge and SB1 (consumption pattern) ($r = - 0.003$; $p < 0.05$) and sustainability knowledge and SB2 (household use) ($r = 0.018$; $p < 0.05$). To check the model fit, goodness of fit indices (GFI) were used. Goodness of fit indices can be seen in **Table 7**.

In this study, χ^2/df, GFI, comparative fit index (CFI), normed fit index, (NFI) and root mean square error of approximation (RMSEA) were used. To have a fit model, χ^2/df should be less than 5, GFI, CFI and NFI should be above 0.85 and RMSEA should be less than 0.08 (Schreiber et al., 2006). As **Table 7** shows, all the goodness of fit indices are within the acceptable range; therefore, the validity of the model is acceptable.

The Relationships between Sustainability Knowledge (SK), Sustainability Attitude (SA) and Nationality

As indicated in **Figure 10**, the two independent variables of SK and nationality are strong predictors of attitude: SK ($\beta = 0.07$, $p < 0.05$) and nationality ($\beta = 0.93$, $p < 0.05$). As the **Figure 10** shows, nationality is the strongest predictor of attitude. In other words, the two independent variables predict attitudes of the participants in a positive and significant manner. To check the model fit, goodness of fit indices (GFI) were used. Goodness of fit indices can be seen in **Table 7**.

In this study, χ^2/df, GFI, comparative fit index (CFI), normed fit index, (NFI) and root mean square error of approximation (RMSEA) were used. To have a fit model, χ^2/df should be less than 5, GFI, CFI and NFI should be above 0.90, and RMSEA should be less than 0.08 (Schreiber et al., 2006).

As **Table 8** shows, all the goodness of fit indices are within the acceptable range; therefore, the validity of the model is acceptable.

As indicated in **Figure 11**, the two independent variables are strong predictors of behavior: SA ($\beta = 0.17$, $p < 0.05$) and nationality ($\beta = 0.23$, $p < 0.05$). As the figure shows, nationality is the strongest predictor of behavior. In other words, the two independent variables predict behaviors of the participants in a positive and significant manner. To check the model fit, good-

Table 8. Goodness of Fit Indices.					
	χ^2/df	GFI	CFI	NFI	RMSEA
Acceptable fit	< 5	> 0.90	> 0.90	> 0.90	< 0.08
Model	3.856	0.955	0.934	0.913	0.053

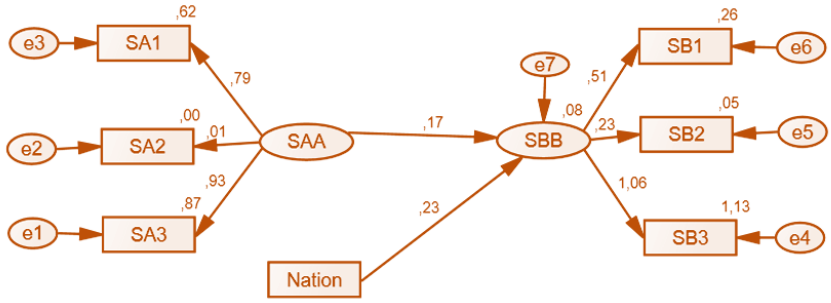

Figure 11. The Model of the Interrelationships between Sustainability Attitude, Sustainability Behavior and Nation.

Table 9. Goodness of Fit Indices.					
	χ^2/df	GFI	CFI	NFI	RMSEA
Acceptable fit	< 5	> 0,90	> 0.90	> 0.90	< 0.08
Model	3.516	0.932	0.921	0.918	0.038

ness of fit indices (GFI) were used. Goodness of fit indices can be seen in **Table 9**.

In this study, χ^2/df, GFI, comparative fit index (CFI), normed fit index, (NFI) and root mean square error of approximation (RMSEA) were used. To have a fit model, χ^2/df should be less than 5, GFI, CFI and NFI should be above 0.90 and RMSEA should be less than 0.08 (Schreiber et al., 2006).

As **Table 9** shows, all the goodness of fit indices are within the acceptable range; therefore, the validity of the model is acceptable.

Discussion and Suggestions

Sustainable literacy seems to be a new competence framework that can pave the way for the transition to a sustainable future. When the relevant literature is reviewed, it is seen that the background of the subject consists mainly of studies investigating the emergence of environmental behavior. In this context, since the creation of the first model by Burgess et al. (1998) where they argued that environmental knowledge determines environmental attitudes, and in turn, environmental behavior, the emergence of environmental behavior has been attempted to be explained through various models. However, these models have focused on identifying the determinants of environmental behavior as the primary outcome, rather than explaining the mutual interaction between environmental knowledge, environmental attitude and environmental behavior. Unlike these models, Kollmuss & Agyeman (2002) have attempted to elucidate how environmental behavior is shaped more clearly on the basis the mutual interaction of the relevant determinants.

However, it is an undeniable fact that as environmental education has evolved into sustainability education, there is still insufficient clarity regarding what sustainable literacy is and how it is formed. Thus, the current study explored the mutual interaction between the dimensions of sustainable literacy through a comparative analysis of the scores of Turkish and British students.

When the findings of the study are generally evaluated, it is seen that there is a positive and significant correlation among all the dimensions of sustainability literacy (SK, SA and SB). At first glance, this situation suggests that there is a mutual and positive relationship between the dimensions of sustainability literacy. However, it is important to note that the correlation among the sub-dimensions of these dimensions varies. Indeed, some sub-dimensions have positive correlations while others show negative correlations and some show no correlation.

For instance, the absence of a significant and positive relationship between the SA (*sustainability attitude*) dimension and its SA1 (*concern/worried*) and SA2 (*social responsibility*) sub-dimensions with the SK (*sustainability knowledge*) dimension suggests that the positive relationship between these two dimensions may be driven by the SA3 (*locus of control*) sub-dimension. Similarly, the negative correlation between the SA1 (concern/worried) sub-dimension of the SA (*sustainability attitude*) dimension with the SB1 (*consumption pattern*) and SB2 (*household use*) sub-dimensions suggests that the positive correlation between these dimensions may be influenced by the SB3 (*participation*) sub-dimension.

Research findings show that there are mutual and quite complex interactions between the dimensions of sustainability literacy. This situation bears a significant similarity to the explanations regarding the nature of the

mutual and complex interactions between environmental knowledge, environmental attitudes and environmental behavior since the 1970s. In the current study, the determination of mutual relationships between the dimensions of sustainability literacy and their sub-dimensions is parallel particularly with the model proposed by Kollmuss & Agyeman (2002). This is because the model proposed by Kollmuss & Agyeman (2002) specifically emphasizes that environmental behavior is shaped by a highly complex and cyclical interaction of numerous internal and external factors.

On the other hand, when examined more closely, the absence of a positive correlation among certain sub-dimensions of the sustainability literacy dimensions, which were found to be positively correlated with each other, also indicates a gap and mismatch between the relevant dimensions. This situation is supported by studies that particularly indicate that there is not always harmony and consistency between environmental knowledge, environmental attitudes, and environmental behaviors (Kollmus & Agyeman, 2002; Rajecki, 1982).

In the study, the understanding that the nationality variable plays an important role in the correlation between SA and SB highlights the necessity of international comparative studies in sustainable literacy research and education because the transition to a sustainable future can only be achieved through effective communication and cooperation at a global level.

As suggested by the "deficit model" put forward in the 1970s, it was envisaged that the gap between environmental knowledge, attitude and behavior would be closed through information and education. However, it is increasingly understood that in most cases, being informed about the environment is not enough to exhibit a corresponding attitude and act in this direction, and that environmental behavior is shaped within a complex process involving many factors.

Further research is needed on different target groups in order to better understand the interaction between the components of sustainability literacy and to gain sustainability literacy competencies through sustainability education. The detection of a negative correlation between some sub-dimensions of the dimensions of sustainability literacy as a result of the study suggests that different variables may be effective in the interaction between these dimensions. In this context, when the economic, psychological, social, cultural and other aspects of the subject are considered from a broader perspective, the nature of the complex interaction among the dimensions of sustainability literacy should be comprehensively elucidated.

Acknowledgements

The study was conducted within the context of a project that was supported by TUBITAK (Turkish Scientific and Technological Research Organization). In this regard, I would like to thank to TUBITAK for their supporting the related project. In addition, thanks to Prof. Dr. Iain STEWART for whose thoughtful collaboration who is the director of SEI at Plymouth University in the UK. Finally, many thanks to three anonymous reviewers whose thoughtful comments were valuable during the development process of the scale.

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Received: 27 November 2023
Revised: 12 January 2024
Accepted: 14 January 2024