

Analyzing Barriers to Transformational Leadership in Education for Sustainability: Case Study at a Cambodian Public University

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In the face of the digital revolution and the rapid advancements in science and technology, education for sustainability has become a critical imperative in the 21st century. The transformative power of digital technologies has reshaped society, fostering globalization and disrupting traditional social, economic, and cultural structures. As the world is coping with the challenges posed by climate change, environmental degradation, and social inequalities, it is evident that the success and development of future generations depend on our ability to develop sustainable solutions and adopt responsible practices. Education thus plays a pivotal role in this process, as it empowers individuals with the knowledge, skills, and values necessary to drive positive change and build a more sustainable future. Hence, there is an urgent need to reform educational curricula and learning outcomes to equip students with diverse competencies, behaviors, and character traits necessary for success. Achieving this goal requires teachers to adapt to the fast-paced changes, embrace lifelong learning, and inspire students to surpass their perceived limits while fostering positive attitudes. However, despite the critical role of transformational leadership in this context, teachers face various challenges in motivating and intellectually stimulating their students. This study aims to investigate the barriers to teacher transformational leadership in the context of education for sustainability or sustainable development. Through a case study conducted at a public university in Cambodia, the Decision Making Trial and Evaluation Laboratory (DEMATEL) methodology is employed to map out the causal relationships and elucidate the complex interdependencies between these barriers. The findings underscore the critical importance of anticipating the prominent and influential barrier, which is providing support and involving university administration in implementing transformational leadership. Moreover, policy for the nationwide adoption of transformational leadership must be developed with the support mechanism to ensure that public universities are provided with sufficient resources to foster the culture of transformational leadership. The present insights will contribute to the growing body of knowledge on transformational leadership in education for sustainability. By addressing the identified barriers and promoting effective teacher transformational leadership, universities can better prepare students with the essential 21st-century skills needed to thrive in a carbon-constrained world and contribute to sustainable development.

1. Introduction

The United Nations has recognized education for sustainable development (ESD) as a crucial element of the Agenda 2030 and a key driver for achieving the Sustainable Development Goals (SDGs). This ESD 2030 framework, focusing on capacity development for educators, aims to equip teachers with the necessary 21st-century skills for sustainability (UNESCO, 2020). Given the critical importance of human capital, transformational leadership, particularly within public universities, has become increasingly essential for driving positive

organizational change. This type of leadership involves various behaviors, such as articulating a vision, supporting personal growth, recognizing achievements, fostering trust and teamwork, and instilling pride and respect (Carless et al., 2000). It is empirically evident that this leadership trait of individualized consideration has a positive impact on teachers' performance and educational reform for Cambodian public high schools in Phnom Penh city (Chheang et al., 2023); such reform in academic institutions and system is vital for the long-term success of individuals and organization as a global community toward education for sustainable development. Additionally, digital transformation with disruptive technology has changed the education landscape and turned teachers into digital nomads, resulting in technostress and innovation resistance. Amid such challenges, the crucial roles of transformational leadership in reducing workplace stress and building staff motivation become indispensable (Ly and Ly, 2024). Despite its potential for promoting positive change and sustainability, cultivating transformational leadership in an organization still faces numerous barriers, ranging from policy (Brandli et al., 2015), implementing mechanisms (Liebermann et al., 2021), and supporting system (Ferreira et al., 2020). Therefore, this study aims to understand the barriers to transformational leadership in education for sustainability, a case study at a Cambodian public university, using DEMATEL methodology, which is known for its practicality in elucidating and analyzing multifaceted and complex barriers, and providing insights for actionable policy recommendation (Kuok and Promentilla, 2021).

2. Methodology

The application of DEMATEL has been proven useful to analyze the problematic and interdependency of barriers, e.g., co-management of urban bio-wastes in Phnom Penh, Cambodia, based on which proper decisions could be made promptly (Meas et al., 2022).

Step 1: The direct-influence matrix $D = [d_{ij}]_{n \times n}$ is populated to demonstrate the direct influence of one barrier on another. For n barriers, experts or stakeholders provide pairwise comparisons of whether barrier i has a direct influence on barrier j , using a 6-point linguistic scale, "no influence = 0," "very low influence = 1," "low influence = 2," "moderate influence = 3," "high influence = 4," and "very high influence = 5." Note that the arithmetic mean of the responses is treated as the consensus of the responses, and all principal diagonal values are equal to zero, given that a particular barrier does not directly influence itself.

Step 2: The matrix D is then normalized using Eq(1), resulting in a normalized initial direct relation matrix N , which represents the direct causality of the drivers.

$$N = D \times k \text{ where } k = \min\left[\frac{1}{\max \sum_{i=1}^n d_{ij}}, \frac{1}{\max \sum_{j=1}^n d_{ij}}\right] \quad (1)$$

Step 3: The total-relation matrix T is constructed using the normalized initial direct relation matrix N where $T = [t_{ij}]_{n \times n}$ is calculated using Eq(2).

$$T = N(I-N)^{-1} \text{ where } I \text{ is an identity matrix.} \quad (2)$$

Step 4: The problematic causal map is plotted by computing the row sum, denoted as R , and the column sum, denoted as C , using Eq(3) and Eq(4), respectively.

$$R = \left[\sum_{j=1}^n t_{ij} \right]_{n \times 1} \quad (3)$$

$$C = \left[\sum_{i=1}^n t_{ij} \right]_{1 \times n} \quad (4)$$

Note that the prominence is the degree of the linkages from one barrier to another in the network of problematics. Thus, the prominence index ($R + C$) is computed by adding vector R to vector C , plotted in the horizontal axis, whereas the network relation index ($R - C$) is computed by subtracting vector C from vector R and illustrated in the vertical axis. The overall effects of barrier i on other barrier j are represented by vector R , while the overall effect experienced by barrier j from another barrier i is represented by vector C . As such, the positive value of ($R - C$) signifies the cause barriers, whereas the negative value of ($R - C$) underscores the effect barriers.

Step 5: A threshold value θ of an average of the entries in the total-relation matrix is set to screen the negligible effects, and only those elements of matrix T whose influence level is greater than the threshold value θ remain and are used for the construction of the prominence-causal relationship diagram. The dynamic network and the degree of influence from one barrier over another barrier are plotted using Gephi, an open-source software with key features to explore and interpret networks interactively (Bastian et al., 2009).

3. Results and discussion

The practical significance of transformational leadership is crucial for maintaining and improving organizational competitiveness, as well as fostering creativity among employees in the rapidly evolving world of technology. As such, the present study delved into the review of barriers to transformational leadership (See Table 1). Allocating time, balancing the workload, and co-constructing a shared vision were the fundamental barriers to transformational leadership, followed by the lack of proper incentives and personnel planning (Liebermann et al., 2021). The lack of university commitment (Ferreira et al., 2020), accessibility to resources (Ávila et al., 2017), and government policy (Brandli et al., 2015) hindered the progress of transformational leadership. Nineteen experts with teaching, managing, and leading experiences of more than 15 years, i.e., 2 Vice-Rectors, 3 Deans, 5 Vice-Deans, and 9 teachers at a Cambodian Public University, reviewed and validated the barriers to transformational leadership in education for sustainability. The direct-influence matrix (D), calculated by averaging the rating of barriers from 19 experts' opinions, is presented in Table 2, and this consensus responses matrix (D) is then normalized and resulted in a normalized initial direction relation matrix N , the direct causality of the drivers (see Table 3). By using Eq(2), the total relation matrix (T) is constructed and tabulated in Table 4. The barrier's prominence ($R + C$) and net relation ($R - C$) indexes are computed subsequently using Eq(3) and Eq(4) and shown in Table 5. Note that the vector ($R + C$) is denoted as the horizontal axis to represent "Prominence" as the result of the strength of influences that a barrier gives and/or receives from another barrier. On the other hand, the vector ($R - C$) is depicted in the vertical axis and denoted as the "Relation" factor. The determination of this vector ($R - C$) illustrates the net effect of a barrier that contributes to the problematic system. The positive sign of vector ($R - C$) signifies the cause barriers, i.e., "Lack of participatory approach in building a common vision (B3)", "Lack of external incentives aside from feedback and social recognition (B4)", "Lack of support and involvement of the university administration (B6)", "Lack of support to access the resources and professionals for capacity development for transformational leadership (B8)", and "Lack of government policy for transformational leadership (B9)", while other effect barriers indicated by the negative value of vector ($R - C$) are "Lack of dedicated time to put transformational leadership into practice (B1)", "Heavy workload from the large variety of administrative tasks and strict deadlines (B2)", "Lack of options for personnel planning or freedom for staff to choose suitable tasks (B5)", and "Lack of a dedicated university committee for transformational leadership (B7)" (see Table 5).

Table 1: Barriers to transformational leadership in education for sustainability

Label	Description of Barriers
B1	Lack of dedicated time to put transformational leadership into practice ¹
B2	Heavy workload from the large variety of administrative tasks and strict deadlines ¹
B3	Lack of participatory approach in building a common vision ¹
B4	Lack of external incentives aside from feedback and social recognition ¹
B5	Lack of options for personnel planning or freedom for staff to choose suitable tasks ¹
B6	Lack of support and involvement of the university administration ^{2,3,4}
B7	Lack of a dedicated university committee for transformational leadership ³
B8	Lack of support to access the resources and professionals for capacity development for transformational leadership ^{2,3,4}
B9	Lack of government policy for transformational leadership ^{2,4}

Note: ¹ (Liebermann et al., 2021); ² (Ferreira et al., 2020); ³ (Ávila et al., 2017); ⁴ (Brandli et al., 2015)

Table 2: Direct-influence matrix (D)

Label	B1	B2	B3	B4	B5	B6	B7	B8	B9
B1	0.00	2.00	1.53	1.00	1.89	2.05	1.42	1.42	1.05
B2	2.47	0.00	2.00	1.47	2.05	1.79	2.00	1.32	1.11
B3	2.53	2.21	0.00	2.16	2.58	3.42	2.42	2.53	1.63
B4	2.37	2.68	2.79	0.00	2.21	2.89	2.68	2.79	1.89
B5	1.05	2.00	2.42	2.21	0.00	1.89	1.79	2.16	1.58
B6	2.53	2.58	2.74	3.26	3.05	0.00	2.95	3.21	2.26
B7	1.84	2.11	2.32	2.32	2.21	2.42	0.00	2.26	1.32
B8	2.11	2.16	2.47	2.68	2.53	2.74	2.63	0.00	1.79
B9	2.21	2.68	3.21	3.21	3.32	3.16	2.58	3.26	0.00

Table 3: Normalized direct-influence matrix (N)

Label	B1	B2	B3	B4	B5	B6	B7	B8	B9
B1	0.00	0.08	0.06	0.04	0.08	0.09	0.06	0.06	0.04
B2	0.10	0.00	0.08	0.06	0.09	0.08	0.08	0.06	0.05
B3	0.11	0.09	0.00	0.09	0.11	0.14	0.10	0.11	0.07
B4	0.10	0.11	0.12	0.00	0.09	0.12	0.11	0.12	0.08
B5	0.04	0.08	0.10	0.09	0.00	0.08	0.08	0.09	0.07
B6	0.11	0.11	0.12	0.14	0.13	0.00	0.12	0.14	0.10
B8	0.08	0.09	0.10	0.10	0.09	0.10	0.00	0.10	0.06
B8	0.09	0.09	0.10	0.11	0.11	0.12	0.11	0.00	0.08
B9	0.09	0.11	0.14	0.14	0.14	0.13	0.11	0.14	0.00

Table 4: Total relation matrix (T)

Label	B1	B2	B3	B4	B5	B6	B7	B8	B9
B1	0.19	0.28	0.27	0.24	0.29	0.30	0.26	0.26	0.19
B2	0.31	0.22	0.31	0.28	0.32	0.32	0.30	0.28	0.20
B3	0.39	0.39	0.32	0.39	0.43	0.46	0.40	0.41	0.29
B4	0.39	0.42	0.44	0.32	0.43	0.46	0.43	0.43	0.30
B5	0.28	0.33	0.35	0.33	0.26	0.35	0.32	0.34	0.24
B6	0.43	0.45	0.47	0.47	0.49	0.39	0.47	0.48	0.34
B7	0.32	0.35	0.37	0.36	0.37	0.39	0.27	0.36	0.25
B8	0.37	0.39	0.41	0.41	0.42	0.44	0.41	0.31	0.29
B9	0.43	0.47	0.51	0.49	0.52	0.53	0.47	0.50	0.27

Table 5: Summary of barrier's prominence (R+C) and net relation (R-C) indexes

Barriers	R	C	R + C	R - C	Group
B1	2.27	3.10	5.37	-0.83	Effect
B2	2.55	3.31	5.86	-0.76	Effect
B3	3.49	3.48	6.97	0.01	Cause
B4	3.63	3.29	6.92	0.34	Cause
B5	2.80	3.54	6.33	-0.74	Effect
B6	3.99	3.62	7.61	0.37	Cause
B7	3.05	3.33	6.38	-0.29	Effect
B8	3.44	3.39	6.83	0.05	Cause
B9	4.20	2.36	6.56	1.85	Cause

Among all cause barriers, "Lack of government policy for transformational leadership (B9)" presents the highest value of (R - C), i.e., more than four times higher than those of "Lack of external incentives aside from feedback and social recognition (B4)" and "Lack of support and involvement of the university administration (B6)", underscoring the importance of government policy to support the implementation of transformational leadership. Such a policy should also be translated into an actionable incentive system and engagement and commitment of the university administration to support transformational leadership in public educational institutions and achieve sustainable development. The values of (R - C) of "Lack of participatory approach in building a common vision (B3)" and "Lack of support to access the resources and professionals for capacity development for transformational leadership (B8)" are close to neutral, suggesting that these barriers could be both the causes and the effects barriers in the present problematique analysis. Therefore, the solution to this complexity of cause-and-effect relations of barriers (B3) and (B8), among other barriers, should be carefully constructed based on the nature and organizational culture. It is quite logical that support to access the resources and professionals for capacity development for transformational leadership must be in place to build a common vision for an organization, and the rebound effects of these barriers (B3) and (B8) must be considered.

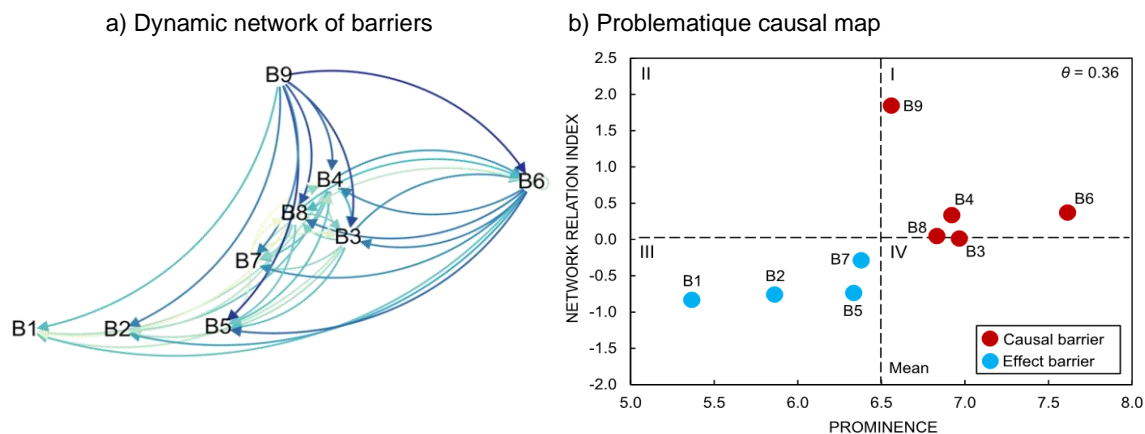


Figure 1: Dynamic network and problematique causal map of barriers to transformational leadership

The complex dynamic network and degree of influence from barriers to other barriers and vice versa are visualized in Figure 1(a) by using an open source software-Gephi. This software is known to have a flexible and multi-task ability to spatialize, filter, navigate, manipulate, and cluster network data (Bastian et al., 2009). Note that a threshold value of $\theta = 0.36$ is utilized to screen the negligible effects in the total-relation matrix (T) before constructing a dynamic network of barriers. The arrow connection indicates the direction of Influence, whereas the darker the color, the more Influence there will be from one barrier over another. For example, the dark-blue arrow connection lines from (B9) show the strong influences from (B9) over (B3), (B5), (B6), and (B8), suggesting that the government policy for transformational leadership has a direct influence and contributes to the establishment of common vision, personnel planning, administrative commitment, and accessibility to resources and professionals for capacity development. Simply said, the realistic and practical translation of policy into organizational action plans with proper capacity development and essential resource support becomes indispensable. The light-blue arrow connection lines from (B7) to (B3), (B4), (B5), (B6), and (B8) illustrate a lesser influence, anticipating that the formation of a dedicated university committee for transformational leadership in the case of the public institution, is necessary to promote and facilitate the common vision, additional incentives system aside from typical feedback and social recognition, staff mobility, administrative support, and accessibility to resources and professionals. Besides having Influence over all other barriers, except (B9), (B6) presents a moderate self-loop, suggesting that a slight commitment to solving barrier (B6) would magnify the solution for the entire network. The problematique causal map of barriers to transformational leadership is shown in Figure 1(b), whereas the horizontal axis represents "Prominence" and the vertical axis denotes "Network relation index." For ease of visualization, this problematique causal map is separated into four quadrants: quadrants I and II signify the cause barriers, and quadrants III and IV represent the effect barriers (see Figure 1(b)). The cause barriers (B3), (B4), (B6), (B8), and (B9) are plotted in red dots, and those effect barriers (B1), (B2), (B5), and (B7) are graphed in blue dots. The self-loop Barrier (B6), located at the farthest right of the prominence axis and in quadrant I, suggests that "Lack of support and involvement of the university administration (B6)" is the core and intertwined influential barrier within the problematique network system. This finding underscores the urgency and necessity to involve and provide administrative support as antecedents for adopting transformational leadership in public institutions (Raut et al., 2022). In the present problematique analysis, all effect barriers are located in quadrant III, suggesting their low prominence, network relation index, and relative disconnection from the network system. For instance, "Lack of dedicated time to put transformational leadership into practice (B1)" is at the farthest left of the prominence axis and lowest point of the network relation index, signifying the independent effect barrier and the least priority for intervention. The perceived transformational leadership behaviors are positively correlated with higher levels of intrinsic motivation, during which employees are highly motivated to engage in transformational leadership for personal inherent satisfaction rather than the desire for reward or incentive (Chua and Ayoko, 2021). A similar case is observed for "Heavy workload from the large variety of administrative tasks and strict deadlines (B2)", suggesting that the perceived barriers (B1) and (B2) could be systematically anticipated by overcoming the cause barriers. The present finding highlights the imperative to take a realistic and balanced approach to the formulation of transformational leadership policy by engaging multiple key actors, including university administration, for the success of policy implementation.

4. Conclusions

The barriers to transformational leadership in education for sustainability, a case study at a Cambodian public university, are systematically analyzed using the DEMATEL method. The dynamic network and problematic causal map of barriers to transformational leadership were visualized to elucidate the interdependencies and Influence of barriers over other barriers. The present findings highlight the essential to anticipate the prominent and influential barrier: the lack of support and involvement of the university administration in implementing transformational leadership. To effectively promote transformational leadership in education for sustainability, developing a policy that facilitates its adoption and ensures nationwide implementation is crucial. Such an action plan incorporates critical elements of transformational leadership such as intellectual stimulation, individualized consideration, inspirational motivation, and idealized Influence into university practices. Additionally, providing public universities with adequate resources, professional support, capacity development opportunities, incentive systems, and a shared vision for sustainability is essential for fostering a transformational leadership culture. By recognizing and addressing these barriers, public universities can create a roadmap for successfully implementing transformational leadership in the future. The present insight has the potential to drive positive change and improve the overall effectiveness of leadership practices in education for sustainability.

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