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Building an Industry-Oriented Business Sustainability Curriculum in Higher Education

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Received: 31 October 2018; Accepted: 7 December 2018; Published: 10 December 2018

Abstract: In the past, research addressing the issues reflecting industrial needs for sustainability-related curriculum design in higher education has been limited. To narrow this gap and to provide students with better business sustainability curricula, we propose employing a mapping concept to extract the opinions and needs of industrial professionals. A total of 14 industrial professionals were invited to brainstorm on topics of business sustainability to be included in the curriculum, and we were able to obtain 52 topics. The participants were then asked to group the topics on the basis of their own perception of similarity, and rated their importance and difficulty levels. To associate the topics into clusters, we conducted multidimensional scaling and hierarchical cluster analysis. We achieved five clusters: resource usage reduction and management, corporate governance and labor safety, business sustainability practices, employee rights and community involvement, and knowledge of the regulations. A derived importance–performance analysis (dIPA) was later implemented to further categorize the topics on the basis of the distinct levels of importance and difficulty of each topic. The four quadrants in dIPA could act as guidelines for designing a series of progressive courses on business sustainability in higher education.

Keywords: industrial needs; concept mapping; importance–performance analysis; business sustainability curriculum; higher education

1. Introduction

Sustainability has become a critical concern for numerous corporations due to the fact that it offers new business opportunities, generates financial benefits, and achieves competitive advantages [1,2]. Nevertheless, determining how to develop sustainability strategies to make a company more sustainable is still a demanding challenge for most businesses [2]. Business-focused higher education is considered to be a solution for this problem as it enables future business leaders to possess the necessary knowledge and skills to manage the ever-changing requirements related to sustainability [1,3].

According to the United Nations Educational, Scientific, and Cultural Organization (UNESCO) [4], sustainability education comprises three major dimensions: economic, social, and environmental. The United Nations' (UN) Principles for Responsible Management Education (PRME) provide a framework for sustainability-focused education by encompassing the issues of human rights, labor standards, environmental stewardship, and anti-corruption to provide thought leadership that can benefit society through responsible management [5]. It has been attempted to use higher education to create awareness and to try to find solutions to the challenges of sustainability over the past

three decades [6]. However, previous research on sustainability education has mainly focused on effectiveness evaluation [7,8] and comparison [9,10]. Some researchers have investigated the sustainability-related curricula offered internationally and compared them among different regions and ranking levels [9,10]. The few studies that have examined the course design perspective are restricted by having needed to conduct surveys with academic professionals [7,11] rather than extracting industrial needs to business sustainability course design [12,13]. Given that committing to sustainability requires revising existing courses and creating new courses [5], higher education must act jointly with businesses to develop courses in accordance with their needs [12].

The Australian Department of Education, Employment, and Workplace Relations mentions that professional and vocational skills are sustainability skills required for green jobs across all industry sectors as a response to climate change and sustainability imperatives [14]. Accordingly, preparing business students to possess capabilities relevant to sustainability is a primary goal of higher education institutions; thus, designing sustainability-related curricula conforming to business needs is a critical task for such institutions. Despite the increasing research interest in developing sustainability-related curricula, the majority of studies are conducted from the perspectives of students [8,15,16], leaders [2], and program managers [17]. Meanwhile, relatively few studies have attempted to develop sustainability-relevant applied learning experiences and identify new knowledge and skills in response to industry needs.

This study attempts to explore the requisite capacities related to sustainability by utilizing the concept mapping approach. Concept mapping is a scientific tool which can extract and organize the most relevant information from experts' experience to facilitate a working group to draw conclusions using statistical techniques [18]. In this study, we collaborated with professionals who are managers of semiconductor supply chain companies in order to extract sustainability-related essentials in the industry. These semiconductor industry professionals were chosen to help us design the curriculum due to the importance of sustainability to the industry and the excellent performance of the participants' companies in sustainability practices. With the experts' assistance, we were able to obtain a structured conceptualization of sustainability based on their previous experiences and elicit the main points to be reinforced when developing the sustainability-related curriculum, thus contributing to higher education.

2. Literature Review

2.1. Sustainability Education

Naeem and Neal [9] gave an overview of the adoption of education for sustainable development (ESD) in higher education institutions in Asia. They employed a questionnaire-based methodology to measure the integration of sustainability in business schools in the Asian Pacific region. Despite the presence of different sustainability education perspectives in the region, the research failed to portray a holistic picture of the ESD in the region's higher education. Endowed with similar interests in Asian sustainability education, Wu et al. [8] adopted a web-based content analysis to the study of higher education sustainability curricula in Asia. By examining the sustainability-related courses offered in 136 universities from 12 countries, their study provided comprehensive information about the current state of sustainability education in Asia.

Fallon and Capella [7] revealed that sustainability education and sustainable management in universities and businesses were not given sufficient attention and that the three composites of sustainability—namely, the environment, economy, and society/human factors—were not addressed equally. Additionally, the impacts of the amount and type of coursework on students' conceptualizations of sustainability were investigated by Fisher and McAdams [8], and the results corroborated the idea that the type of coursework, rather than the amount, influences the way in which students conceptualize sustainability. Furthermore, Stubbs and Cocklin [19] contended that "understanding the worldviews that underlie the different interpretations of sustainability in the

context of business to avoid this educational disconnect" is essential for students. Although an increased attention to management education that addresses sustainability has emerged, Dickson et al. [5] argued that the deficiencies of sustainability-focused education resulted from business schools' inconsistent ways of addressing the topics. To narrow this gap, they relayed a case study of a multi-institutional program to show how innovative strategies promote sustainability-focused education and prepare students for management positions in global apparel and footwear companies. A few studies further proposed that, aside from faculty needing professional development, industrial factors must also be addressed when developing sustainability education [5,20,21].

Rowe and Wehrmeyer [22] mentioned that management education plays an important role in forming the way in which future generations learn business practices. However, a research gap still exists in sustainability deduction between industrial need and academic education [7,23]; thus, narrowing this gap to help business school students possess the sustainability knowledge and skills required for the ever-changing world is imperative. The diverse approaches to the study of sustainability-related issues have been affected by goals and situations [24,25]. The majority of the studies which have attempted to investigate sustainability education from different aspects or scopes have employed a questionnaire approach [7,8,11,24–27]. However, despite the efficiency of questionnaires in obtaining first-hand information, this approach could be influenced by participants' personal preferences and stereotypes [10].

2.2. Industry-Oriented Sustainability-Related Curriculum Design

Past research has affirmed that only a few studies have considered industrial needs in sustainability-related course design in higher education. Wen and Tsai [28] developed a green management competency index oriented towards industrial needs which can be used for evaluating green management-related course design. In order to design a pedagogical approach using sustainable technologies, Lockrey and Johnson [23] proposed a project-based learning (PBL) approach to build connections between an industry partner and students, and confirmed the impacts of such collaboration on cultivating students' deep knowledge and skills in the ever-evolving area of sustainability. Thomas and Depasquale [14] examined the importance of sustainability capabilities in the workplace and confirmed that a problem-based learning curriculum can be effective in delivering five capabilities: namely, system thinking, anticipatory, normative, strategic, and interpersonal skills. Etse and Ingley [6] analyzed the higher education curriculum for sustainability in Ghana and appealed for more deliberate efforts to integrate sustainability in the curriculum. Barber et al. [1] utilized the University of New Hampshire as a case study to illustrate how business schools develop sustainability education through building innovative and collaborative relationships with internal (e.g., students and faculty) and external (e.g., industry professionals) stakeholders.

Although these aforementioned studies attempted to build a link between sustainability-related pedagogy and industrial needs, they failed to integrate the professionals' opinions into curriculum design. Wen and Tsai [28] only proposed an index for green management without delineating how to implement the index for course design. Lockrey and Johnson [23] and Barber et al. [1] regarded industrial cooperation as the key to reflecting the dynamic and ever-changing industrial needs for sustainability-related courses. However, their study was executed through either PBL or a case study approach instead of cooperating with industrial experts to develop sustainability-related curriculum design for college and Master of Business Administration (MBA) students. This study aimed to adopt a concept mapping (CM) technique to elicit industrial experts' perspectives on sustainability and further illustrate how to incorporate the perspectives into sustainability-related curriculum design for college and MBA pedagogy in order to fill the gap between industrial needs and higher business education.

3. Methodology

3.1. Concept Mapping

Concept mapping, originally proposed by Trochim [29], is a useful participatory research approach combining qualitative and quantitative methods that is able to overcome the inherent subjective and individual biases resulting from various research approaches, such as surveys, interviews, and case studies [13,30,31]. Its effectiveness in eliciting and constituting the most relevant information from experts and developing a structured conceptual framework has led to the implementation of concept mapping in various research fields. A few studies have adopted concept mapping to investigate health-related issues [32–35]. For example, Bigne et al. [36] used the technique to generate construct dimensions to study customer loyalty to travel agencies in Spain. Additionally, several researchers have successfully employed concept mapping to address complex topics in higher education. For instance, Wopereis et al. [37] utilized concept mapping to explore the factors that affect the failure and success of the creative use of information and communication technologies (ICT) in higher education in the Netherlands. Furthermore, Wu [12] adopted concept mapping techniques to identify the key skills relevant to logistics licenses in Taiwan and provided logistics-related firms with valuable information on training and recruiting. Moreover, Hay and Kinchin [38] applied concept mapping to assess learning quality in higher education. Concept mapping has also been utilized for designing the electronic engineering curriculum [18] and developing the global logistics management curriculum [13]. The present study uses a concept mapping approach to elicit the critical issues related to sustainability in the business world through the collaboration of industrial experts and accordingly develops a conceptual framework of business sustainability curriculum design. With the participatory research approach of concept mapping, we can facilitate the design of more appropriate sustainability-related higher education courses by combining qualitative and quantitative methods.

The concept mapping of Trochim and Kane [36] consisted of six major steps: preparation, idea generation, idea structuring, idea representation, the interpretation of the maps generated, and the utilization of the maps. Steps 2 to 6 can either be conducted in one very long group session or be divided into multiple sessions [33]. In the following section, we delineate how we utilize the first four steps of concept mapping to address our research interests.

3.2. Concept Mapping for Business Sustainability Curriculum

Step 1: Preparation

Trochim [29] mentioned that selecting the participants and developing the focus of the process are the two major tasks in the preparation step. Conceptualization is best when it includes a wide variety of relevant participants. The present study preferred participants with practical experiences with the aim of developing a curriculum based on business sustainability. We located a training course sponsored by the Advanced Semiconductor Engineering, Inc. (ASE) Cultural and Educational Foundation pertaining to business sustainability for semiconductor industrial practitioners in Kaohsiung, Taiwan. ASE is based in Taiwan and is the largest outsourced semiconductor assembly and test (OSAT) company in the world [39]. ASE has been working on promoting sustainability practices and cultures within the company and for its supply chains and was listed in the Dow Jones Sustainability Indices in 2016 and 2017 as well as on the Climate A List issued by the CDP (formerly the Carbon Disclosure Project) in 2016. Toral et al. [18] suggested the inclusion of 10–20 participants for easy brainstorming and quick conceptualization. In the present study, after a voluntary selection, a total of 14 participants were invited from the business sustainability training course. Table 1 displays the participant profiles. It shows that they have a large range of working experiences: besides two juniors, most have between 6 and 26 years of experience, with an average of 11 years and a standard deviation of 6.9 years. Half of the participants work in the semiconductor industry and the other half work for logistics service providers, information service providers, government offices, etc. The central focus of concept

mapping is to identify the participants' perceptions regarding which business contexts are relevant to sustainability education and how important these contexts are to business sustainability.

Step 2: Generation of ideas

The actual concept mapping process begins at this step, and the purpose is to obtain a set of statements related to the research topic [29]. Moreover, brainstorming is usually employed for the generation of ideas, either live or over the web [36]. At the beginning of the brainstorming session, the participants were asked this focal question: "What topics regarding business sustainability might be included in a college course?". As facilitators, we guided the discussion and encouraged the participants to generate ideas and opinions as much as possible. The brainstorming session, which was held on 22 April 2017 during a training course, lasted approximately 90 min, and 52 business sustainability-related items were drawn from the activity (Table 2). During the brainstorming process, the participants arranged themselves into groups of 2–4 people and discussed the themes among themselves before raising the topic items. Although some topics have related meanings, they are still recorded because, in the later steps, topics with similar meanings are conglomerated into one cluster.

Table 1. Participant profiles.

	Industry	Job Title	Experience (Yr)
Participant 01	Logistics service provider	Manager	12
Participant 02	Government office	Director	14
Participant 03	Semiconductor	Senior engineer	8
Participant 04	Semiconductor	Senior director	26
Participant 05	Semiconductor	Engineer	4
Participant 06	Semiconductor	Manager	7
Participant 07	Information service provider	Senior manager	10
Participant 08	Semiconductor	Engineer	6
Participant 09	Semiconductor	Senior manager	8
Participant 10	Semiconductor	Engineering director	12
Participant 11	Green recycling	Director	12
Participant 12	Government office	Technician	7
Participant 13	Education	Professor	24
Participant 14	Logistics service provider	Engineer	2

Step 3: Structuring of ideas

Once the list of items describing the conceptual domain of the research focus is obtained, the relationships of the items to each other must then be identified. We proceeded to Step 3 on 29 April 2017, one week after Step 2 (generation of ideas). In this step, each item that was generated from the brainstorming session was printed on a 3 cm × 5 cm index card. Every participant received a complete set of cards and was asked to sort the cards into piles depending on his or her perception of which items on those cards represented similar concepts. The restrictions for the structuring were that all cards could not be sorted into one single pile and that all cards could not be sorted into their own pile. After sorting, each participant was instructed to rate each item on the basis of the importance of the topic on business sustainability education and the difficulty in learning the topic. Both rating tasks were accomplished using Likert-type response scales (1 = not important, 5 = very important; and 1 = not difficult, 5 = very difficult). Since rating importance and difficulty levels at the same time is mentally demanding, it took 90 min to finish this step. Table 2 shows the rank of the importance weight (mean), the topic coding number, and the weights of the importance and difficulty of topics. Of the 52 topics, 28 were assigned an importance weight larger than 3.5, while only one was assigned an importance weight below 2.5. For the difficulty level, only five topics were assigned a weight larger than 3.5, while 21 topics were assigned a weight below 2.5. Thus, the participants perceived that many topics were important but not too difficult to learn. After the items were sorted and rated, the obtained data for all the topics was analyzed statistically.

Table 2. The 52 topics of business sustainability obtained during the brainstorming process.

Rank In Importance	Topic No.	Cluster	Topics	Importance Weight	Difficulty Weight
1	12	2	Disaster prevention	4.3	2.3
2	13	3	Internal audit for business sustainability	4.3	3.2
3	45	3	Knowledge of green supply chains	4.1	3.0
4	49	2	Managing CO_2 emission reduction and energy saving	4.1	3.0
5	35	2	Labor safety	4.0	2.2
6	5	2	Company energy management	3.9	2.7
7	11	3	Investment analysis for business sustainability	3.9	3.6
8	30	3	Embedding plan, do, check, act (PDCA) into sustainability operations	3.9	3.2
9	34	2	Disaster response	3.9	2.5
10	7	1	Greenhouse gas emission	3.8	2.8
11	17	3	Business ethics and social responsibility	3.8	2.0
12	18	3	Knowing business sustainability	3.8	2.0
13	27	4	Cultivating employee morality and integrity	3.8	1.9
14	52	2	Awareness of ISO (International Organization for Standardization) certification systems (e.g., ISO14000, 14064, OHSAS18000, SA8000)	3.8	3.3
15	9	3	Sustainable product life-cycle planning	3.7	3.1
16	43	2	Management and control of raw materials	3.7	3.4
17	3	5	Human resource management	3.6	2.3
18	15	1	Waste recycling management	3.6	2.5
19	44	5	Awareness of food quality and safety	3.6	2.0
20	47	4	Moral consciousness	3.6	1.8
21	4	2	Production management	3.5	2.8
22	6	1	Water resource reduction and recycling	3.5	2.5
23	8	2	Quality management	3.5	3.1
24	10	3	Investment payback period analysis	3.5	2.8
25	20	3	Communicating with enterprise stakeholders	3.5	2.6
26	33	2	Human resource management	3.5	2.9
27	38	2	Education on occupational accident prevention	3.5	1.6
28	51	2	Performing business continuity management (BCM) in risks and operations	3.5	3.7
29	1	5	Lacking talented personnel	3.4	2.1
30	2	1	Carbon emission	3.4	2.8
31	24	5	Awareness of global resource scarcity	3.4	1.9
32	28	3	Building sustainability culture	3.4	2.5
33	48	3	Studying cases related to sustainability operations	3.4	2.0
34	29	5	Knowledge of corporate operational regulations (tax, HR, etc.)	3.3	2.5
35	36	3	Sustainable procurement cost analysis	3.3	2.9
36	16	5	Environmental protection regulations and initiatives	3.2	2
37	19	2	Capability of analyzing financial statement	3.2	3.4
38	21	3	Analysis of corporate annual sustainability data	3.1	3.5
39	25	5	Knowledge of sustainable procurement-related regulations	3.1	2.8
40	37	5	Fundamental knowledge of laws and regulations	3.1	2.3
41	41	5	Knowledge of fundamental procurement operations	3.1	2.3
42	42	1	Water footprint management	3.1	2.7
43	26	3	Analysis of the impacts of business operations on social costs	3.0	3.1
44	32	3	Transparency in business operations	3.0	2.6
45	46	4	Employee benefits and bonuses	2.9	1.7
46	23	5	Intellectual property rights	2.8	2.3
47	40	4	Community communication	2.8	2.1
48	14	5	Proficiency at ERP (Enterprise Resource Planning) operations	2.7	2.4
49	22	3	Knowledge of sustainability investment	2.7	3.5
50	31	3	Social return on investment (SROI)	2.7	3.5
51	50	4	Educating employees and community on sustainable environment	2.7	1.8
52	39	4	Encouraging employees to participate in charity activities	2.1	1.2

Step 4: Representation of ideas

Step 4 is a synthesis process performed by running computerized analysis to summarize and correlate items with the associated sorting and rating results, and multidimensional scaling is applied for this purpose. Proximity is a common measure used to represent relationships between objects [40]. To represent the conceptual domain, we used multidimensional scaling and hierarchical cluster analysis using the SPSS software version 21 based on the data from the piling up of topics by participants in order to transform the original qualitative data set of 52 topics into coordinate values. The coordinate values were then used as the input values for cluster analysis. The number of dimensions selected

was based on the slope of the stress with a value close to 0 [41]; thus, 11 dimensions are selected. The 11 dimensional values were used as the coordinates for hierarchical cluster analysis, and five clusters were selected, as the eigenvalue in the scree plot increases smoothly before five clusters; the dendrogram plot from Ward's algorithm [42] shows appropriate clustering. Ward's algorithm measures the sum of squared errors (SSE) of clusters as the proximity measure, and the five clusters obtained assure the minimum within cluster variances to differentiate clusters. This technique sorts the topics into smaller groups; thus, determining the representative name for the clusters and the features in a cluster becomes easy [43]. Table 3 shows the five clusters of topics obtained and their internal consistency and reliability as determined by the Cronbach's alpha evaluation; all clusters with values larger than the threshold of 0.7 were deemed acceptable.

Table 3. Clusters of topics and the reliability statistics.

	Cluster (No. of Topics in the Cluster)	Alpha	F	Sig.	Grand Mean Importance/Difficulty	Percent
1	Resource usage reduction and management (5)	0.821	4.871	0.001	3.48/2.66	21.15%
2	Corporate governance and labor safety (13)	0.977	6.371	0.001	3.72/2.84	9.62%
3	Business sustainability practices (17)	0.741	3.687	0.001	3.48/2.89	25.00%
4	Employee rights and community involvement (6)	0.863	7.236	0.001	2.98/1.75	32.69%
5	Knowing the laws and regulations (11)	0.807	5.511	0.001	3.21/2.26	11.54%

4. Results

Table 3 shows the resulting five clusters: resource usage reduction and management, corporate governance and labor safety, business sustainability practices, employee rights and community involvement, and knowledge of the regulations. Cluster 1 contains topics such as water and waste usage reduction and recycling, greenhouse gas emission, and carbon and water footprint management. These topics concern emission footprints and water and waste recycling and reduction and are the fundamental concepts most people would consider from the sustainability perspective. As indicated by previous studies [16,44,45], protection for the environment to mitigate the impacts of climate change and for sustainable development is the significant management decision faced by most businesses. Thus, Cluster 1 is named "resource usage reduction and management". The grand mean for the importance level ranks second and the difficulty level ranks in the middle, thereby suggesting that these topics are important but are easy to learn and that they can be considered general education topics.

Cluster 2 contains topics concerning business operations for risk aversion in the labor and management system, and is named "corporate governance and labor safety" to reflect the characteristics of topics comprising the cluster. During the brainstorming step, the participants came up with many topics associated with business operations, which range over a wide spectrum, from labor management and education to sustainability-related business operational management and business continuity management (BCM) in risk aversion and management. Labor management and education contains topics such as labor safety and regulation, education on occupational accident prevention, disaster response, and labor management; sustainability-related business operational management contains topics such as ISO certification awareness, quality management, and production management; and BCM in risk aversion and management contains topics such as supplier management, material management and control of raw materials, managing CO_2 emission reduction, and energy saving. The topics form part of Cluster 2 and are mainly associated with resource management and labor rights; they are all connected with business daily operations by also taking sustainability into consideration. Based on the grand mean of this cluster, it has the highest importance value and the second highest difficulty value; this exemplifies the fact that the topics in this cluster are averagely important and can require some effort to learn. The high importance level of this cluster results from the fact that its topics concern corporate daily operations and are thus very important for students to learn.

Cluster 3 is named "business sustainability practices" since the 17 topics in this cluster are connected to practices relating to sustainability performance, investment, cost, and audit. Cluster 3

also comprises business ethics, social responsibility, sustainable product life-cycle planning, green supply chains, and transparency in business operations, concurring with Simpson and Radford [46]. These practices represent many aspects of business sustainability and the constituents of sustainability, and such practices are imperative for a business working toward sustainability. The grand means show high importance and difficulty for the topics in this cluster, thereby demonstrating that its topics are important to college students despite their high difficulty level. Cluster 3 has the highest grand mean difficulty among the five clusters.

Cluster 4, named "employee morality formation and community involvement", contains six topics on employee morality formation and encouragement and community involvement and communication, which include employee morality and integrity cultivation, moral consciousness, community communication, employee welfare and bonuses, educating employees and the community on sustainability, and encouraging employees to participate in charity activities, coinciding with the social dimension of sustainable development proposed by some studies [47,48]. The cluster's grand mean shows that it has the lowest importance and difficulty values, illustrating that the topics are not very important nor are they difficult to learn. The morality formation is easy to learn, but it requires real appreciation to be embedded at work, and community communication may require some interpersonal techniques. However, Cluster 3's topics are more associated with "knowing" rather than "doing".

Cluster 5 is named "knowing the laws and regulations" and, as the name implies, consists of topics related to knowledge of the laws and regulations regarding sustainability, such as knowledge of sustainable purchasing regulations, awareness of food quality and safety problems, knowledge of scarcity of resources, and knowledge of environmental protection laws and initiatives. The grand means of importance and difficulty levels are approximately in the middle of the five-point scale, and denote that these topics are only somewhat important and not too difficult to learn. For average business college students, the laws and regulations pertaining to sustainability are fundamental and may usually be embedded in their work after they graduate; therefore, laws and regulations are not taught in great detail compared with other professional programs directly related to the topic.

The topics obtained from the brainstorming process and cluster analysis provided us with the important topics and their levels of difficulty in sustainability course design. It may be impossible to include all 52 topics in one course; however, they can be spread over a series of courses at different levels or diverse disciplines. Details on the number of courses and the topics to be included in each course are beyond the scope of this study; however, this study can provide guidelines for academics in designing sustainability-related courses. Diverse disciplines may have different numbers of courses and may focus on distinct topics. Therefore, our next step after identifying the topics and clusters was to arrange the topics into program curricula. For this purpose, we introduced the importance–performance analysis (IPA) to provide a more structured framework.

IPA was proposed by Martilla and James [49] within the context of the automobile industry to classify items into four categories based on two different levels of importance (y-axis) and performance (x-axis). Some studies infer that IPA provides benefits for analyzing, evaluating, and comparing the factors that affect service quality or understanding consumer behaviors for proper marketing actions [50,51]. Variations of IPA application are available. For instance, Lee and Hsieh [52] modified IPA to evaluate the safety culture of patients by replacing "performance" with "agreement" to identify the critical factors. Additionally, Burns [53] suggested using simultaneous importance–performance analysis (SIPA) in managerial decision making. Bei and Shang [54] later utilized SIPA for organization self-improvement, while Lee et al. [55] integrated SIPA and decision making and trial evaluation laboratory (DEMATEL) to ascertain competitive differences with competitors. On the basis of Lee and Hsieh [52], our study replaces "performance" in IPA with "difficulty" to differentiate the difficulty level of topics in curriculum design, and IPA thus becomes a derived IPA (dIPA) (see Figure 1). By categorizing the high and low levels of the values, we use the means of importance and difficulty for separation. As shown in Figure 1, four categories based on the different levels of importance and

difficulty exist. The topics in Quadrant 1 have high difficulty and importance levels, and the topics can be arranged in a more advanced course. Quadrant 2 has low difficulty and high importance levels, and the topics within are appropriate for fundamental courses. The topics in Quadrant 3 have low difficulty and importance levels, and are suitable for introductory courses or general education courses. The topics in Quadrant 4 have high difficulty levels and low importance levels. Topics can be designed as special topics because a low importance level is appropriate for ordinary personnel; however, some are also important for professional personnel. Tables 1 and 2 show that topics in Clusters 2 and 3 have the two highest grand means for importance and difficulty. Figure 1 shows most of the topics that are included in a cluster with dotted squares.

Hurney et al. [56] incorporated sustainability content and pedagogy into program curricula through faculty development with a belief that, if a consensus on the topics to be included in the sustainability curriculum emerges among faculty members, the next step would be to design those topics into program curricula. Content-driven and backward design approaches are implemented to produce effective course designs for sustainability teaching. The content-driven approach is similar to the integrated results in Table 2, with dIPA occurring with course classification. Fink [57] proposed the backward design to align outcomes with assessment and pedagogy. The faculty conceptualizes their journey of designing sustainability into their courses, and the approach coincides with our brainstorming process in concept mapping.

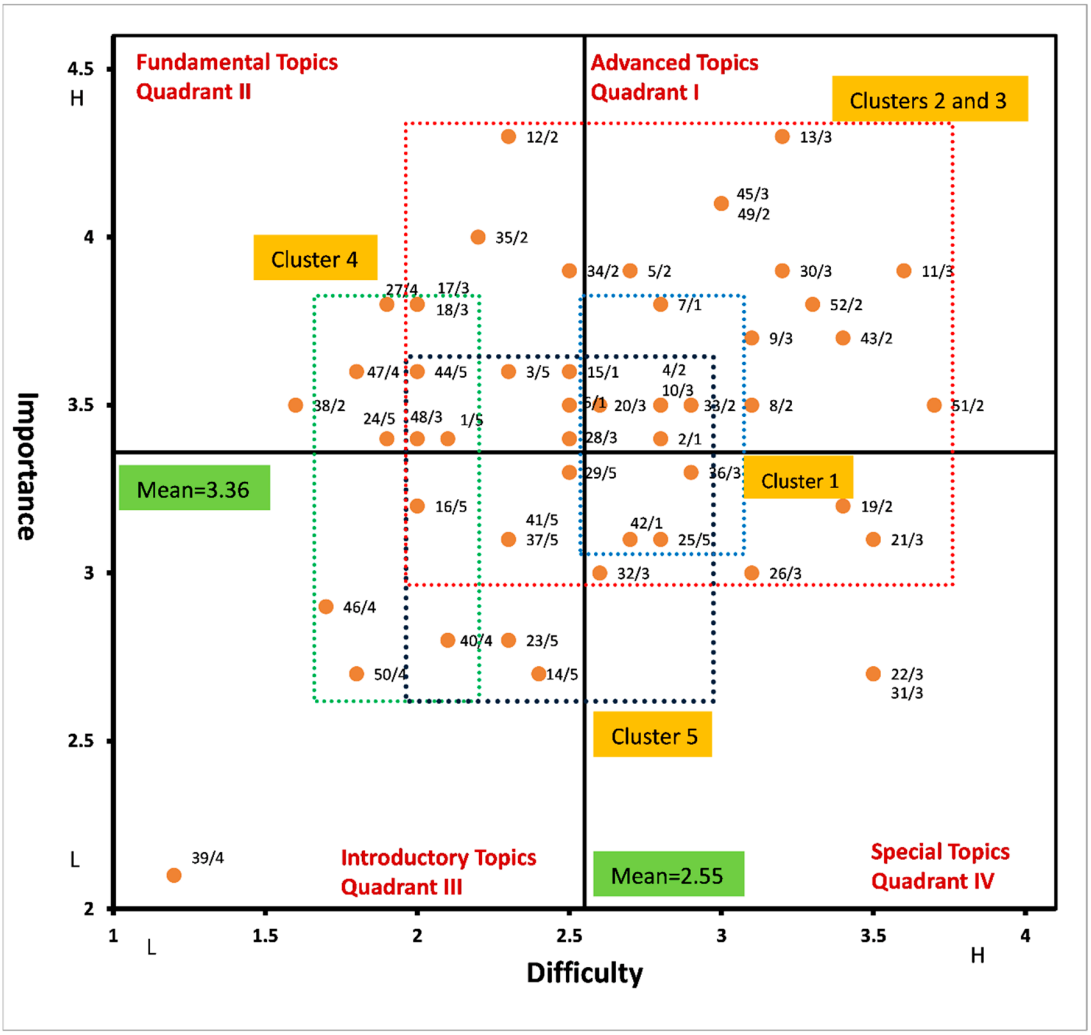

Figure 1. Importance–performance analysis (IPA) for the importance and difficulty levels of the various topics and clusters.

5. Conclusions and Discussions

Despite the importance of sustainability in higher education, limited research work has been conducted on this issue to reflect industrial opinions in the design of business sustainability-related curricula in higher education. Past research regarding sustainability education has mainly been focused on outcome evaluation and comparison (e.g., [8,10,11]). While some studies looked into course design problems, they were constrained by the fact that the survey subjects were from academia instead of from industry [10,11]. The present study implemented concept mapping to draw knowledge from industrial professionals in order to narrow the research gap and to provide a better design guideline for sustainability curricula. After performing a brainstorming process, 52 topics were obtained. The participants were later asked to rate the importance and difficulty levels of those topics. To represent the conceptual domain of those topics, we applied multidimensional scaling and hierarchical cluster analysis with data from piling up the topics by participants. Finally, five clusters of topics were achieved: Cluster 1—resource usage reduction and management; Cluster 2—corporate governance and labor safety; Cluster 3—business sustainability practices; Cluster 4—employee rights and community involvement; and Cluster 5—knowing the regulations. These five clusters coincided with the definition of the three major dimensions of business sustainability proposed by UNESCO [4] and represented almost the whole picture of business sustainability. Cluster 1 was mainly related to environmental aspects, Clusters 2 and 3 were more closely related to the economic aspect, while Cluster 4 was more involved with social perspectives. Although Cluster 5 was not directly linked to any one of the three dimensions, it contained the associated regulations and laws for the employment of the three dimensions of business sustainability.

Table 2 shows all 52 topics. The topics needed to be placed in a series of courses to offer a more comprehensive education on sustainability. Thus, to further analyze the topics and clusters regarding diverse levels or classes of business sustainability, we implemented dIPA with the importance and difficulty measures of topics evaluated by the participants. We used dIPA to categorize the realm of all topics into four quadrants; on the basis of the different levels of importance and difficulty, the topics or clusters that were in one of the four quadrants represented one type of course design. By analysis with dIPA, the topics were suggested to be included in one of the four categories—namely, introductory, fundamental, advanced, and special topics—based on their location in the quadrants (see Figure 1). The introductory course could be integrated with general education, and the topics were from Cluster 4 (on labor and community) and some topics from Cluster 5, such as knowing fundamental business laws and regulations and environmental protection regulations and initiatives, etc. The fundamental course contained a rich spectrum of topics belonging to all the clusters, and due to the high-importance but low-difficulty features, students could learn important topics without much difficulty. The topics could be designed in the course including water and waste reduction and recycling, disaster prevention, labor safety, knowing business sustainability and ethics and having social responsibility, cultivating employee morality and integrity, and awareness of global resource scarcity. The topics for advanced courses in Quadrant 1 were important and difficult and belonged to Clusters 2 and 3, and included investment analysis for business sustainability, internal audit for business sustainability, awareness of ISO certification systems, performing BCM in risks and operations, sustainable product life-cycle planning, and greenhouse gas emission. These topics were more associated with systems and regulations for business sustainability, such as BCM, ISO, product life cycle, and gas emission, and were imperative for the success of business sustainability. The special topics in Quadrant 4 were mostly topics from Clusters 2 and 3, with two from Clusters 1 and 5. The low importance level for this quadrant mainly suggested that the topics were not that important for most students; however, a course on this could be designed for more serious students. Special training would be required as the topics were mostly challenging. Thus, a course such as "Special Topics in Business Sustainability" could be designed to cover topics such as the analysis of corporate annual sustainability data, analysis of the impacts of business operations on social costs, and knowledge of sustainability investment.

This study contributed to business sustainability research by extracting industrial practitioners' knowledge via a brainstorming step in concept mapping, such that the topics and clusters obtained could reflect the opinions and needs of the industry. Moreover, some topics in Clusters 2 and 5 concerning business continuity have not been discussed in previous studies, such as BCM, labor safety, disaster prevention, and knowledge of sustainable procurement-related regulations. Thus, this study helps broaden the academic spectrum of sustainability by including significant topics in business sustainability from industrial outlooks. Later, dIPA was implemented to seamlessly categorize those topics into the four quadrants of dIPA for the progressive course design based on the distinct importance and difficulty levels of the topics. The discussion explained the effectiveness of integrating the two methods together in curriculum design, and the integration provided an additional research route for academics for studying curriculum design. The results from the topics, clusters, and dIPA analysis provided insights relevant to academia and industry. For academia, the results provided a guideline for designing business sustainability curricula in higher education; whereas for industry, the results were beneficial to internal training, as business sustainability had been a comparably new topic for most companies.

One limitation of the study was due to the 14 participants whose expertise was mainly in semiconductor-related areas. Despite the fact that these 14 participants represented many other industries, such as metalworking, chemicals, plastics, packaging, and environmental engineering, they were nevertheless limited in their representativeness by their number and their industries. Moreover, this study was limited by the duration of the brainstorming process only being approximately 90 min; more topics would have been raised if the process had been longer.

One of the major contributions of this research was obtaining opinions from industry; however, we did not obtain opinions from academia. Wu et al. [13] studied the development of global logistic management curriculum from practitioners' perspectives using concept mapping, and also sent out the resultant items to academia. The results show that, even though there are items which foster similar opinions, in general, practitioners and academics have diverse opinions on the importance of the skills students should have, mainly because academia emphasizes the fundamental education more while practitioners focus more on practical knowledge and skills required for work. Because this research aimed to obtain opinions from practitioners, we only obtained opinions from these people. However, future research could perform similar processes while including participants from academia for comparison, even though it is very likely that they will have diverse attitudes on the items and their ranking [58]. This research only provided guidelines for the topics to be included in progressive sustainability-related courses. Future studies could also consider integrating the four approaches proposed by Hurney et al. [53], namely, addition, integration, transformation, and engagement with the results from dIPA in order to obtain a more comprehensive coverage of progressive curriculum design in business sustainability.

Author Contributions: The first two authors contributed to the development of the theory and concept mapping manipulation. The third author helped develop the theory organization and denoted the writing structure.

Funding: This research was funded by the Ministry of Science and Technology, Taiwan, under project nos. MOST 105-2511-S-327-004 and MOST 106-2511-S-003-029-MY3.

Conflicts of Interest: The authors declare no conflict of interest.

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