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IDENTIFICATION OF BEST ELEMENTS FOR PRACTICES IN DEVELOPING ENVIRONMENTAL SUSTAINABILITY ASSESSMENT INDEX

LAILATULFARIHA MAMAT[1], NOOR EZLIN AHMAD BASRI[1]*, SHAHROM MOHD. ZAIN[1], RAHMAH ELFITHRI[2]

[1]Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi Selangor, Malaysia
[2]Institute for Environment & Development (LESTARI), Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia
*Corresponding Author: noorezlin@ukm.edu.my

Abstract

The 1990 Talloires Declaration has increased awareness of the need to preserve the environment. Thenceforth, various initiatives have been undertaken by parties keen in forging a more sustainable environment for future generations. The main objective set for this study is to develop an environmental sustainability assessment index for campuses. In the effort to ensure that environmental sustainability runs concurrent with the development of human capital at university campuses, it is crucial to identify the best elements for practices. In the effort to achieve this objective, content analysis technique along with validity and reliability test were conducted. These methods involve consolidating, extracting, and analysing the sustainability index that are being applied at various universities globally between 1990 and 2010. Only seven elements passed the cut-off value. The best elements identified for practical implementation in sustainability assessment are waste, administration involvement, transportation, energy, education, and water.

Keywords: Content analysis technique, Environmental index; Sustainability; Universities.

1. Introduction

The first official statement by university administrators regarding their commitment to the preservation of environment for institutions of higher education was made in 1990 at an international conference in Talloires, France [1]. At the conference, 22 university presidents and chancellors voiced their concerns regarding the state of the world and produced a document called the Declaration of Talloires.

Sustainability aims to provide comfort and the continuance to all parties involved directly or indirectly in a particular action [2]. There are, however, some discrepancies in the definition of sustainability. Bell and Morse [3] stated that almost every article, research paper, or book on sustainability expressed regret over the fact that the concept of sustainability is so broad without any consensus on its definition. This is usually followed by the author's preferred definition, which further contribute to the discrepancy.

A multitude of sustainability assessment indexes are applied globally on campuses. Tables 1 to 7 show the summary of seven sustainability assessment indexes applied on campuses worldwide. From these sustainable indexes being reviewed, there are a total of 77 elements and 425 indicators which have been used to evaluate the sustainability performance of a campus.

Table 1. University leaders for sustainable future (ULSF) [1, 4-6].

• ULSF was founded to support the 1990 Talloires Declaration.
• More than 400 universities and colleges are signatories to the Talloires Declaration.
• The ultimate goal of ULSF is to support sustainability as a critical focus in teaching, research, operations, and outreach in colleges and universities across the globe through publications, research, and evaluation.
• The sustainability assessment conducted by ULSF includes 7 criteria: curriculum, research, operations, faculty development, outreach programs, opportunities for students, as well as administrative and planning.
• The assessment involves students, faculty, staff, and university administration.

Table 2. Auditing instrument for sustainability in higher education (AISHE) [7, 8].

• AISHE is built on the quality management model developed by the European Foundation (EFQM) and is enhanced by the Quality Management Institute Netherlands (INK). Thus, AISHE also known as the 'Model EFQM-INK'.
• The goal of AISHE is to audit universities (and other institutions of higher education, such as the Dutch "Hogescholen" and German "Fachhochschule") or part of an institutions (such as a separate faculty or course). Twenty different criteria are defined for internal audit which include five areas.
• Based on the EFQM model, criteria were developed with the concept of quality management (Plan-Do-Check-Act). This cycle should be implemented continuously as quality audits are conducted.
• AISHE audits covers four areas, namely reference staff, students, professionals, and community groups.

Table 3. Campus sustainability assessment framework (CSAF) [9-12].

• Founded in 2003 for research scholars and was subsequently developed and adapted for use in Canadian university campuses.
• The goal of the CSAF is to act as an audit tool for various indicators related to students, staff, and faculty of study.
• CSAF combines more than 20 aspects of the existing framework, including ISO 14000 (environmental management).
• CSAF includes two main aspects of the ecosystems and human to help institution of higher education understand the exact environmental and socio-economic impact.

Table 4. College sustainability report card [13].

• The first edition was released in 2007.
• The goal is a grading system that serves as an incentive in the classrooms, which aims to promote sustainability as a priority in college operations and investment practices.
• Nine categories with the same weights were summed to calculate the grade point average (GPA) on a 4.0 scale. The GPA is then translated into an overall grade for sustainability, with the 'A' to 'F' being based on standard grading scale.
• In 2011, 322 institutions in the United States and Canada participated in the assessment.
• In 2012, of the data obtained during the 5-year assessment period, the grade for energy efficiency is very disappointing. As a result, the Sustainable Endowments Institute led the efforts to facilitate investments in energy efficiency by launching the Billion Dollar Green Challenge (GreenBillion.org). Due to the focus being given to this effort, work on the Green Report Card was suspended.

Table 5. University of Maryland sustainability metrics [14-18].

• Environmental Guidelines was published in 2005, and the first annual report for Campus Sustainability was published in 2007. The Climate Action Plan was published in 2009.
• The main goal is self-reporting which would allow University of Maryland to see the achievements of the assessment.
• Evaluation is carried out each year to determine whether the trend for the precious year show: i. Progress in achieving sustainability ii. No significant progress iii. Trend in the wrong direction
• Although this metrics is adopted only by the University of Maryland, these self-reporting assessment is to be done each year to measure sustainability which would then allow for improvement measures can be taken for relevant indicators

Table 6. UI greenmetric world university ranking (UIGreenmetric) [19-22].

- Launched in 2010
- The main objectives are:
  i. Open to global participation
  ii. Can be accessed by institutions of higher education in both developed and developing countries
  iii. Contribute to the preservation of academic discourse in education and green campus
  iv. Promote university-led social change with regard to sustainability goals.
- Existing systems referred to during the design phase are The Holcim Awards Sustainability, GREENSHIP, The Sustainability, Tracking, Assessment and Rating System (STARS), and The College Sustainability Report Card (also known as the Green Report Card).
- The design of the university rating system is based on the Times Higher Education World University Rankings (THE), the QS World University Ranking, the Academic Ranking of World Universities (ARWU), and the Webometrics Ranking of World Universities (Webometrics).

Table 7. Sustainability tracking, assessment & rating system (STARS) [23-25].

- First developed in 2008 by the Association for the Advancement of Sustainability in Higher Education
- In 2012, 300 universities submitted their assessment reports to STARS
- Present Platinum, Gold, Silver, and Bronze Award to evaluated universities.
- The goal of STARS are:
  i. Provide a framework for understanding sustainability in all sectors of higher education.
  ii. Enable continuous comparisons between all institutions by using the same set of measurements with full participation of campus committee.
  iii. Create incentive to continue working towards achieving sustainability.
  iv. Facilitate the sharing of good practices in sustainability and the achievements of higher performance.
  v. Build stronger and more extensive sustainable campus communities.

This study focused on developing an environmental sustainability assessment index for campuses. It is important to identify the best elements for practices in the effort to ensure that environmental sustainability runs concurrent with the development of at university campuses. In order to achieve the objective of this study, content analysis technique together with validity and reliability test were conducted.

2. Content Analysis Technique

Content analysis is a research technique used to make reproducible and legitimate conclusion from data with the aim of providing knowledge and new insights that are representatives of the facts and are a practical guide for action. In short, this technique

is used by researchers to analyse information from a text or a document in a systematic and orderly manner in order to make inferences from it.

Open materials, which do not need to be created, or already existing documents collected by the researchers are analysed. Literature review is usually done with two objectives: first, to summarize existing research to identify patterns, themes, and related issues. Second, to identify the content of the concept in their respective fields and contribute to the development of a new theory [26].

According to Krippendorff [27], content analysis is unique and is designed to be fast when used concurrently with statistical techniques, which are used to manage large amounts of data in a more productive and meaningful way. This view is supported and described in detailed by Seuring and Gold [28]. The scope of comprehensive information analysis comprises two phases of analysis. In the first phase, texts or documents are analysed and converted into a form of statistics. In the second phase, the contents which are implicit in the texts or documents are extracted. This requires interpretation of the meaning of implicit arguments contained in the text being studied. Together, the two phases form a powerful technique which combines content analysis of qualitative approach in maintaining important information by using quantitative analysis method. There are many advantages in using content analysis. However, it should be noted that this technique also has some limitations. The strengths and limitations of content analysis are summarized in Table 8.

Three approaches, namely conventional, directed and summative, are used in this study of the content analysis technique. The differences between these three approaches are presented in Table 9.

Table 8. Strengths and limitations of content analysis [29].

Strength
• Ability to use previous data to detect change over time at a low cost compared to other methods
• Can be used to detect change in an event or occurrence
• Useful in building a new database system
• Allows researchers to improve and add value to previous studies
• Allows trend analysis over a long period of time
• Any archived communication material from interviews, questionnaires, documents, and diaries can be used as research material. This expands the feasibility of the technique.
Limitation
• Content analysis can identify the relationships and correlations between variables, but, by itself is not able to explain how they happen.
• Can be time consuming due to the amount of material which must be studied.
• Can be difficult to computerize since this requires a more complex coding scheme.

Table 9. Differences between three approaches in content analysis [30].

Approach	Study begins with	When codes or keywords are defined	Source of codes or keywords
Conventional	Observation	During data analysis	Codes are derived from data
Directed	Theory	Before and during data analysis	Codes are derived from relevant theory
Summative	Keywords	Before and during data analysis	Keywords are derived from interest of researchers or review of literature

Three approaches, namely conventional, directed and summative, are used in this study of the content analysis technique. The differences between these three approaches are presented in Table 9.

Therefore, based on the difference in the initial stage, determination of research code or keyword is made to suit the investigation to be carried out. The summative approach is recommended for this study. Compared to conventional of analysis which is more focused, summative analysis is based on keywords derived from a collection of literature before and during the data analysis stage. This study does not require any observation or clear and strong theory during the initial stage, which state that the presence of certain elements will determine the success of a university sustainability index.

According to Wiese et al. [31], summative approach is deemed to be more suitable for analysis of sustainability in research studies as well as for daily practice. This approach usually begins with identification and determination of key words in the text. Quantification or calculation is then done on the basis of the keywords. The results of such calculations are given inference frequency by researchers according to the needs. Content analysis is usually defined by six-step procedure, as summarized in Fig. 1.

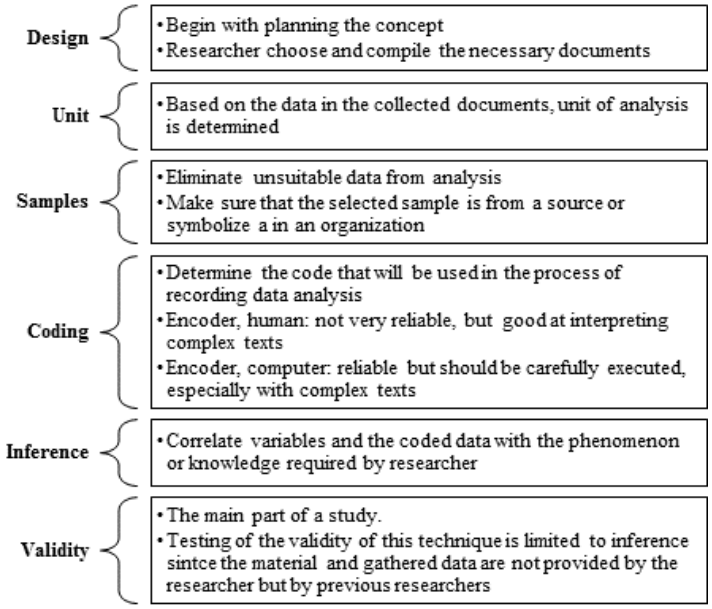

Fig. 1. Procedures for content analysis technique [32].

Various standard values are used to determine reliability, and the value chosen is dependent upon its application. Seven agreement coefficients can be used when using dichotomous data, namely data with two possibilities(agree or disagree), to analyse a study. They are percentage of agreement (*Ao*), Osgood (*CR*), Bennet (S), Scott *(μ*), Krippendorf *(α),* Cohen *(κ),* Benini *(β*) [33, 34].

Table 10 shows the two coefficients used in this study, *kappa (κ)* and alpha *(α).* Some researchers are of the opinion that an α coefficient greater than or equal to 0.80 is very suitable for application in this instrument. However, an α coefficient greater than or equal to 0.70 is also acceptable [35]. Viera and Garrett [36] conducted a study using a κ coefficient greater than or equal to 0.57. Therefore, it can be concluded that the value required in a particular study depends on the suitability of the assessment.

Table 10. Interpretation of statistical test [34, 36, 37].

Test	Cohen's Kappa *(κ)*	Cronbach's Alpha *(α)*
Interpretation	< 0.00 : Less than chance agreement	< 0.50:; Unacceptable
	0.00 - 0.20 : Slight agreement	> 0.50 : Poor
	0.21 - 0.40 : Fair agreement	> 0.60 : Questionable
	0.41 - 0.60 : Moderate agreement	> 0.70 : Acceptable
	0.61 - 0.80 : Substantial agreement	> 0.80 : Good
	0.81 - 1.00 : Almost perfect agreement	> 0.90 : Excellent

3. Results and Discussion

Analysis of information and data in this study was done using IBM SPSS software for reliability testing and agreements.

3.1. Sampling and coding

Technical analysis begins with collecting information on university sustainability assessment issued and used between 1990 and 2010. In the selection process, all elements from seven indexes were consolidated and aggregated by keywords. A set of 11 keywords were analysed using IBM SPSS software.

Research and screening were done once the sustainability assessments of the listed university were collected. The main question that serves as a guide in the analysis is whether or not the elements are incorporated into the environmental sustainability indicators stated for the sustainability of the university. Table 11 shows the list of elements required for a sustainable university. A total of 77 elements with 425 indicators were collected for sustainability assessment. Abbreviation of sustainability assessment is used as item code to simplify the coding process.

Table 12 presents a summary of the frequency the elements were used keywords for each item code. Of the eleven elements, Administration was used most frequently, namely100%. Both Soil and Innovation recorded lowest percentage of applications of 14.3%. Other elements show almost the same frequency of application. Just by looking at the percentage values that are almost the same, it is quite difficult for researchers to decide which of these elements the best practices are. Thus, the findings for the coding process were put through validity and reliability testing for further evaluation through statistical methods.

Table 11. Elements for sustainable university.

Sustainability Index	Item Code	Number of elements
University Leaders for Sustainable Future	ULSF	7
Auditing Instrument for Sustainability in Higher Education	AISHE	20
Campus Sustainability Assessment Framework	CSAF	10
College Sustainability Report Card	TCSRC	9
University of Maryland Sustainability Metrics	UMSM	7
Sustainability Tracking, Assessment & Rating System	STARS	18
UI Greenmetric	UIG	6
		77

Table 12. Keywords for elements according to item code.

Keyword	ULSF	AISHE	CSAF	TCSRC	UMSM	STARS	UIG	Application (%)
Administration	+	+	+	+	+	+	+	100
Involvement	+	+	+	+	+	+		85.7
Education	+	+	+		+	+	+	85.7
Health & Wellness			+			+		28.6
Water			+		+	+	+	57.1
Energy			+	+	+	+	+	71.4
Air			+			+		28.6
Transportation				+	+	+	+	57.1
Waste			+	+		+	+	57.1
Soil			+					14.3
Innovation						+		14.3

'+' the element listed is applied in the sustainability index of the universities.

3.2. Validity and reliability test

The elements and items encoded into the IBM SPSS software were analysed for validity and reliability. The keyword Administration was used as a constant variable since this element was found in all ratings with 100% application. Table 13 and 14 presents the summary for the agreement and reliability tests.

The cut-off value chosen for this study is $\alpha \geq 0.70$ and $\kappa \geq 0.50$. Based on the results presented in Table 6, the α value for all 11 items exceed the cut-off value. Four items in Table 7 do not reach cut-off value, namely Health and Wellness, Air, Land, and Innovation. All four items were removed from the list and α test was carried out again with the remaining seven items. This second test is important to ensure that only impactful items are included.

The value for Cronbach's alpha is higher and closer to 1.000 when the four items were excluded. Thus, only seven items were included due to the better α value, which is closer to 1.000 compared to the α value for 11 items; all seven items exceed the cut-off value for the κ test.

Table 13. Result for Cronbach's Alpha test.

Cronbach's Alpha	N Item
0.907	11
0.925	7

Table 14. Result for Cohen's Kappa *(κ)* test for 11 keywords through crosstab between Administration and 10 other elements.

Element	Kappa Cohen
Involvement	0.837
Education	0.837
Water	0.533
Energy	0.682
Transportation	0.533
Waste	0.533
Health & Wellness	0.255
Air	0.255
Soil	0.125
Innovation	-0.021

4. Summary and Conclusions

Seven elements that passed the validity and reliability test were selected as the best elements for practices in university environmental sustainability index. They are Administration, Involvement, Education, Water, Transportation, Waste, and Energy. This study will be help institutions of higher education to use these elements as their focus area in developing environmental sustainability assessment index.

One recent research which used content analysis techniques is a study on obesity which share health information through social networking sites such as Twitter that began on 23rd January 2012 and ended on 23rd March 2012 [38]. Additionally, Xu et al. [39] studied the development of science-based research communication on scientific publications in China between 1986 and 2014, while Erdogan [40] used this technique to develop problem-based learning through scientific publications in Turkey between 2002 and 2013.

Based on the examples cited above, it is obvious that content analysis was used rather extensively. In this particular study, the researchers try to identify the best element for practices in higher education environmental sustainability index through indexes that were applied and published between 1990 and 2010 to identify the trend in the research subject. This process provides the researchers with more knowledge in identifying the needs to fill the knowledge gaps between current and future requirements.

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