IMPACT OF SUSTAINABILITY EDUCATION ON QUANTITY SURVEYORS IN SRI LANKA

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ABSTRACT

Sustainability Education (SE) is recognised as a lifelong learning process aiming towards sustainable development which spreads beyond the limitations of formal education. In order to ensure proper commitment towards sustainable development through sustainable construction (SC) concept, quantity surveyor (QS) as a leading professional in the construction industry should go through a proper SE. Even though certain HEIs (Higher Education Institutions) in Sri Lanka have incorporated SE up to a certain extent into their curriculum, their effectiveness is questionable. Addressing this gap, the research analyses perceived importance, level of SE received and the effectiveness of SE of Sri Lankan QSs while identifying the knowledge areas where improvements are required. A comprehensive literature review was executed identifying knowledge areas to be included in SE of QSs globally. Through a survey of experts, 39 knowledge areas related to quantity surveying education were identified under six main categories considering the local context. Even though Relative Important Index (RII) values denoted that SE is substantially important to QSs, overall SE level of Sri Lankan QSs was found to be in 'moderate level'. QSs perceived their SE more on 'economic sustainability' as it exhibited the highest mean and RII values. Moreover, the results found that curriculum contribution to deliver SE is currently lower and QSs gain more knowledge on sustainability through industry practice than through formal education. The created matrix plot indicated that certain knowledge areas require further attention in curricula in HEIs which is revealed as the strategy that needs improvements.

Keywords: *Curriculum; Higher Education; Quantity Surveyor; Sustainability Education.*

1. INTRODUCTION

Despite the positive impacts that construction industry makes on a country's economy, it also has substantial negative effects on the natural environment (Xia et al., 2016). As per Ofori (2000), construction activities cause certain adverse environmental and social impacts and these impacts could be minimised through the concept of SC. The concept of SC is being adopted to align the construction industry with the sustainable development process (Murray & Cotgrave, 2009). SC considers three main domains namely environmental protection, social well-being and economic wealth (Tan et al., 2011).

In order to attain benefits through SC, construction professionals such as QSs, architects and engineers should have substantial knowledge and skills related to SC concept (Kwon et al, 2010). In this vein, increased recognition on SC has influenced to enhance the need for SE (Thomas & Nicita, 2002). As depicted by Wu and Shen (2016), "sustainability education", "education for sustainability", and "education for sustainable development" are interchangeable and synonymous terms in this field and this paper refers the term "sustainability education (SE)". As discussed by Wijesundara and Gunarathne (2012), construction professionals require SE to lead proactive actions towards SC and to apply specific knowledge and skills to take required actions and decisions together with self-motivation.

A research done by Ekundayo et al. (2012) for quantity surveying students in Northern University at United Kingdom (UK) indicated that there is a considerable sustainability related void in the quantity surveying

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education. In the Sri Lankan context, Samaratunga (2013) carried out a study intended to discover the relationship between the sustainable design practice and architectural education. The study concluded that there is a gap between architectural education on sustainability and the practice approaching Sri Lankan architectural students.

QS is one of the key professionals in the construction industry who adds value to the contractual and financial management of construction projects throughout the various stages (Hardie et al., 2005). As stated by Royal Institution of Chartered Surveyors, QSs can contribute to SC through lifecycle costing, alternative materials and technologies, renewable energy schemes, recycled content schemes, appropriate methods of supply chain management, value engineering and the ethical sourcing of materials and labour throughout the lifespan of the project (RICS, 2007). Therefore, considering the significant role played by quantity surveying professionals in promoting SC, it is essential for QSs to receive a proper SE in order to gain best outcomes through SC (Xia et al., 2016).

Since the Urban Development Authority in Sri Lanka, Green Building Council of Sri Lanka and the Ministry of Environmental and Natural Resources of Sri Lanka have directed their consideration towards sustainability, it is clear that there is an increasing trend towards sustainable development in Sri Lanka. In this vein, QSs involvement will be vital to achieve SC as a leading professional in the industry. Karunasena et al. (2016) identified the lack of education in SC concept as one of the significant barriers to implement SC in the Sri Lankan construction industry. Hence obtaining an effective SE has identified as essential for QSs.

Perera and Hewege (2016) mentioned that there is a strong positive relationship between incorporating sustainability in the curriculum and students' knowledge and understanding of sustainability through their study. Adegbile (2012) showed with a study in Nigeria, that there is a need to introduce sustainability related curriculum to higher education in architecture field to improve ability of providing sustainable design solutions within the built environment. Though certain construction related higher education programs have incorporated SE up to a certain extent into their curriculum, the effectiveness is questionable. Studies conducted focusing on the SE level of Sri Lankan QSs are lacking. Thus, the non-appearance of long standing viewpoint in literature and the need to identify the effectiveness of SE in Sri Lankan construction industry leads to a researchable gap in identifying impacts of SE on QSs in Sri Lanka. Addressing this gap, this study aimed to analyse the impact of SE on QSs in Sri Lanka.

2. LITERATURE REVIEW

Literature findings present about the concept of SE and knowledge areas that QSs should be educated in, which provide a platform to achieve objective one.

2.1. SUSTAINABILITY EDUCATION

The learning process on making decisions considering the ecology, economy and equity of entire communities in the long-term future is identified as SE (UNESCO, 2013). United Nations Education, Scientific and Cultural Organization (UNESCO) took the lead to approach towards sustainable development through the Decade of Education for Sustainable Development (DESD) (from 2005 to 2014) by integrating principles, values and practices of sustainable development into education and learning programs (UNESCO, 2013). Hence SE is considered to be essential to achieve sustainability.

SE has been identified as a vital element to affirm sustainable development by most of the HEIs around the world (Velazquez *et al.,* 2005). Several international declarations can be seen with the intention of providing guidelines and frameworks to HEIs to apply sustainability concepts into their systems (Lozano *et al*., 2013). Commencement with the Stockholm Declaration in 1972, a substantial development could be identified in international sustainability declarations applicable to higher education where many HEIs attempt to turn out to be more sustainable by signing these declarations (Wright, 2002).

Since the implications of SE vary among different disciplines, the various strategies can be adapted for educating, to suit with the nature of the discipline (Wijesundara & Gunarathne, 2012). It verifies that most of the findings in previous studies highlight four main education strategies in SE within higher education arena namely curriculum, research, campus operations and outreach. According to Uhl and Anderson (2001), the most effective way to attain SE by QSs is to gain adequate sustainability knowledge and skills through higher

education before entering into the construction industry. Curriculum afford the highest contribution of student learning experience in higher education regarding sustainable development compared to other strategies (Hopkinson *et al.,* 2008).

Mazhar and Arain (2015) mentioned that there is an increasing demand for construction professionals who are competent with sustainable skill sets which would be critical to improve sustainability practices with the increasing complexity of the construction projects. Therefore, as future construction professionals, construction related students should have gone through proper SE during their higher education in order to build up knowledge, attitudes and competencies on SC (Kwon *et al.,* 2010). Thus, SE should be incorporated within construction related higher education programmes focusing on QSs as one of major construction professionals.

2.2. SUSTAINABILITY KNOWLEDGE AREAS RELATED TO QUANTITY SURVEYING EDUCATION

Quantity surveying professionals are experiencing changing roles in SC process where HEIs have the responsibility to develop their competencies and skills up to the required level (Thayaparan *et al.,* 2011). Furthermore, the competencies and skills required by a QS in performing SC have identified by various professional bodies such as Royal Institution of Charted Surveyors (RICS), Australian Institute of Quantity Surveyors (AIQS), Pacific Association of Quantity Surveyors (PAQS) and Institute of Quantity Surveyors Sri Lanka (IQSSL) (Yogeshwaran *et al.,* 2014). Beside the accountability for sustainability, SE has become a challenge for quantity surveying profession (RICS, 2012; Yogeshwaran *et al*., 2014). Hence, the requirement for SE for QSs is well-established.

Ekundayo *et al.* (2012) have developed a framework which includes knowledge areas to be included in QS education under six main categories. The framework has been developed capturing perceptions of university academic staff and industry professionals in UK (Ekundayo *et al.,* 2012). The same framework including 46 sustainability knowledge areas is also adapted by Tan *et al*. (2017) during their research which has focused on quantity surveying students in UK universities. Xia *et al*. (2016) also found a set of knowledge areas in SE of quantity surveying professionals, through a case study of Queensland University of Technology (QUT) quantity surveying course in Australia. Also, they categorised knowledge areas under environmental, economic and social sustainability pillars and their findings denote that environmental and economic sustainability were more visible than social sustainability (Xia *et al*., 2016).

Altogether Literature review identified 56 knowledge areas related to SE of QSs under six main categories namely; Background knowledge and concept, Policies and regulations, Environmental issues, Social issues, Economic issues and Technology and innovation which were presented by Ekundayo *et al.* (2012) and Xia *et al.* (2016) and also supported in a study by Tan *et al.* (2017) and further warranted by several other studies such as Ofori (2000), Ogunbiyi *et al*. (2013), Pitt *et al*. (2013) and Verster (2005).

3. METHODOLOGY

After the comprehensive literature review which identified 56 sustainability knowledge areas that QSs should be educated in, a survey of experts was conducted in the form of semi structured interviews with three experts in the field of quantity surveying selected using purposive sampling. They have substantial experience in the industry and/or academia for more than 20 years. The experts were asked two main questions; first to validate and refine SE knowledge areas identified through the literature considering their relevance to Sri Lankan context and as the second question to identify most appropriate category for the SE knowledge areas which are commonly identified under two or more categories in literature review and finally the outcome was used to develop a questionnaire.

Respondents of questionnaire survey had to indicate strategies by which SE is obtained, the perceived importance and SE level considering each knowledge area. The questionnaire was distributed among Sri Lankan QSs adapting convenience sampling which is a non-probability sampling technique.

The importance of each identified knowledge area in the role of QS were analysed with regard to categories, by ranking categories with their Relative Importance Index (RII) values using below equation.

$$RII = \frac{\sum_{i=1}^{n} Wi}{A \times N} \qquad \text{Eq. (01)}$$

Where, W=Constant expressing the weighting given to each response, A=The highest weighting, n=The frequency of responses, N=Total number in the responses

Mean Weighted Rating (MWR) values of each category were compared to analyze the SE level of Sri Lankan QSs using below equation.

$$MWR = \frac{\sum_{i=1}^{n} Wi}{N} \quad \text{Eq (02)}$$

Where, W=Constant expressing the weighting given to each response, n=The frequency of responses, N=Total number in the responses

Importance Performance Analysis (IPA) Matrix was adapted to determine the effectiveness of SE of Sri Lankan QSs using the data collected through the questionnaire. The IPA matrix consists a pair of coordinate axis in which 'y' axis denotes the 'importance' while the 'x' axis depicts the 'performance'. In the matrix created in this study 'x' axis was identified as SE level while 'y' represented the importance of each knowledge area in the role of QS. Hence the effectiveness of SE could evaluate by analysing the matrix illustrated in Figure 3 where 'Quadrant I' denotes the highest effectiveness while 'Quadrant II' was given more concern as it includes knowledge areas that improvements should be made in quantity surveying education

4. DATA ANALYSIS AND FINDINGS

Through expert validation, 39 knowledge areas were determined as relevant within the Sri Lankan context as presented in the Table 1, and considered for further analysis. Moreover, the categorization of knowledge areas identified within the literature was also validated considering the Sri Lankan context with the usage of expert views. The knowledge areas identified as common under two or more categories were given most appropriate category considering the expert opinion. All 39 knowledge areas were categorised under six main categories namely Background knowledge and concept, Policies and regulations, Environmental sustainability, Social sustainability, Economic sustainability and Technology and innovation.

Table 1: Knowledge Areas for SE of QSs - Findings of Survey of Experts

Category/ Knowledge areas	
A. Background knowledge and concept	**D. Social sustainability**
A1. Sustainable development overview and principles	D1. Corporate Social Responsibility (CSR)
A2. Impact of the construction industry on the environment	D2. Individual sustainability/ morale
A3. Sustainable construction concept and strategy	D3. Cost Benefit Analysis
A4. Role of QS in sustainable development	D4. Ethical issues such as ethical sourcing of materials and labour, for instance
	D5. Health and safety
B. Policies and regulations	**E. Economic sustainability**
B1. Building regulations related to sustainability	E1. Cost planning and management
B2. Energy Performance certificates	E2. Value management or engineering
B3. International conventions and treaties	E3. Sustainable procurement strategies
B4. Planning and regulation act	E4. Feasibility studies
B5. Environmental act	E5. Whole-life appraisal/ Life cycle costing
	E6. Sustainable project management practices
	E7. Sustainable facility management practices
	E8. Environmental economics
C. Environmental sustainability	**F. Technology and innovation**
C1. Protecting and enhancing the built and natural environments	F1. Professional and management software packages such as BIM, etc.
C2. Environment Impact Assessments (EIA)	F2. Modern methods of construction
C3. Environmental Management Systems; ISO 14001	F3. Supply chain management
C4. Environmental Assessment Methods; BREEAM, LEED	F4. Effective information control and management (using e-business)

Category/ Knowledge areas
C5. Reducing energy consumption and greenhouse gases
C6. Carbon Agenda
C7. Sustainable transport
C8. Sustainable building practices
C9. Green building materials
C10. Sustainable and efficient energy
C11. Sustainable building services
C12. Raw materials usage trend
C13. Waste reduction principles

Questionnaires were distributed among 97 QSs who are currently practicing in the Sri Lankan construction industry and 69 were responded resulting a response rate of 71.13%. Demographic characteristics of the 69 respondents are elaborated in Table 2. Considering the number of higher education institutes offer QS education in Sri Lanka, and the QSs available in Sri Lanka, this can be considered as a representative sample.

Table 2: Demographic Characteristics Questionnaire Respondents

Variable	Categories	Frequency	Percentage
Type of organization	Contractor	27	39%
	Consultant	29	42%
	Client	13	19%
Experience as a QS	1-10	34	49%
	10-20	24	35%
	More than 20	11	16%
Type of higher education received	BSc - Local	39	57%
	BSc – (Local in collaboration with International Institutions)	16	23%
	Diploma	14	20%

4.1. IMPORTANCE OF SUSTAINABILITY EDUCATION

The perception of the respondents about the importance of each knowledge area to the role of QS were measured. They were asked to indicate the level of importance using a five points scale (1 - "Not important", 2 - "Little important", 3 - "Somewhat important", 4 - "Important" and 5 - "Highly important"). The relative importance of each knowledge area was calculated using RII and importance of each category is presented in Figure 1.

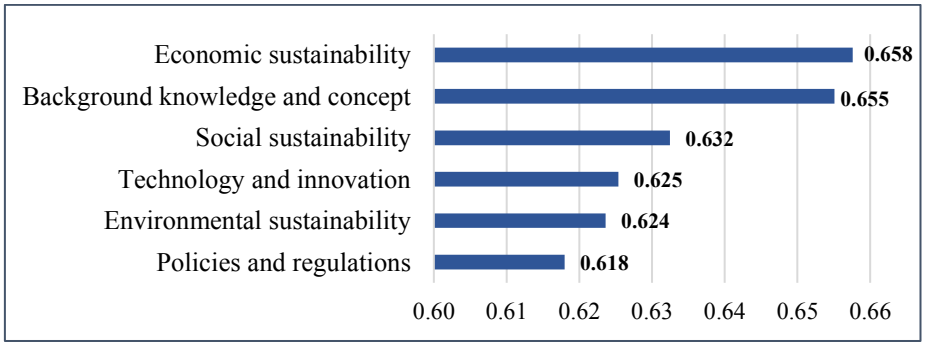

Figure 1: RII Value for Importance Based on Categories

Figure 1 indicates that category E - 'Economic sustainability' and category A – 'Background knowledge and concept' have substantial relative importance than the other four categories and 'Economic sustainability' driven to the top denoting the highest RII value of 0.658. 'Policies and regulations' reported the lowest RII value of 0.618.

4.2. SUSTAINABILITY EDUCATION LEVEL

The respondents were asked to indicate the level of SE they gained in a five points scale (1- "Not educated", 2- "Little educated", 3- "Somewhat educated", 4- "educated" and 5- "Highly educated"). Figure 2 demonstrates the MWR value of each category with regard to the SE level of the Sri Lankan QSs.

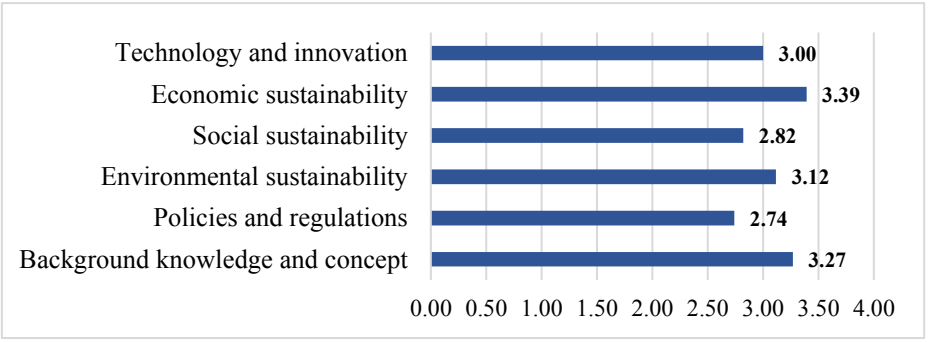

Figure 2: MWR Value for SE Level Based on Categories

QSs in Sri Lanka denote the highest education level within the Category E- 'Economic sustainability' with MWR value of 3.39. When three pillars of SC are considered within SE of Sri Lankan QSs, the priority order from highest to lowest varies as economic, environment and social. The overall SE level was calculated as 3.09 by taking the average of MWR values from all categories where overall SE level of QSs can be considered as 'moderate level'.

4.3. EFFECTIVENESS OF CURRENT SUSTAINABILITY EDUCATION

Although there are important knowledge areas to the role of QS, the SE level is yet to be questionable. Hence, in order to seek on the effectiveness of SE received by QSs, IPA matrix was created scattering the MWR values of perceived importance and SE level of each knowledge area. Quadrants were formed using the neutral values in the two scales where both are having 3.00 as the middle value in the five-scale considered. IPA Matrix was illustrated in Figure 3.

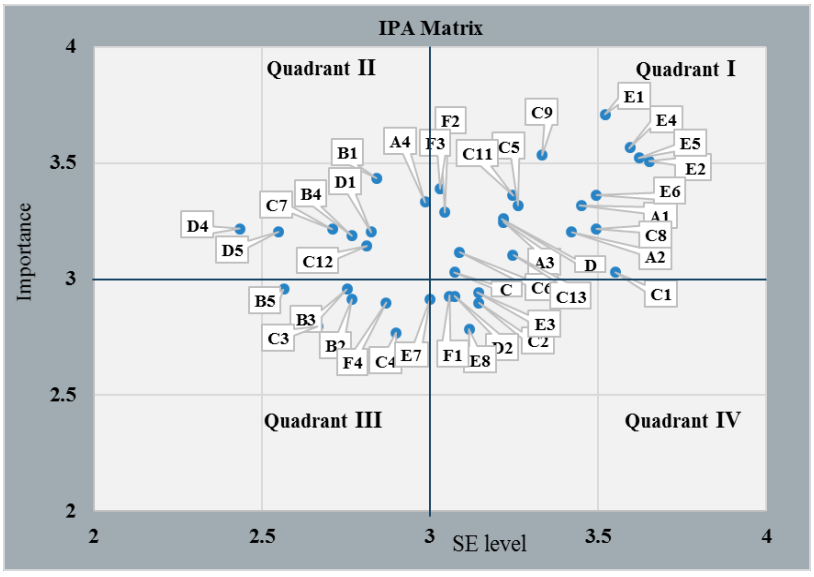

Figure 3: Matrix Plot for Importance vs SE Level

Quadrant I denotes the SE knowledge areas with highest SE level and highest level of importance in which displaying the highest effectiveness in the SE (keep up with the good work). The Quadrant II is consisting with knowledge areas with higher importance but, lower SE levels are received (area for improvement). Quadrant III represents the knowledge areas with lower education level and lower importance where lower priority can be given. Knowledge areas with higher SE level and lower importance are given in the Quadrant IV (possible overkill). Hence knowledge areas in Quadrant I and II need to be focused.

Quadrant I includes 19 knowledge areas and these effective knowledge areas should be continuously adapted within the curriculum. Further, eight knowledge areas that require improvements in the incorporation to formal education are identified in the Quadrant II.

Sustainability Education Strategies

The composition of SE strategies illustrating in which ways respondents have obtained SE, are denoted in Figure 4.

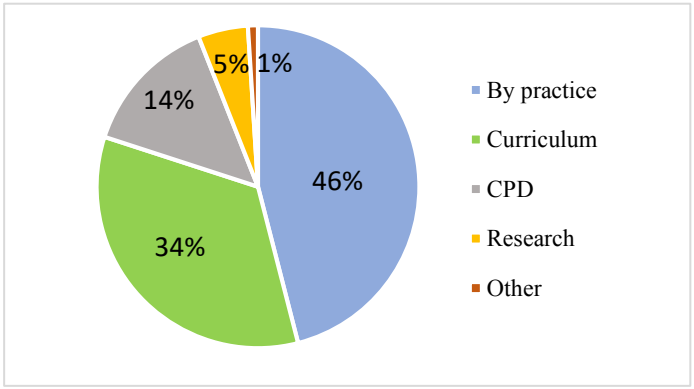

Figure 4: Composition of SE Strategies

It can be noted in Figure 4 that the majority of the respondents (60% - combining 'By practice' and 'CPD') have gained SE during practice in the industry. Only 39% of respondents (combining 'Curriculum' and 'Research') have gained SE through formal education. Some of the 'other strategies' mentioned by the respondents are symposiums and courses which address the given sustainability aspects within the quantity surveying education. Thus, the results depict that the contribution of the curriculum to SE is substantially lesser than the SE gained through the practice.

The Detail Evaluation of Sustainable Strategies in Knowledge Areas of Quadrant I and II

Since there are different strategies, Quadrant I and II were further analysed based on two main strategies 'By practice' and 'Curriculum' as presented in Figure 5.

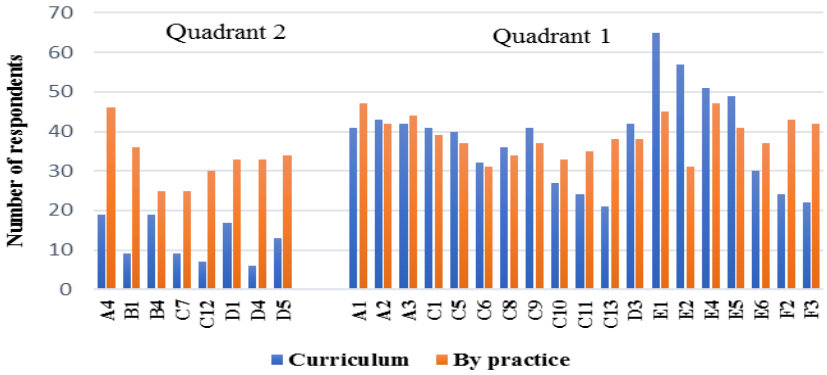

Figure 5: 'Curriculum' and 'By Practice' Comparison of Quadrant I and II

It can be noted that the values under the industry practice and curriculum are almost similar in the knowledge areas in the Quadrant I. Moreover, the SE gained through the curriculum is substantially higher in the Quadrant I when compared with Quadrant II. A massive gap can be seen between curriculum and practice within the knowledge areas in Quadrant II. Since Quadrant II depicts a lower SE level apart from higher importance of those knowledge areas, the less curriculum contribution can be the reason behind. It reveals that knowledge areas with lower SE level have less contribution from curriculum but obtained mainly by practice.

Since QSs can gain knowledge through practice over the time, the analysis was carried out to seek the impact of level of experience of respondents on the SE level as illustrated in Figure 6. As expected, it can be noted in Figure 6 that more experienced QSs have gained higher SE level. The reason could be that more experience denotes more industry practice within the role of the QS. So further analysis was done considering 'Curriculum' and 'By practice' contribution to SE level with regard to experience level as shown in Figure 7.

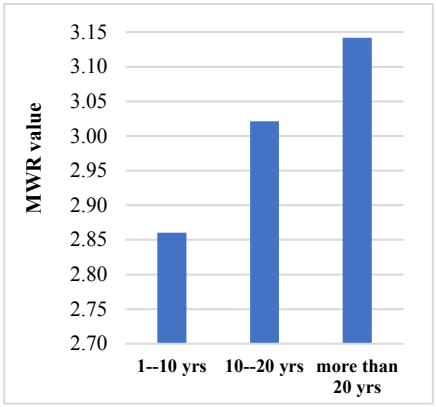

Figure 6: SE Level based on Level of Experience

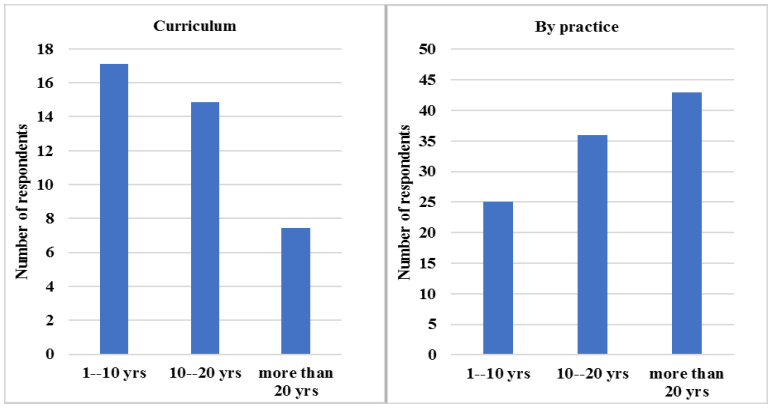

Figure 7: Curriculum' and 'By Practice' Contribution as per the Experience Level

As expected, most of the QSs with higher experience level have gained SE more through industry practice. Referring to Figure 7, the behaviour of the 'number of respondents educated through curriculum' is solely opposite with 'number of respondents who gained education through practice' related to their experience level. Hence the results imply that the quantity surveying curriculum has been increasingly incorporated SE within its content in the near present than in the past. Therefore, incorporation of SE to curriculum has increased over the time but there are knowledge areas which are important but yet to be improved and to be incorporated to formal education through curriculum.

5. DISCUSSION

As explained in the Introduction Section, Karunasena et al. (2016) highlighted lack of education in SC concept as one of the significant barriers to implement SC in Sri Lankan construction industry. Since the findings elaborated that Sri Lankan QSs are having a 'moderate SE' level, the findings seem to be still supporting the literature up to certain extent.

Referring to Sub Section 2.2, in a study which has done for quantity surveying students in UK, the level of quantity surveying students' knowledge had been evaluated (Tan et al., 2017). When the results of that study were compared with the findings of current study, it can be noted that the priority of incorporating three pillars is entirely same in both studies in UK and Sri Lanka as economic being the highest and then environmental and social. Further 'Policies and regulations' is least addressed within the quantity surveying curriculum of UK and Sri Lanka.

Referring to Sub Section 2.2, due to less visibility of knowledge areas on social sustainability in QUT quantity surveying course, the requirement to incorporate social knowledge areas has been emphasised (Xia et al., 2016). Samaratunga (2013) concluded in her study (Refer Introduction Section) that Sri Lankan architects more perceived towards environmental sustainability within their education, where this study denoted Sri Lankan QSs are more perceived towards economic sustainability among the three pillars economic, social and environment. Hence incorporating economic pillar more in the QS education is reasonable.

Results show that curriculum contribution is identified as insufficient with regard to quantity surveying education in Sri Lanka. Referring to Sub Section 2.1, curriculum afford the highest contribution of student learning experience in SE compared to other strategies in United Kingdom (Hopkinson et al., 2008). Hence curriculum incorporation within the education of Sri Lankan QSs is required to be upgraded.

6. CONCLUSIONS

The research findings revealed that SE has a substantial importance to the role of a QS. Moreover 'economic aspects' are perceived more importance within the role of a QS. The overall SE level of Sri Lankan QSs lies in the 'moderate level'. However, current SE for Sri Lankan QSs have focused more on economic perspectives overcoming other two pillars; social and environmental. The reason could be the given perspective of economics of construction which is crucial for QSs.

Among different strategies that QSs have gained SE, Sri Lankan QSs have gained SE mainly 'by practice'. Although incorporation of sustainability knowledge areas within the quantity surveying curriculum shows a gradual development over the time, it is yet to be improved in several areas as identified with a gap between importance and level of SE received.

The study highlights the SE level and the effectiveness of SE gained by Sri Lankan QSs. The findings proved that the most effective knowledge areas tend towards 'economic sustainability'. It is found that further improvements should be made focusing the curriculum of HEIs as suggested through the study. It supports the view highlighted by scholars in the global context that more focus should be given to curriculum improvements in higher education related to the key professionals in the industry in achieving sustainable construction goals in a country (Adegbile, 2012; Perera and Hewege, 2016). Further education level on effective knowledge areas should be maintained and can also improve within HEIs. Thus, SE need to be improved among QSs in Sri Lanka.

7. REFERENCES

Adegbile, M., 2012. Nigerian architectural education in a sustainable age. In: *Proceedings of Sustainable Futures: Architecture and Urbanism in the Global South Conference*, 224–231.

Ekundayo, D., Zhou, L., Udeaja, C., Pearson, J. and Perera, S., 2012. Mapping of sustainability education to construction related curricula: A case study of quantity surveying (QS) degree programme. In: *Proceedings of RICS COBRA Conference 2011*, 12–13.

Hardie, M., Miller, G., Manley, K. and McFallan, S., 2005. *The quantity surveyor's role in innovation generation, adoption and diffusion in the Australian construction industry* [online]. Available from: https://digitalcollections. qut. edu. au/1661/ [Accessed 18 August 2017].

Hopkinson, P., Hughes, P., and Layer, G., 2008. Sustainable Graduates: Linking Formal, Informal and Campus Curricula to Embed Education for Sustainable Development in the Student Learning Experience. *Environmental Education Research*, *14(4),* 435–454.

Karunasena, G., Rathnayake, R. M. N. U. and Senarathne, D., 2016. Integrating Sustainability Concepts and Value Planning for Sustainable Construction. *Built Environment Project and Asset Management, 6(2),* 125–138.

Kwon, H., Ahn, Y. H. and Shin, H., 2010. *The Attitude of Construction-Related Students toward Sustainability in the Built Environment in South Korea* [online]. Available from: https://peer.asee.org/the-attitude-of-construction-related-students-toward-sustainability-in-south-korea.pdf [Accessed 25 August 2017].

Lozano, R., Lukman, R., Lozano, F. J., Huisingh, D. and Lambrechts, W., 2013. Declarations for Sustainability in Higher Education: Becoming Better Leaders, Through Addressing the University System. *Journal of Cleaner Production, 48,* 10-19.

Mazhar, N. and Arain, F., 2015. *Leveraging on Work Integrated Learning to Enhance Sustainable Design Practices in the Construction Industry, 118*, 434–441.

Murray, P. E. and Cotgrave, A. J., 2009. Sustainability Literacy: The Future Paradigm for Construction Education?. *Structural Survey, 25(1),* 7-23.

Ofori, G., 2000. Greening the Construction Supply Chain in Singapore. *European Journal of Purchasing & Supply Management, 6(3),* 195–206.

Ogunbiyi, O., Oladapo, A. and Goulding, J., 2013. An Empirical Study of the Impact of Lean Construction Techniques on Sustainable Construction in the UK. *Construction Innovation*, *14(1),* 88–107.

Perera, C. R. and Hewege, C. R., 2016. Integrating Sustainability Education into International Marketing Curricula. *International Journal of Sustainability in Higher Education, 17(1),* 123–148.

Pitt, M., Tucker, M., Riley, M. and Longden, J., 2013. Towards Sustainable Construction : Promotion and Best Practices. *Construction Innovation*, *9*(2), 201–224.

Royal Institute of Chartered Surveyors (RICS)., 2007. *Surveying Sustainability: A Short Guide for the Property Professional.*

Royal Institution of Chartered Surveyors (RICS)., 2012. *Methodology to Calculate Embodied Carbon of Materials* [online]. Available from: http://www.rics.org/Documents/Methodology_embodied_carbon_final.pdf [Accessed 14 July 2017].

Samaratunga, M., 2013. Approach to Sustainable Development Through Architectural Education: Insight to the Perceptions of Sri Lankan Students. In: *Proceedings of World Construction Symposium 2013: Socio-Economic Sustainability in Construction*, 1–15.

Tan, A., Udeaja, C., Babatunde, S. O. and Ekundayo, D., 2017. Sustainable Development in A Construction Related Curriculum – Quantity Surveying Students' Perspective. *International Journal of Strategic Property Management, 21(1)*, 101–113.

Tan, Y., Shen, L. and Yao, H., 2011. Sustainable construction practice and contractors' competitiveness: A preliminary study. *Habitat International, 35(2),* 225–230.

Thayaparan, M., Siriwardena, M., Amaratunga, D., Malalgoda, C. and Keraminiyage, K., 2011. Lifelong Learning and The Changing Role of Quantity Surveying Profession, *15th Pacific Association of Quantity Surveyors Congress*, 351–360.

Thomas, I. and Nicita, J., 2002. Sustainability education and Australian Universities, *8(4),* 475–492.

Uhl, C. and Anderson, A., 2001. Green Destiny: Universities Leading the Way to A Sustainable Future. *Bio Science, 51(1),* 36–42.

UNESCO., 2013. Education for Sustainable Development (ESD) in the UK – current status, best practice and opportunities for the future.

Velazquez, L., Munguia, N. and Sanchez, M., 2005. Deterring Sustainability in Higher Education Institutions: An Appraisal of the Factors Which Influence Sustainability in Higher Education Institutions. *International Journal of Sustainability in Higher Education, 6(4)*, 383–391.

Verster, J., 2005. Managing Cost, Contracts, Communication and Claims: A Quantity Surveying Perspective on Future Opportunities. In: *Proceedings of 1st ICEC & IPMA Global Congress on Project Management, 5th World congress on Cost Engineering, Project Management and Quantity Surveying,* 1–22.

Wijesundara, J. and Gunarathne, N., 2012. Education for Sustainability: Its Implication on Built Environment Studies. In: *Proceedings of International Conference on Sustainable Built Environment (ICSBE),* 13–15.

Wright, T. S. A., 2002. Definitions and Frameworks for Environmental Sustainability in Higher Education. *International Journal of Sustainability in Higher Education, 3(3*), 203–220.

Wu, Y. J. and Shen J., 2016. Higher Education for Sustainable Development: A Systematic Review. *International Journal of Sustainability in Higher Education, 17(5)*, 633-651.

Xia, B., Rosly, N., Wu, P., Bridge, A. and Pienaar, J., 2016. Improving Sustainability Literacy of Future Quantity Surveyors. *Smart and Sustainable Built Environment, 5(4),* 325–339.

Yogeshwaran, G., Perera, B. A. K. S., and Perera, K. T. P. K., (2014). Competencies Expected of Graduate Quantity Surveyors by the Construction Industry at Present and Future. *FARU Journal*, 6(1), 7–17.