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Enhancing Education for Smart Cities: Evidence from Omani Higher Education Institutions

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Abstract: The focus of this study is to examine the interrelated influences of service delivery in Institutions of Higher Education (HEIs) in Oman to advance sustainable education for smart cities. An important objective of this study is the evaluation of the pertinent educational curriculums and programs used by HEIs in Oman to stimulate and develop the sustainability of the smart city approach. Researchers intend to adopt aspects of the triple helix model which have been used as an analytical framework to analyze the knowledge-based innovation systems in HEIs. Data is collected from stakeholders in HEIs through structured and semi-structured interviews and questionnaires combined with statistical trends from officially published reports. Data analysis will keep with methodology and the employment of Stata Software will help in the examination of correlation between variables. The study contributes to the debate on HEIs' role in smart city initiatives and has implications to their part in advancing higher education for the development of smart city initiatives in the region which is an evolving concept that requiring ample investigation to further our understanding of it, especially in developing countries.

Key words: Sustainable education, smart city, institutions of higher education, technology, innovation, published reports

INTRODUCTION

Education has been revolutionized by technology and so Higher Education Institutions (HEIs) must create a richer and inspiring experience in learning is crucial. HEIs need to know their position for them to benefit fully from current smart methods in education like social learning and networks as well as game-based learning. The current study examines the educational setting in Omani HEIs as part of the smart city ecosystem. The study includes smart learning initiatives already in place and vital components of the curriculum that nurtures innovation among its alumnae which is anticipated to have strategic consequences for the country which is in the process of endorsing a smart learning education configuration. The smart city approach in Oman is still budding and there is a strong need to support this ecosystem. Some of the most important concepts relating to teaching are innovation, smart technology and industrial innovation that power sustainability and these must be addressed for next students generation (Wolff *et al*., 2015).

Studies in the fields of smart cities have widely emphasized the positive impact of a smart city to " tackle urban sustainability issue" and the role of higher education institutions on stimulating and promoting innovation and smart cities (Wolff *et al*., 2015). Meijer and Bolivar (2016) stated that "Smart technologies, smart collaboration, a highly educated population and effective institutions are argued to be needed to face the challenges of modern cities". Education has been widely discussed in the literature as one of the significant elements for the development of the necessary human capital as well as technological infrastructures for a smart city (Caragliu *et al*., 2011; Hollands, 2008 and Meijer and Bolivar, 2016). Promoting centres for a smart city at HEIs is important to develop the smart cities so that students can play their active and innovative roles in smart city initiatives (Winters, 2011). In that sense, the debate in the literature continues regarding either building the human capital first or the necessary technology (Nam and Pardo, 2011). The 2020 Europe strategy has focused on education, research and innovation areas as major factors in the promotion of smart cities (Cocchia, 2014).

Two clear gaps in the arena of smart city education inspire the present study. First, a few studies have been done in developing countries that explored education as the main player in stimulating smart city initiatives. This

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is in spite of the shared view that "a smart city is a humane city that has multiple opportunities to exploit its human potential and lead a creative life" (Nam and Pardo, 2011). Though there are many instances from advanced economies, evidence of the influence of HEIs on supporting students to be more creative, innovative and able to create applications on smart city initiatives in developing economies continue to berare (Fadaeenejad *et al*., 2014). Second, little answers are available inthe literature that focuses on the part played by HEIs in developing countries and their sustainable education for smart cities (Liu *et al*., 2017). Most studies focused on guesstimating the development of smart cities without observing the main factors that promote improved life in smart cities, which is mostly due to people (Winters, 2011).

The aim of this research is to review the relevant educational curriculums, activities and programs used in Omani HEIs to encourage and advance the sustainability of the smart city ecosystem. Several studies suggest that people, education systems, learning and knowledge or what they call " human dimensions" are the key aspects for smart cities approach (Cocchia, 2014). Furthermore, our study sheds light on the effectiveness of these HEIs education methods and strategies that are used to develop this concept, mostly among undergraduate students in Oman. A literature review indicated that such insights are still scarce especially with when it comes to developing countries.

Consequently, the present research aims mainly to contribute to the debate on smart city education at HEIs. This is because smart city education in developing regions is a budding notion and requires more research to advance our understanding of what it takes to build smart cities in the region. The study delivers thorough indications and analyses of the smart education situation in Omani universities and colleges, the effectiveness of curriculums, activities and programs used by HEIs in Oman to kindle and endorse the smart city approach through improved preparation of its graduates giving them the tools, settings and network to actively participate in the smart city movement. The study contains smart learning initiatives now in place that are anticipated to have strategic implications for the country. The second contribution of the research lies in the examination and confirmation of the triple helix model as an analytical framework for gauging the capabilities of HEIs in Oman. The end goal of this being to help decision makers strive for as well as cultivate the creativity and smart education necessary for building the human capital to promote the smart city approach.

To conclude this study, education has been revolutionized by technology and so HEIs must create a richer learning experience for its constituents. In turn, smart learning initiatives can have a vital role in nurturing innovation in and preparing alumnae for smart city initiatives. The smart city approach in Oman is still budding and there is a strong need to support this ecosystem. Some of the most important concepts with this regard are the fostering of innovation and smart technology that power sustainability and the current study hopes to address this gap by in the preparation of the next generation of students (Wolff *et al*., 2015). With that respect, the role of HEIs in stimulating and promoting innovation and smart city initiatives is undeniable (Meijer and Bolivar, 2016). Moreover, a few studies have been done in developing countries that explored education as the main player in stimulating smart city initiatives. Little answers are available in the literature that focuses on the part played by HEIs in developing countries and their sustainable education for smart cities (Liu *et al*., 2017). Most studies focused on guesstimating the development of smart cities without observing the main factors that promote improved life in smart cities which is mostly due to people (Winters, 2011). Finally, building on the grounds put forth in the above this study aim at answering the following four main research questions:

- What are the applicable curriculums and programs used by HEIs in Oman that can support and help in the development of a smart city in Oman?
- Does the education system in Omani HEIs effectively support the development of smart city initiative?
- What are the recommended methods to promote the interest of smart city approach among students?
- Do Omani HEIs have the capabilities to strive and nurture a creative environment for smart city initiatives?

Furthermore, from the mentioned analysis the following study objectives emerged:

- Explore the impact of service delivery in Omani HEIs to develop sustainable education for smart cities
- Adopt aspects of the triple helix model (Etzkowitz, 2008) that can be employed to analyze the knowledge-based innovation systems in HEIs

MATERIALS AND METHODS

The smart city concept is made up of 'smart people' features and the level of educational services afforded that is fundamental to 'urban growth' and sustainable development (Winters, 2011). The present research project explores the relationship between the ability of Omani HEIs to implement smart education systems to

develop human capital to its citizens and prepare them in the best way for smart city initiatives (Batagan and Boja, 2012).

In the current study, researchers implement aspects of the triple helix framework to analyse the knowledge-based innovation systems (Lombardi *et al.*, 2012). In a recent study, Etzkowitz (2008) stressed that the move towards a knowledge-based society has given universities a bigger role to play. In fact, the role of universities as originators of knowledge has become more valuable, since, innovation is increasingly based on science. Consequently, university, industry and government have very equal responsibilities that it's not just one specific component that is necessarily the impetus of the triple helix model of innovation. For this reason, the increased potential role played by universities for smart city intiatives is being suggested particularly with regard to how technology transfer offices were set up by universities to promote the transformation of university research from commercial value to actual commercial goods.

To conclude this study, the methodology followed by researchers in the present work includes conducting structure and semi-structured interviews and discussions with relevant focus groups comprising of various stakeholders from the Omani HEIs including individuals in management, professional and decision making positions (public and private). Further, questionnaires are distributed to selected samples of the population such as students, academic and professional staff in HEIs in Oman (public and private). All this will be backed up by statistical trends and observations by policy makers and officially published reports.

RESULTS AND DISCUSSION

The current study has HEIs performance in delivering smart sustainable education as the dependent variable estimated using five main categories that are based on the triple helix model. The research framework shows the proposed antecedents to HEIs performance with regard to smart city initiatives (Fig. 1). These five categories are:

- Smart governance (related to participation)
- Smart economy (related to competitiveness)
- Smart human capital Indicators (related to people)
- Smart living (related to the quality of life)
- Smart environment (related to natural resources)

For the purpose of this study an empirical examination requires the operationalization of the following variables and connecting them to the five main categories above in the triple helix model factors that are assessed in Omani HEIs (Caragliu *et al*., 2011; Hall *et al*., 2000; Lee and Hancock, 2012 and Neirotti *et al*., 2014).

Campus investment in infrastructures and building intelligence sustainability like building smart applications, network, smart access, data usage, using digital education (e.g. interactive whiteboards, e-learning systems) and smart green services, etc.

Investing in human capital by attracting talents and academics as well as collaborative partnerships. Student's awareness of smart city concepts in terms of curriculums, workshops, creative classes and participating in local and international competitions. Smart city governance by using prototypes to oversee smart city traditions.

Finally, data analysis will keep with the methodology employed by Lombardi *et al*. (2012) and software such as Stata to investigate the correlation between variables. For the time being, data will be collected from several sources including.

Conducting structure interview with top management, professional and decision makers at some selected HEIs in Oman (public and private). In addition to structured and semi-structured interviews, researchers need to use focus groups to gather important ideas and viewpoints from relevant stakeholders in HEIs, government and industry on how to improve educational programs for smart city initiatives.

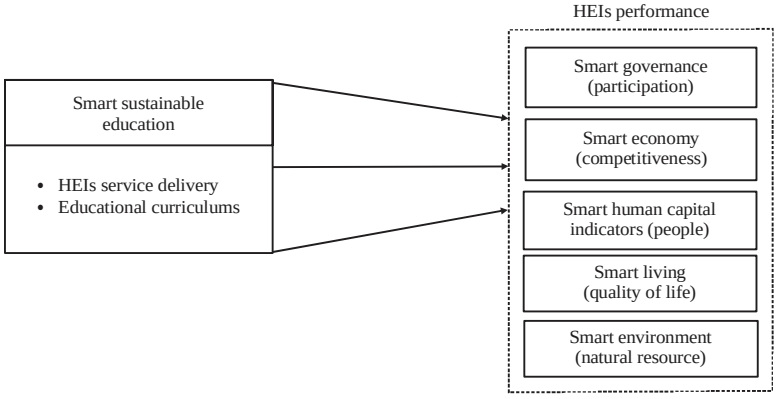

Fig. 1: Research framework

Distribution of a questionnaire from selected focus groups such as students, academic and other professionals in some selected HEIs in Oman (public and private). Observing statistical trends from officially published reports.

The primary contribution of the current study with broad implications is a more profound understanding of the best practices that are implemented in HEI and what particular role they play in the development of smart city initiatives. This research attempts to examine the influences of service delivery in HEIs on the development of sustainable education for smart cities in Oman. The study reviews the relevant educational curriculums, activities and programs used by HEIs that are needed to stimulate and develop the sustainability of smart city initiatives. Researchers adopt aspects of the triple helix model which have been used as an analytical framework to analyse the knowledge-based innovation mechanisms in HEIs. Data collected from various stakeholders in HEIs through structured interviews and questionnaires and statistical trends collected from official published reports can reveal considerable information about the HEI effectiveness in that regard. The study contributes to the debate of HEI's role in smart city initiatives and has implications to their role in education for smart city initiatives developing in the region which is an emerging concept that demands more research to improve our understanding particularly in developing countries.

CONCLUSION

In conclusion, to narrow down the scope of the current study, researchers must make their way backward from the long-term government and universities plans to the present state to figure out the missing links that need addressing. Further research is required to find practical ways to evaluate educational curriculums and programs used by HEIs. Moreover in-depth expertise of specific aspects of the triple helix model must be uncovered before using it as an analytical framework to analyze the knowledge-based innovation systems in HEIs. Finally, combining Lombardi *et al*. (2012) methods in collecting and analysing data with focus group interviews will need further exploration for practical implementation in the current study.

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