

## Chapter 7

# Influence of Constant Returns to Scale and Variable Returns to Scale Data Envelopment Analysis Models in ICT Infrastructure Efficiency Utilization

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### **ABSTRACT**

*A lot of research has been done using Data Envelopment Analysis (DEA) to measure efficiency in Education. DEA has also been used in the field of Information and Communication Technology for Development (ICT4D) to investigate and measure the efficiency of Information and Communication Technology (ICT) investments on Human Development. Education is one of the major components of the Human Development Index (HDI) which affects the core of Human Development. This research investigates the relative efficiency of ICT Infrastructure Utilization on the educational component of the HDI in order to determine the viability of Learning Analytics using DEA for policy direction and decision making. A conceptual model taking the form of a Linear Equation was used and the Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS) models of the Data Envelopment Analysis were*

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*employed to measure the relative efficiency of the components of ICT Infrastructure (Inputs) and the components of Education (Outputs). Results show a generally high relative efficiency of ICT Infrastructure utilization on Educational Attainment and Adult Literacy rates, a strong correlation between this Infrastructure and Literacy rates as well, provide an empirical support for the argument of increasing ICT infrastructure to provide an increase in Human Development, especially within the educational context. The research concludes that DEA as a methodology can be used for macroeconomic decision making and policy direction within developmental research.*

## **INTRODUCTION**

The growth of Information and Communication Technology (ICT) in recent years has been remarkable in all countries and sectors throughout the world because of its transformational power that favours productivity and efficiency (Kayisire & Wei, 2016). Many governments have heeded the call for increased investments in ICT with the aim to improve national development with respect to the Human Development Index (HDI) (Oyerinde & Bankole, 2019a). Over the last three decades, the literature on national development research has grown to encompass certain intervening variables and social factors such as education and some other aspects of human welfare. (Desai, 1991; Anand & Ravallion, 1993; Bankole & Mimbi, 2017). This is ever more evident considering that countries have defined policies that show an emphasis on creating support mechanisms for the use of ICT (Hinostroza, 2018), however, the opinions on the bearings of ICT Infrastructure for development are in two perspectives vis a vis national development: The adoption of ICTs has the potential to empower communities and countries while secondly, the ICT revolution can lead to imbalances and inequalities through lack of ICT adoption, access and usage (Bankole, 2015).

In the on-going discourse on international human development within the Information and Communication for Development (ICT4D) context, the concept of national development has been said to encapsulate the notion of human development as the means of enlarging people's choices to acquire knowledge, amongst others, in order to have access to the resources needed for a decent standard of living (UNDP, 2006; Bankole & Mimbi, 2017). When considering the importance of educational attainment, itself being one of the core indices for measuring development with respect to the Human Development Index (HDI) (UNDP, 2006; Bankole et al., 2011a; Bankole et al., 2015), in the national development discourse, coupled with the considerable successes of data analytics in business for decision making, it is

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