PREPARING CONSTRUCTION MANAGEMENT STUDENTS TOWARDS A KNOWLEDGE-BASED ECONOMY: A COMPARATIVE STUDY OF DEVELOPED AND EMERGING ECONOMIES

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Preparing Construction Management Students Towards a Knowledge-Based Economy: A Comparative Study of Developed and Emerging Economies

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A thesis submitted in partial fulfilment of the requirements for the degree of

Doctor of Philosophy

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CERTIFICATE OF ORIGINALITY

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it reproduces no material previously published or written, nor material that has been accepted for the award of any other degree or diploma, except where due acknowledgment has been made in the text.

----------(Signed)

Daniel Yamoah Agyemang (Name of Student)

DEDICATION

I dedicate this thesis to Almighty God for his guidance and inspiration to successfully undertake the study, my family for their tremendous support prayer wise, encouragement and investment in my life, my lovely wife – Mrs. Barbara Yamoah Agyemang and my dear friends for their support.

ABSTRACT

The technological insurgency which characterizes the era of Knowledge-based economy coupled with the emergence of Industry 4.0 makes the future of the construction industry very promising especially for the prepared. With many young graduates getting ready to enter the workforce amidst high unemployment rates and hiring firms' difficulty in employing people with the requisite entry-level job skills, the emphasis therefore on the essence of innovations in education and development of desired skillsets is greater now more than ever. Globally, there exist a mismatch between employers' expectations as against students (graduates) perceptions with regards to the importance of relevant skills especially in the construction industry. Education and training are therefore expected to play major roles in the provision of these new skills required to drive the knowledge-based economy. Construction Management (CM) education has tapped into Knowledge Management (KM) principles in dealing with this situation. As the World Bank report on Knowledge Economy rightly puts it, an educated and skilled population is a requisite for creating, sharing and using knowledge, a pillar of any Knowledge-based economy. This goes without saying that students in construction management education are expected to exhibit desirable skills set and competencies needed for this knowledge-based economy so as not to be rendered redundant. However, an apropos holistic framework that assesses the stance of academia and industry to bridge the widening skill gap needful for future endeavor is lacking.

This research work therefore seeks to fill this gap via the following stipulated objectives: to explore past and current trends on existing literature on the numerous concepts and themes of knowledge management and construction management education; to identify and model the desirable skillsets and competencies of construction management students needed to prepare them for the knowledge-based economy; to investigate the effective teaching and learning strategies by

Institutions of Higher Learning in preparing students for the knowledge-based economy both in developing and developed countries; and finally to develop and propose a comprehensive framework needed to prepare construction management students for the knowledge-based economy.

The results indicate that the ever-widening expectancy gap needs action to be taken from all stakeholders involved. Although the negative constructs (the barriers to active instructional methods) were revealed to have a significant impact on the way future construction management graduates are to be prepare for the knowledge-based economy, none of the strategic measures to alleviate these barriers was identified to be ineffective. The insight from this study bridges the gap via educating both students and institutions of higher learning who may want to take note of the skill they should be cultivating in their students. Universities on the other hand can take note of the differences revealed from the skill gap in this study in whichever context be it country or industry specific and adjust relevant syllabus accordingly as well as provide effective means of impacting these desirable skillsets to the students. Employers' role in making known their expectations and objectives to graduates, focusing on the skill gaps identified and addressing key areas for improvement were highlighted. Moreover, the overall framework developed is intended to inform stakeholders such as Institutions of Higher Learning, Academic staffs, Students, Industry practitioners, government institutions and other relevant construction education related bodies about the dynamic nature of the construction industry with its associated differences in desirable skillsets and competencies and the specific efforts to extirpate their influence and ensure a future-ready construction professional.

Keywords: Sustainable Construction Management Education, Knowledge Management, Desirable Skillset, Active Instructional Methods, Employability, Developed and developing context

LIST OF RESEARCH PUBLICATIONS

Below is a list of research publications that the author of this thesis contributed during his Ph.D. study. Some chapters of the thesis have been fully or partially published, or under consideration in the following articles:

A. Conference Publications (Accepted or Presented)

1. **Yamoah Agyemang D.*,** Fong, P. S. W., & Kissi, E (2022). Operationalization of desirable skill sets in novice construction management professionals. Conference Proceedings in ASCE Construction Research Congress (CRC). 9-12 March 2022, Virginia, USA

2. Owusu, E.K, Chan A.P.C., Nani, G & **Yamoah Agyemang D**. (2020). A Turn to Smart Contracts and Future Applications towards Construction Innovation: A Hybrid-Metric Review. Conference Proceedings in ASCE Construction Research Congress (CRC). 8-10 March 2020, Arizona, USA

3. **Yamoah Agyemang D.***, & Fong, P. S. W. (2019). Towards desirable skill set acquisition of Construction Management Students in a Knowledge-based economy: A systematic review and trend analysis. Conference Proceedings in 16th International Conference on Intellectual Capital, Knowledge Management and Organizational Learning. 9-12 December, Sydney, Australia

4. **Yamoah Agyemang, D.*,** Fong, P. S. W., & Kissi, E. (2019). The influence of Organizational Infrastructure on Organizational Effectiveness in the Construction Industry. Conference Proceedings in CIB World Building Congress. 17-21 June 2019, Hong Kong.

6. Agyekum, B., Kissi, E., **Yamoah Agyemang, D.,** & Badu, E. (2019). Strategies for the Utilization of Non-Traditional Cost Estimation Models in the Construction Industry of Ghana. 13th Built Environment Conference - Technology, Theory, Truth: Constructing a Sustainable Built Environment, South Africa

B. Refereed Journal Papers (published/accepted)

1. Tetteh, M.O., Chan, A.P.C., Mohandes, S.R. and **Yamoah Agyemang, D**. (2022), "Diagnosing critical barriers to international construction joint ventures success in the developing country of Ghana", Construction Innovation. https://doi.org/10.1108/CI-01-2022-0021

2. Zhang, Yi, Patrick S.-W. Fong, and **Daniel Yamoah Agyemang**. (2021). "What Should Be Focused on When Digital Transformation Hits Industries? Literature Review of Business Management Adaptability" Sustainability 13, no. 23: 13447. https://doi.org/10.3390/su132313447

3. Kissi, E., Asare, S. S., **Yamoah Agyemang, D.*,** Oteng, D., & Debrah, C. (2020). Identification of factors influencing the pricing of sustainable construction materials in developing countries: views of Ghanaian quantity surveyors. International Journal of Construction Management, DOI: 10.1080/15623599.2020.1768462

4. Kissi, E., Asare, O.A., Agyekum, K., **Yamoah Agyemang, D.** & Labaran, M. (2019). Ascertaining the interaction effects among organizational citizenship behavior, work overload and employees' performance in the Ghanaian construction industry. International Journal of Productivity and Performance Management, Vol. 68 No. 7, pp. 1235-1249.

5. Agyekum, B., Kissi, E., **Yamoah Agyemang, D.** & Badu, E. (2018). Examining barriers for the utilization of non-traditional cost estimating models in developing countries: Ghanaian quantity surveyors' perspectives. Journal of Engineering, Design and Technology, Vol. 16 No. 6, pp. 814-827. https://doi.org/10.1108/JEDT-02-2018-0021.

C. Refereed Journal Papers (Under review)

1. **Yamoah Agyemang, D.*,** Fong, P. S. W., & Yi, Z. (under review). Education For the Knowledge Economy: Towards Operationalizing Desirable Skillsets For Future Construction Professionals. Journal of Engineering Education, Ref: Ms COEE 18462

D. Refereed Journal Papers (Pending submission)

1. **Yamoah Agyemang, D.*,** & Fong, P. S. W. (2021). Trends and Gaps in Knowledge Management and Construction Management Education Research In 1990-2020: A Systematic Review.

2. **Yamoah Agyemang, D.*,** & Fong, P. S. W. (2021). The soft skills gap: a bottleneck in the industrial skill requirement in emerging economies

3. **Yamoah Agyemang, D.*,** & Fong, P. S. W. (2021). A Fuzzy Synthetic Evaluation of effective teaching and learning strategies by Institutions of Higher Learning in producing future-ready construction management graduates.

4. **Yamoah Agyemang, D.*,** & Fong, P. S. W. (2021). Analysis of the effectiveness of Active Instructional Strategies in preparing construction management students towards the knowledge-based economy

5. **Yamoah Agyemang, D.*,** & Fong, P. S. W. (2021). Comparative analysis of the Traditional Instructional Methods Vulnerabilities Affecting Construction Management Education: Developed and Emerging economy's perspective

E. Honors and Awards

1. **1st Price – Best PhD Presentation Award**, 16th International Conference on Intellectual Capital, Knowledge Management and Organizational Learning, Australia, 2019.

2. **Overall GPA** for course credits in partial requirements for the degree of Doctor of Philosophy = 3.80

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE - GENERAL INTRODUCTION[1]

1.1 RESEARCH BACKGROUND

Drucker (1968) introduced and popularized the term "knowledge economy" and noted that businesses will have to convert themselves into organizations of knowledge specialists to remain competitive, maybe, even to survive. Knowledge Management emerged in the mid-1990s as a solution to the challenge of managing intellectual assets in the post-industrial era widely known as knowledge economy, which is transforming every sector of the global economy – both private and public. According to Nonaka (1987, 1994) and Toffler (1990), private and public institutions are now finding innovative ways to develop strategies to optimize the use of their resources, especially knowledge, which has become a source of lasting competitive advantage (Drucker, 1968). In response to the needs of a more dynamic environment in this era, Sandhawalia and Dalcher (2011) and Kipley et al. (2008) opined that there is the need for effective utilization of an organization's assets with regards to knowledge in addition to scarce resources to support essential innovative and operational activities.

Prior to the 21st Century was the industrial revolution which transformed most parts of the world. However, according to Brynjolfsson and Mcafee (2016), this era of globalization (21st century) is characterized by information (Knowledge) as the transformative power of revolution and was thus triggered by the availability of a number of information and communication technologies (ICTs) as well as movement towards human capital, technology and service-oriented economy (Ojanperä, Graham and Zook 2019). Governments in developed economies, including the United States of

[1]This Chapter is largely based upon:

Yamoah Agyemang D.*, Fong, P. S. W., & Kissi, E (2022). Operationalization of desirable skill sets in novice construction management professionals. Conference Proceedings in ASCE Construction Research Congress (CRC). 9-12 March 2022, Virginia, USA

Yamoah Agyemang D.*, & Fong, P. S. W. (2019). Towards desirable skill set acquisition of Construction Management Students in a Knowledge-based economy: A systematic review and trend analysis. Conference Proceedings in 16th International Conference on Intellectual Capital, Knowledge Management and Organizational Learning. 9-12 December, Sydney, Australia

America, Australia and United Kingdom, have embraced knowledge management initiatives in various facets of public management with encouraging results (BSI, 2003). As posited by the World Bank, challenge for African countries is their inability to create a favorable environment that nurtures knowledge creation and sharing (World Bank, 2003). The challenge for Ghana - a developing economy- according to the World Bank, is how to proceed on the progress to date, to be advantageous to the opportunities put forward by the knowledge economy. In other words, continuing to develop the parameters for the more effective formation, access as well as usage of knowledge, while at the same time taking pragmatic moves, driven by knowledge initiatives, for new forms of income generation to be stimulated.

One way of embracing KM in all facets of management is through formal education. In Africa, for instance, education plays key role as one of the six key areas where tremendous innovations are emerging. The essence of innovations in education and development of desirable skills are far reaching as many young people are entering the workforce (Leke and Yeboah-Amankwah, 2018) in a quest to develop a future-focused capability building. Consequently, the construction industry finds itself in this knowledge-based economy. There has always been the need for educated and highly skilled professionals as a result of the construction industry's peculiar characteristics such as complexity of projects, dynamism, 3D computer aided modelling, sophisticated usage of construction equipment requiring advanced IT skills, competition among stakeholders (Leifer, O'Connor, and Rice, 2001; Christodoulou, 2004; Atalah and Muchemedzi, 2006). However, education in the Built Environment is at crossroads in ensuring that the workforce is equipped with the right capabilities thus skills and knowledge to take the industry to the next level. Addressing this need would require Institutions of Higher Learning to transition through the nature and scope that skillset and knowledge are taught to students as well as existing professionals. To achieve

these ambitious skillsets deemed a game changer for the construction industry would require a wide and swift extension of the desirable knowledge and related skills. The skill gap as a matter of urgency must be addressed now more than ever as the window of time to realize this change is closing in as a result of technological advancement. The present system therefore needs to be challenged so as to produce the needed forms of interdisciplinary skills and knowledge. This puts forward a new need for current training and educational pedagogies or curricula in construction education to be revisited with skill enhancement at heart. This research work therefore seeks to emphasize that effective knowledge management in especially the education sector of any economy provides the opportunity for governments to meet these challenges to an appreciable extent by way of effectively preparing their students to be ready to take on new challenges.

More specifically, this thesis explores the main issues regarding the preparation of construction management students toward a knowledge-based economy given rise to a novel framework (guiding principle) for Ghana in particular and developing countries, in general. Principally, this research takes a closer look at the Knowledge management concept and construction management education, desirable skill set acquisition of construction management students, effective teaching and learning strategies and holistic sustainability principle incorporation in construction management education curricula. Models are developed from the identified constructs from this study to serve as a guiding principle to aid Institutions of Higher Learning be better positioned to prepare their construction management students towards the knowledge-based economy. The checklist elicited for this study may also serve as a guide to policy makers, accreditation bodies, industry practitioners, institutions of higher learning and researchers to develop dynamic strategies that looks at the future desirable needs of the construction industry and thus prepares students towards fulfilling these needs. To easily understand and identify the variables and constructs as

used in this study, a tentative conceptual framework comprising of all the subtopics has been developed.

1.2 PROBLEM STATEMENT

Britz et al. (2006) undertook a reality check as to whether Africa is moving towards a knowledge society. They analyzed the effectiveness of on-going initiatives aimed at putting the continent on the road towards a knowledge-based economy. The main findings of their research indicated that Africa has still a long way to go to become a true knowledge society. The World Bank, acknowledging the potential positive impact of harnessing knowledge resources, organizes policy workshops for countries to help them transition into knowledge-based economies. Ghana, Tanzania and Senegal benefited from the African series of the knowledge economy workshops in 2002. In particular, the report encouraged Ghana to promote attentiveness among policymakers, civil society and private sector on the opportunities and challenges of the revolution of knowledge, while developing coherent strategies to reduce adverse impact and take advantage of opportunities (World Bank, 2003). The report revealed that Ghana risked dropping further down because it was not making use of its potential and was not tapping into worldwide knowledge. Ghana was therefore urged to propose strategies to make use of new as well as existing knowledge for performance improvement in the traditional sectors and to develop competitive new sectors. It was also suggested that Ghana must assess where it stood in terms of progress towards becoming a knowledge society and also learn from other well standing countries.

Knowledge economy framework proposed by the World Bank is a comprehensive and long-term strategy for transitioning into the knowledge-based economy (World Bank, 2003). The four

constituent pillars: Education and Skilled Workers, An Institutional Regime and Economic Incentive, A Modern and Adequate Information Infrastructure and An Effective Innovation System as posited in the assessment done by the World Bank provide a holistic road map for governments and for that matter Ghana to steer their economies in a way that knowledge will be increasingly applied in every facet of economic activity. This study will primarily focus on one of the four pillars thus Education and Skilled Labour force since investments in human capital have become more important as the nature of work has evolved especially that witnessed in the construction industry. Despite substantial progress, significant gaps in human capital investments are leaving the world poorly prepared for what lies ahead.

In line with the United Nations Sustainable Development Goal (SDG) 4 - thus Quality Education, this study is positioned to provide a framework needed to reach the target 4.4 and 4.7 of SDG 4 as shown below.

> "4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.
>
> 4.7 By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development."

The intended framework will provide guidelines that will enable construction students prepare efficiently to work in this knowledge-based economy. It is also intended to further discussions within government circles and academia towards Ghana's quest to become a knowledge society.

This position is in line with the World Bank's preliminary Knowledge Economy Assessment of Ghana following the knowledge economy policy workshop in 2002, which recommended the creation of 'forums' to advance the knowledge economy discourse in Ghana.

The world bank estimates a growth of 18% in human capital in 2023 (World Bank, 2018). However, technological advancement in this era of globalization renders this policy's achievement questionable. This research therefore aims to fill the gap by addressing the needs of the modern-day construction management student through the answering of industry's expectations as well as academia's perception on preparing these new generation of construction management students towards a knowledge-based economy.

1.3 RESEARCH AIM AND OBJECTIVES

1.3.1 Research Questions

As a result of the theoretical and knowledge gaps revealed after a thorough preliminary review, the following research questions are put forward:

1. What are the current trends on knowledge management and construction management education worth probing further?
2. What are the desirable skillsets and competencies deemed necessary to prepare construction management students towards knowledge-based economy?
3. How best can the hindrances to active instructional methods be reduced if not eliminated?
4. How are Institutions of Higher Learning dealing with the preparation of students by way of teaching and students by way of learning in construction management education?
5. How best can construction management students be prepared by way of a holistic framework towards the knowledge-based economy?

1.3.2 Research Aim

The overall aim of the research is to develop a comprehensive framework (guiding principle) for preparing construction management students to work in the knowledge-based economy in the Ghanaian public sector in particular and in developing economies, in general.

1.3.3 Research Objectives

To reach this broad goal of the study, the objectives of the research will include the following:

1. To explore past and current trends on existing literature on the numerous concepts and themes of knowledge management and construction management education.
2. To identify and model the desirable skillsets and competencies of construction management students needed to prepare them for the knowledge-based economy.
3. To identify and model the barriers inhibiting active instructional methods by Institutions of Higher Learning.
4. To investigate the effective teaching and learning strategies by Institutions of Higher Learning in preparing students for the knowledge-based economy.
5. To develop and propose a comprehensive framework needed to prepare construction management students for the knowledge-based economy.

1.4 RESEARCH SCOPE

This research work is positioned in both the contextual and geographical scope. Contextually, the study's focus will be skill development of construction management students and specifically look closer into the constructs or areas of construction management education which comprises of desirable skillset acquisition, effective teaching and learning strategies and sustainability principles incorporation into construction management curricula in an effort to prepare CM students towards a knowledge-based economy. These thematic constructs will be explicated in the

succeeding chapters to identify the variables in each construct. Geographically, Ghana – a developing economy is selected for this research.

1.4.1 The Case of Ghana

Ghana was chosen as the geographical focus since it served as a model case for developing economies. Besides, the World Bank (2020) report on Human Capital Index (HCI) places this country as having an HCI of 0.45 that is to say a child born in Ghana today will be 45 percent as productive when he or she grows up as he or she could be if he or she enjoyed complete education and full health as shown in Table 1.

Table 1.1: HCI of Ghana

Component	**Girls**	**Boys**	**Overall**
HCI	0.45	0.44	0.45
Survival to Age 5	0.96	0.95	0.95
Expected Years of School	11.7	11.5	11.6
Harmonized Test Scores	306	308	307
Learning-adjusted Years of School	5.7	5.7	5.7
Adult Survival Rate	0.78	0.74	0.76
Not Stunted Rate	0.83	0.8	0.81

Source: World Bank (2020)

Out of 174 countries surveyed by the World Bank Group working on HCI, Ghana is ranked at 128 signifying the need for this country to take a cue from the developed countries to enrich its human capital for eventual economic growth to be evidenced.

1.5 RESEARCH WORTH AND SIGNIFICANCE

Globally, there exist a mismatch between employers' expectations as against students (graduates) perceptions with regards to the importance of relevant skills especially in the construction industry.

Recent trends in the competitive global market dictates that construction management graduates must manage at higher levels of sophistication. Report from the World Economic Forum (2016) indicates that from a current level of 11%, there is an expected rise to 15% of jobs requiring cognitive abilities as a core skill. That is to say education and training are expected to play major roles in the provision of these new skills required to drive the knowledge-based economy.

Arguably, such contradictions between the views of employers and students contribute to the existence of a skill gap as graduates focus on honing skills which could be less relevant to employers. The insight from this study can bridge the gap via educating both students and institutions of higher learning who may want to take note of the skill they should be cultivating in their students.

Among the drivers of this skill gap is the lack of knowledge and communication between employers as well as students. Educators on the other hand do have a responsibility of communicating what skills students should be developing at the various universities. A partial blame also resolves from the fact that some highly valued skills are not necessarily teachable, instead they are developed over time during one's professional life such as dependability and promptness in action. Universities on the other hand can take note of the differences revealed from the skill gap in this study in whichever context be it country or industry specific and adjust relevant syllabus accordingly. Employers' role in making known their expectations and objectives to graduates, focusing on the skill gaps they have identified and addressing key areas for improvement will also be highlighted. Graduates through examination of individual skills can determine skill gaps they are plague with and invest in upskilling opportunities (internship, study abroad, mentorship etc.) and communicating regularly with employers about improvement strategies. Through constructive feedback and open communication, universities and employers

can work together to rectify these skill gaps and provide a better foundation for graduates entering the world of world of work.

Finally, the skill gap is a problem of socioeconomic nature cutting across public and private sectors, the developed framework (guiding principle) would encompass variables that other educational sectors other than construction can adapt to better prepare generation Z students for the knowledge-based economy.

1.6 PROPOSED RESEARCH PLAN AND METHODOLOGY

Research Methodology offers the theoretical underpinning for understanding which method or set of methods are applicable to specific cases culminating in the gathering and analyzing of data (Thurairajah et al., 2006). To provide a guide to research directions, theories would need to be incorporated into this research work which will also serve as a background for a sound systematic analysis and buildup of existing stock of knowledge. According to Brewer and Hunter (2006), the makeup of these theories will be the statement of the problem, important variables identification relevant to the study, research question development, framing of research aim and objectives, data gathering techniques best suited for the study and identifying the right tools needed to analyze the collected data and lastly, the provision of answers to identified problems. As posited by Kumar (2019), there is the need to review existing methodologies if genuine contribution to knowledge is to be achieved. Concurring to Kumar's (2019) findings was Wahab (1996) who added that a complete meaning of present knowledge on underpinnings of methodology is gained from the reviewing of previous methodologies.

1.6.1 Research Approach

An in-depth discussion of the research approach adopted for this study will be presented in Chapter two. That notwithstanding, this section provides a brief summary and a flowchart model of the research procedure. This study presents how institutions of higher learning will better prepare students of construction management programs in terms of desirable skillset acquisition, effective teaching and learning strategies as well as incorporating the principles of sustainability in the curricula of construction management programs for the knowledge-based economy. This research study will make use of nine (9) unique qualitative and quantitative research methods during its entirety. These include comprehensive literature review; thematic analysis; questionnaire survey; expert interview; content analysis; mean score ranking; factor analysis; human capital theory approach; fuzzy synthetic evaluation. Chapters two (2), six (6) and seven (7) would explicate the justifications behind the adoption of these techniques to achieving the research aim and objectives.

1.6.2 Plan and Methodology

1.6.2.1 Preliminary Stage

Presented in the form of a research proposal, this stage employed an exploratory literature review of construction management education in the era of knowledge-based economy with the view of identifying how graduates can be better positioned to be future-ready career prospects. This resulted in the development of research questions to be addressed, aim and specific research objectives for the study. Informal discussion with some academics helped align the perceived research objectives in a more meaningful and achievable manner. A methodology and a mode of research approach were designed to carry out the objectives following the preliminary stage.

1.6.2.2 Primary Stage

A comprehensive and critical review of literature on construction management education was conducted which explored landscape of world undergraduate construction management education, knowledge management and construction management education, desirable skillset acquisition, effective teaching and learning strategies of construction education and sustainability principles incorporation into the curricula of construction management education. The reviews conducted exposed the underlining important variables in each of the constructs listed. Current and past trends of knowledge management and construction management education were examined with global perspective in mind revealing five (5) important themes. Sources of analytic considerations with regards to the choice of dataset for the review included relevant literature reviews from highly ranked journal articles, conference proceedings, textbooks, publications from International Organizations such as UN, World Bank, OECD etc. Another critical review was conducted to identify the desirable skillset acquisition of construction management students so as to guide curricula preparation. This review revealed seven (7) main constructs of skillsets deemed necessary for the 4th industrial revolution era serving as a guide to institutions of higher learning in the development of program outcomes informing curricula design. The primary stage ended with the development of a conceptual framework in Chapter four (4) awaiting validation.

1.6.2.3 Secondary Stage

Data collection and analysis as research input for Chapter five (5), and six (6) of the research work characterized the secondary stage. A general questionnaire survey and expert's interview formed the main sources of data. A set of questionnaires were developed following the findings from the comprehensive reviews of literature, where expert's opinion had to be sought on the identified

constructs (with underlining variables). The final questions sought to identify the desirable skillset of future-ready construction management graduates, effective learning and teaching strategies of construction management education and sustainability principles worthy of inclusion in the learning outcomes of construction management programs. To suit the conditions of both Ghana (developing economy) and Hong Kong (developed economy), the questionnaire was developed and tested with these countries in mind so as to warrant a common platform for the necessary comparative analysis to be conducted. To attain an international perspective of the principle of incorporating sustainability in construction management education, expects' interview will be conducted to solicit for rich data. With the aid of the Human capital theory approach, the collected data will then be analyzed to develop the theoretical constructs for further testing and validation. The secondary stage, therefore, concludes at the collection and gathering of quantitative and qualitative data ready for analysis.

1.6.2.4 Tertiary Stage

The Tertiary stage will make use of statistical analysis in the development of Models as well as verification of the models with the aid of experts' interviews. The pertinent variables obtained after the questionnaire survey would be analyzed to reveal the desirable skillset of career ready construction management professionals, effective teaching and learning strategies to prepare construction management students for the industry and the principles of sustainability deem necessary to be inculcated in construction management program curricula. A T-Shaped Construction Profession (TSCP) Model which is purported to guide institutions of higher learning especially in construction management in their preparation of future career-ready graduates to perform in the knowledge-based economy will be developed. The models will be developed with

the aid of tools as mentioned earlier to include social network analytical tool, Partial Least Square – Structural Equation Modelling and the fuzzy synthetic evaluation (FSE) tool.

1.6.2.5 Closing Stage

The closing stage will take a comprehensive look at the entire thesis to reveal the study's findings as well as propose the relevant actions to be taken looking from the perspectives of short to long term run. Recommendations for future research will be outlined and the outcome of the entire research prepared for public consumption in the form of journal publications and conference proceedings. Figure 1 below depicts the overall process of the research from the Chapter one (1) to Chapter eight (8) of the study.

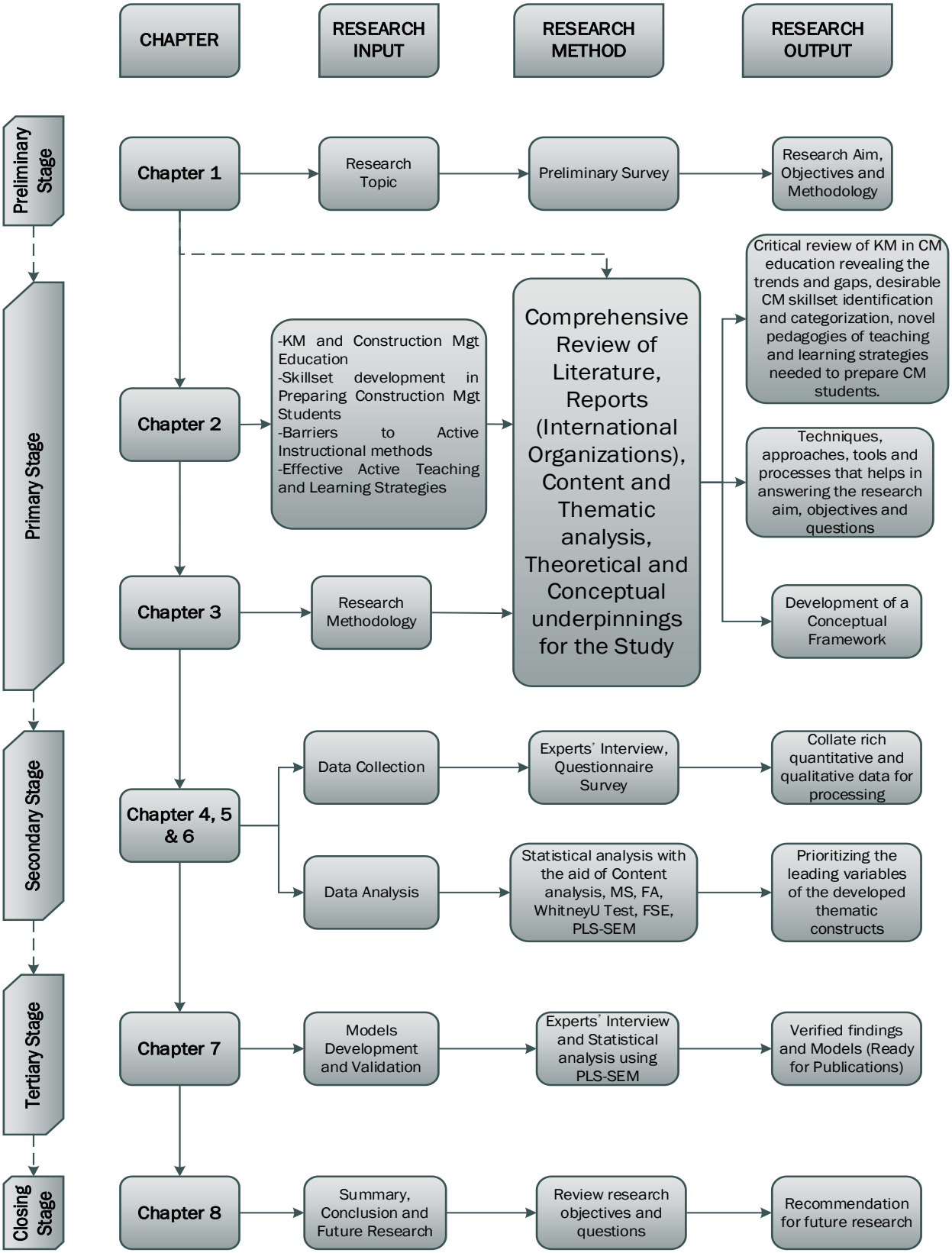

Figure 1.1: Flowchart model of research process

1.7 STRUCTURE OF THE THESIS

Presented in eight (8) chapters, this thesis is detailed out as follows:

Chapter One – General Introduction

Serving as the General Introduction, this Chapter presents the main analogy behind this research study, highlighting the background behind this comparative study, identifying the research gaps via a comprehensive literature review informing the problem statement. The research questions, objectives and aim as well as the focus (geographical and contextual scope) of the research follows suit. This Chapter concludes with the research worth, and the methodology used highlighted.

Chapter Two – The Evolution and Trends in Construction Management Education

Section One – Knowledge Management and Construction Management Education

This chapter is set to detail out the intricacies on how Knowledge Management plays a role in construction management education. With many young graduates getting ready to enter the workforce amidst high unemployment rates and hiring firms' difficulty in employing people with the requisite entry-level job skills, the emphasis therefore on the essence of innovations in education and development of desired skillsets is greater now more than ever. Construction Management (CM) education has tapped into Knowledge Management (KM) principles in dealing with this situation. There, however, exist paucity of knowledge on KM and Higher education especially in construction. Through a careful analysis of relevant literature, this section will address this issue and close out by revealing the recent and future research trends in this domain.

Section Two – Towards Desirable Skillset and Competencies Acquisition of Construction Management Students

Similar to the first section, this section explores the desirable skillset and competencies acquisition of construction management students to help bridge the skill gap. An appropriate systematic review of literature is conducted to identify these desirable skillsets, which will be tested empirically in the geographic regions chosen under the study.

Section Three –Effective Teaching and Learning Strategies of Institutions of Higher Learning in Construction Management Programs

To tackle the skill gap as evidenced in the construction industry would demand Higher Education Institutions delivering curricula through effective teaching strategies to students who are also expected to employ effective learning strategies to grasp the concepts. This section of the thesis will explore the effective teaching and learning strategies needed to prepare future-ready construction management graduates via a thorough review.

Sector Four – Conceptual Framework Development

This chapter presents the conceptual framework for assessing how prepared construction management students should be when employment opportunities beckon on them. This section of the research thesis will highlight the concept of human capital by clearly explicating the fundamentals and the complexities involved in the processes of preparation of students towards the knowledge-based economy. Similar to the methods in the third chapter, a thorough review was employed to identify the stakeholders, systems, and procedures involved in preparing a construction management graduate for career-ready environment.

Chapter Two – Research Methodology

The methodology that will be adopted is detailed out in Chapter three. The ten (10) qualitative and quantitative research methods employed are presented. They include comprehensive literature review; thematic analysis; questionnaire survey; expert interview; content analysis; mean score ranking; factor analysis; social network analysis; human capital theory approach; fuzzy synthetic evaluation. The theory underpinning the adoption and application of these methods, approaches, techniques and processes in answering the set research questions, objectives and ultimately the aim would be explicated in this chapter.

Chapters Four, Five and Six – Data Collection and Analysis

This chapter prudently presents the outcome of the general questionnaire survey as well as all the qualitative data that will be gathered from the structured interviews. Gathered quantitative and qualitative data will be analyzed holistically and presented in this chapter.

Chapter Seven – Strategic Model Development

This chapter puts forward the development of a T-Shaped Construction Professional (TSCP) Model and recommend Code of Guidance (COG) Model with the aid of the following analytic tools: Partial Least Squares Structural Equation Modelling tool and the Fuzzy Synthetic Evaluation (FSE) tool as well as Human Capital theory approach. Details with respect to the application of the respective analytic tools to realize the expected outcomes are thoroughly deliberated in this chapter.

Chapter Eight – Findings Summary, Conclusions, and Recommendations.

Concluding this research study is the chapter 8 which will present the review of the entire research study's findings. The achievements of the aim and all the objectives will be highlighted. Also presented in this section is the limitations of this research as well as the recommendations for future research.

CHAPTER TWO-LITERATURE REVIEW[2]

2.1 KNOWLEDGE MANAGEMENT AND CONSTRUCTION MANAGEMENT EDUCATION

2.1.1. Introduction

According to Leke and Yeboah-Amankwah (2018) in their Harvard Business Review article entitled "Africa: A Crucible for Creativity", opined that education plays a key role as one of the six key areas in Africa where tremendous innovations are emerging. The essence of innovations in education and development of skills are far-reaching as many young people are entering the workforce (Leke and Yeboah-Amankwah, 2018) in a quest to develop a future-focused capability building. Unemployment rate world-wide according to Leke and Yeboah-Amankwah (2018), stands at more than 75 million young people against the backdrop that many firms find it difficult looking for people with requisite skills for entry-level jobs. This is a result of an education system that fails to provide either behavioral or technical skills needed to survive as well as adapt to the rapidly changing environment of work (Leke and Yeboah-Amankwah, 2018).

Today, universities perform different roles and functions that are multifaceted and include research, teaching, and entrepreneurship (Etzkowitz et al., 2000; Perkmann et al., 2011a, 2013; Bishop et al., 2011; Audretsch, 2014; Hvide and Jones, 2016). The mechanisms of and financial gains from universities' knowledge transfers have since been researched into and triggered

[2]This Chapter is largely based upon:

Yamoah Agyemang D.*, Fong, P. S. W., & Kissi, E (2022). Operationalization of desirable skill sets in novice construction management professionals. Conference Proceedings in ASCE Construction Research Congress (CRC). 9-12 March 2022, Virginia, USA

Yamoah Agyemang D.*, & Fong, P. S. W. (2019). Towards desirable skill set acquisition of Construction Management Students in a Knowledge-based economy: A systematic review and trend analysis. Conference Proceedings in 16th International Conference on Intellectual Capital, Knowledge Management and Organizational Learning. 9-12 December, Sydney, Australia

Yamoah Agyemang, D.*, Fong, P. S. W., & Yi, Z.(2023). Education For the Knowledge Economy: Towards Operationalizing Desirable Skillsets For Future Construction Professionals. Journal of Engineering Education, Ref: Ms COEE 18462 (under review)

concerns across policymakers and entrepreneurship scholars in developing countries (Sedaitis, 2000 (Russia); Varblane et al., 2007a, 2007b (New EU member states); Bajmócy et al., 2010 (Hungary); Marozau and Guerrero, 2016 (Belarus); Guerrero and Urbano, 2017 (Mexico)) and developed countries (Kenney and Patton, 2009 (USA); Kalar and Antoncic, 2015 (Netherlands, Belgium, Slovenia, London); Abreu et al., 2016 (UK)).

For the last decade and a half, many colleges have catered for millennials, but they are no longer the traditional undergraduates. Generation Z students have arrived on campuses just as four-year residential institutions are competing for a declining number of high-school graduates.

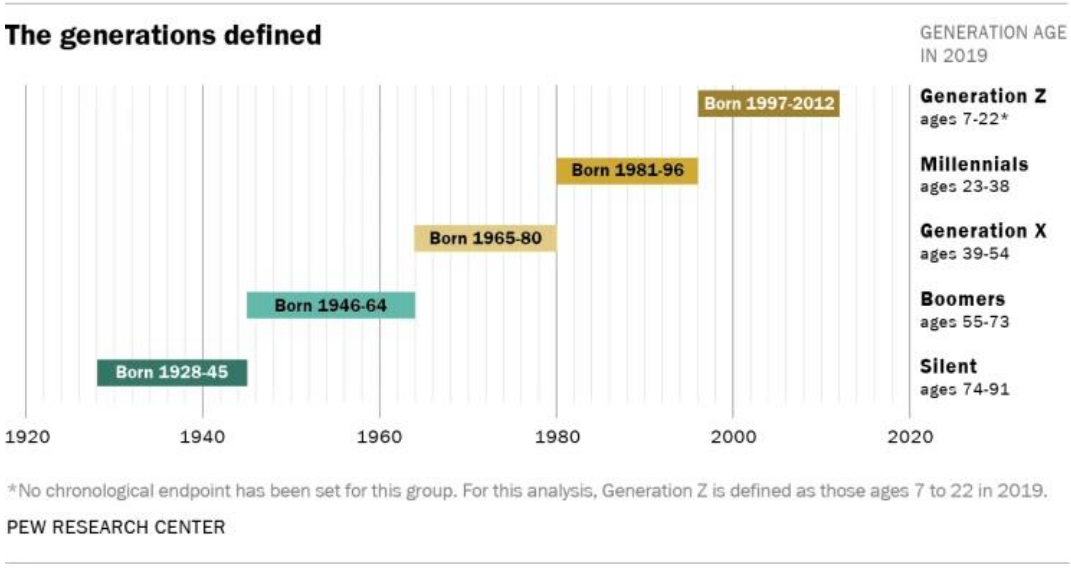

Figure 2.1: Generations Defined
Source: Michael D., (2019)

From Figure 2.1, Pew Research Centre defined anyone born between the ages of 1981-96 (thus ages 23-38 in 2019) as Millennials whiles anyone born after 1996 qualifies as part of Generation Z (Michael, 2019). Planning for this transition means rethinking strategies and priorities to create

an effective educational experience for especially Generation Z students (The Chronicle of Higher Education, 2018).

Key reports from different Organization for Economic Co-operation and Development (OECD) programs have discussed distinctly classifying main arguments in response to two broad questions as:

1. What does the body of OECD work on knowledge management informs the environment in which schools are located as well as the major visible trends? In what ways is this environment changing what schools are expected to do and how they operate?
2. What clarity does the analysis show on the diverse main models that underpin them - the influence of diverse social interests, bureaucratic systems, networks of learning organizations, focal points for community action, markets of diverse providers and agencies?

Of particular concern, given the centrality of knowledge management ideas to the re-schooling scenarios, (particularly "schools as focused learning organizations"), is whether these different analyses propose that school systems are already heading towards these directions and what restraints them from doing so.

Despite the growing interest in construction management education over the past two decades (Naveed et al., 2017), there is lack of attention to the need to review and analyze what has been found in literature. To broaden the understanding and scope of practitioners, higher education institutions, researchers and students alike, there is, therefore, a need to conduct a systematic and critical review of literature on Knowledge management (KM) and Construction Management (CM) education. With the following objectives in mind, a systematic review of KM and CM education is conducted:

1. To identify the trends of annual publication of KM in CM education from 1990 to 2018;
2. To identify the contributions of authors, their countries of origin and research institutes in their exploration of KM and CM education from 1990 to 2018; and
3. To capture and identify themes trending in this research area to identify gaps and recommend suitable directions for future research.

This section commences with definitions of KM and adopt a suitable one for this review, and then presents the methodology adopted. From the selected academic journals, findings are presented and discussed. The review ends with conclusions while directions for future research are proposed.

2.1.2. Knowledge Management (KM) Definitions

As practices and concepts advanced quickly through the 1990s, definitions of KM like knowledge itself has become difficult to define since a range of standpoints reflects current meanings of knowledge. Wiig (1997) held the view that KM is a process to try to understand and manage systematic, explicit, and deliberate knowledge creation, renewal, and application. KM is also a systematic procedure used to identify, store, retrieve, share, adapt and use knowledge in order to promote the goals of organizations (Karamitri et al., 2015). Lee and Wong (2017) had also defined KM as management of knowledge processes, KM resources, and factors with the objective of creating value and improving organizational competitiveness and performance.

Coming from a broader perspective, Quintas et al. (1997) referred to knowledge management as the process of continually managing a variety of knowledge to meet emerging as well as existing needs, by identifying and making use of acquired and existing assets of knowledge and developing opportunities that are novel. The definition given by Davenport and Prusak (1998) provided more insight by looking closely at a myriad of phenomena like insight, values, and information. They

defined knowledge as "a fluid mix of contextual information, framed experience, insight of expert and values providing a framework for incorporating and evaluating new information and experiences in organizations. It often becomes embedded not only in repositories or documents but also in organizational practices, routines, norms, and processes" (Davenport and Prusak, 1998: 5). Knowledge comes to play when information is mixed with experience, interpretation, context as well as reflection and thus ready in applying to actions (Davenport et al., 1999). According to Klasson (1999) and Choi et al (2005), KM is referred to as the management of organizational knowledge to create and retain greater value from core business competencies and obtain a competitive advantage.

KM can also be viewed from another angle as an optimal management of a complex mixture of knowledge-based system, business process improvement, organizational concepts, artificial intelligence, software engineering and human resource management (Liebowitz and Suen, 2000). In much the same vein, Bhatt (2001) defined KM as a process of creating, validating, presenting, distributing, and applying knowledge thus giving room for an organization to reflect, learn, and unlearn and relearn, usually seen as essential for maintaining, building, as well as restocking of core-competencies. As posited by Wong (2008), factors such as cultural management, operational, organizational, technological, and behavior are tended to affect KM. Remarkably, all the authors cited above, drew a conclusion that KM refers to the management of all kinds of knowledge, but only for developing new opportunities.

However, the KM definition suggested by Iandoli and Zollo (2007) looks at the knowledge involved, objectives, phases, and tools of KM and defined KM as the process of creating, capturing, and using knowledge to enhance organizational performance. Based on the synthesis of different definitions and for the purpose of this study, KM is defined as the optimal management

of knowledge by organizations through KM processes, tools and practices for improving organizational performance. Higher education therefore plays an important role in preparing students to assume the KM roles so necessary to organizations. Construction Management education equips students with the requisite knowledge, skill and competencies for future work through effective instructional strategies by lecturers. KM techniques are employed in the dissemination of these desirable skillsets by institutions of higher learning to students. Figure 2.2 depicts the inter-relationships among Knowledge economy, Knowledge management and Construction management education.

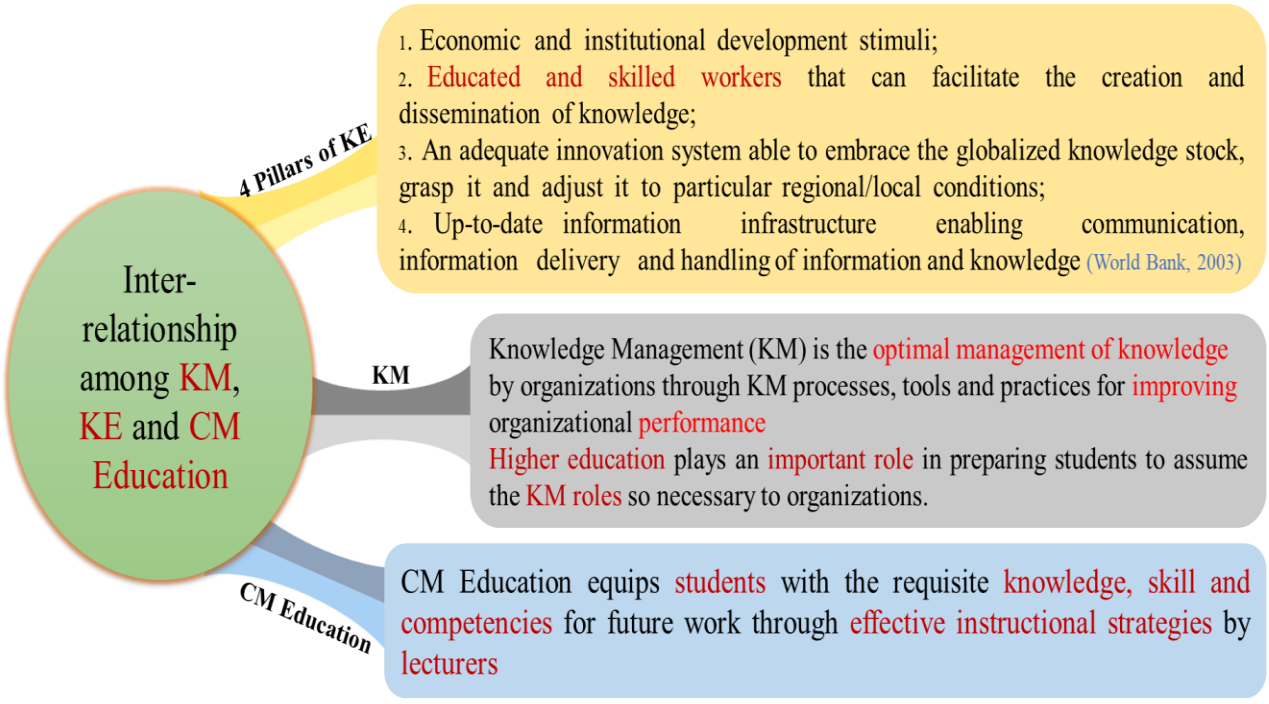

Figure 2.2: Inter-relationship among Knowledge economy, Knowledge management and Construction management education

2.1.3. Research Methodology

Essential to the research community, as according to Tsai and Wen (2005), are the methodological analysis of papers accepted and published in refereed academic journals as practitioners as well as researchers gain considerable insights into the trends thus current and future of research on a particular research area or topic. Popay et al. (2006) proposed a 12-step process for systematically reviewing literature, to comprehensively identify, and evaluate and encapsulate all relevant studies on a given topic. In the view of Easterby-Smith et al. (2012), the key process for a systematic review is first, to define the review protocol and map the subject area by accessing, retrieving and judging the relevance of studies in the research area under examination. The next step is to elaborate on the identified gaps contingent on the existing body knowledge.

Close to three decades (from 1990 to 2018; 2018 was taken as the cut-off year for this study), Yu and Yang (2016), and Yi and Yang (2014), have conducted document studies of KM in the construction industry in three-phase literature reviews since research works in KM were systematically analyzed since 1990. The three-phase review of Yu and Yang (2016) and Yi and Yang (2014), however, failed to include the assessment of contributions in terms of countries, universities, and authors compared with this study that includes them. KM research papers published in construction management journals from 1990-2018 using the three-phase search process were systematically analyzed upon retrieval to gain insights into the trends as well as identify key and potential areas for further research as presented in figure 2.3.

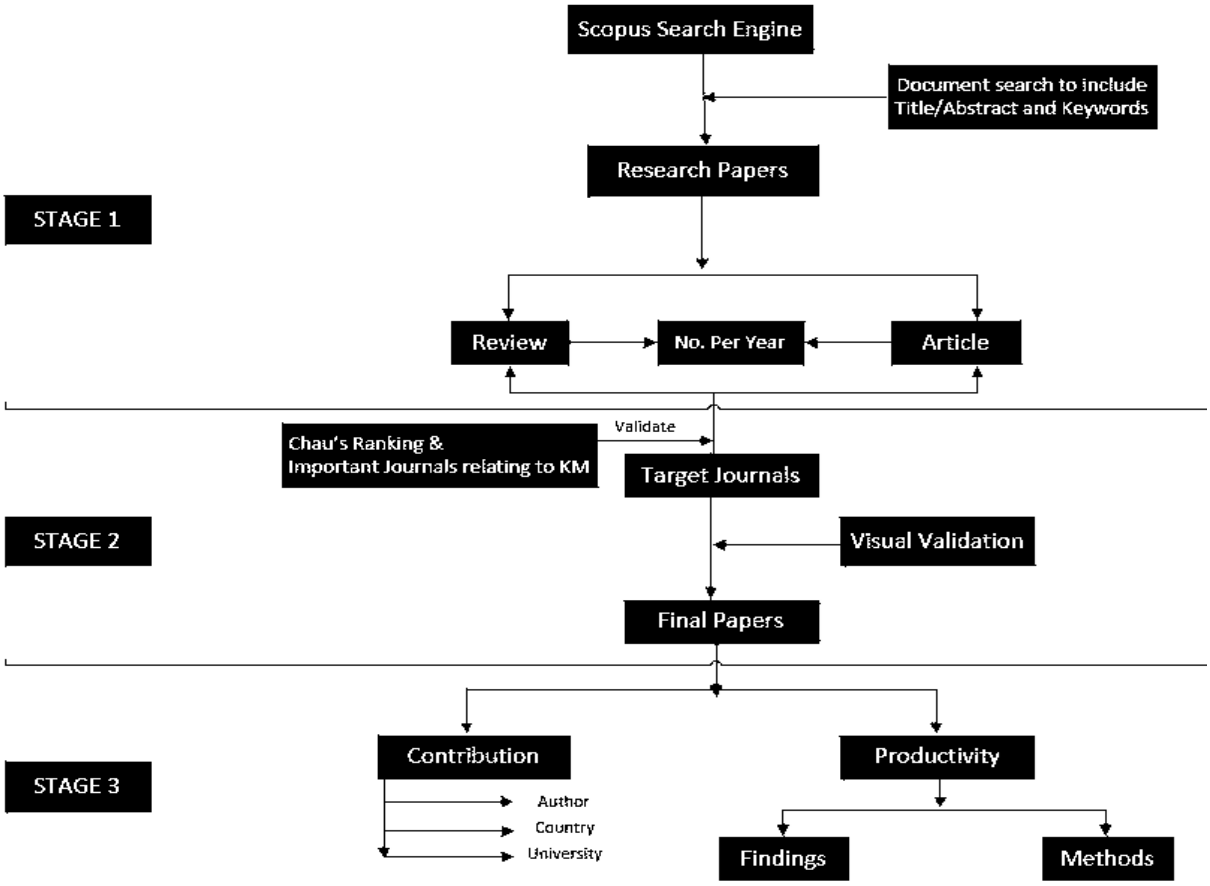

Figure 2.3: Research Framework for KM and CM Education

Sources: Adapted from Hong et al (2012) and Yi and Wang (2013)

The three-phase literature review took the following form:

1. identification of academic journals;
2. critical selection of relevant papers to ensure valid representations; and
3. findings and methods as well as an assessment of contributions in terms of countries, universities, and authors.

2.1.3.1 Identification of academic journals

The list of publications in academic journals on KM-related papers on construction education was obtained by a powerful search via Scopus search engine. The adoption of Scopus was on three reasons: 1) serve as a source of database or archive for the most comprehensive research publications in management, engineering, accounting and business fields (Hong and Chan, 2014), 2) use Scopus as according to Falagas et al. (2008) as search engine performs better as compared to other search engines, such as Google Scholar, Web of Science and PubMed with regards to coverage and accuracy, and 3) model after similar reviews of literature studies in construction management (Yu and Yang, 2016; Yi and Wang, 2013; Hong and Chan, 2014; Darko and Chan, 2016). A systematic desktop search was carried out to select a list of journals relevant to the construction industry for this study with the aid of Scopus.

Keywords utilization in searching for relevant papers have been employed by many researchers for review studies (Darko et al., 2018, Yi and Yang, 2016, Owusu et al., 2017). In much the same way, this study makes use of keywords search to identify and select construction journals as well as KM-related papers. Acknowledgment is made of the fact that KM is, a broad area with abundant keywords in literature and as such the size of the search might be huge depending on the adopted keywords. Nonetheless, since not a single study can capture all the complexities related to the selection of KM keywords, the challenge in getting a workable number of KM-related papers was minimized by the assumption that common keywords in KM research included “knowledge”, “knowledge management”, “knowledge management research”, “higher education”, “construction” and “construction education”. These keywords were therefore used in this study.

A pilot desktop search under the “article title/abstract/keywords” field of Scopus was conducted choosing document type as “article or review”. It is worth noting that the search was restricted to

"construction management" or "construction engineering and management" and "construction education". Moreover, the search was further limited to subject areas of "social sciences", "engineering", "business", "computer science", "arts", "environmental sciences", "economics", "decision sciences" and "multi-disciplinary". The full code for searching is as follows:

(TITLE-ABS-KEY (*knowledge management* OR *higher education*) AND "Construction" AND DOCTYPE (ar OR re) PUBYEAR > 1989) AND (TITLE-ABS-KEY ("Knowledge" OR "Knowledge management" OR "Higher education" AND "Construction" AND "Education") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989) AND (TITLE-ABS-KEY ("Knowledge" OR "Knowledge management research" OR "Higher Education" AND "Construction") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ENGI") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "ARTS") OR LIMIT-TO (SUBJAREA , "ENVI") OR LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "DECI") OR LIMIT-TO (SUBJAREA , "MULT")). (Initial Search results: 798 documents)

Despite many attempts to rid the search of non-construction journals, a few of them showed up. It is worth noting that as a general rule of ensuring papers limited to KM coverage in construction journals are used, journals, such as "Computers and Education" and "Nurse Education Today", which are not construction journals, were exempted. Consequently, either one of the following criteria was adopted in the selection of construction journals:

1. The showing of at least three papers from a journal (as a result of the search).
2. The ranking of the journals within the top ten of Chau (1997) ranking of Construction Management journals as it is widely accepted in this professional domain.
3. Other essential KM-related journals that were not captured in the desktop search.

The above criteria gave rise to a total of over twenty journals. The targeted journals, i.e. Journal of Construction Engineering and Management (JCEM), Journal of Management in Engineering (JME), Engineering, Construction and Architectural Management (ECAM), Construction Management and Economics (CME), and Automation in Construction (AIC) also falls within the ten top ranked construction journals by Chau (1997). This clearly indicates that the target journals for this study are of good quality and reliable. The search results indicated that the top targeted journals identified were also ranked as top-tier construction management journals that have published the most KM related papers as can be seen in Table 3.1.

2.1.3.2 Critical selection of relevant papers

The selected construction journals resulted in 145 documents out of the initial search results of 798. The keywords appeared in either article titles, abstracts or keywords of these documents hence considered to have satisfied the initial requirement for further analysis. There were however still the possibility of irrelevant documents showing up as there has been widespread use of these keywords in general construction management studies. Phase two was therefore initiated to include scanning thus reading abstracts of all 145 documents in a bid to remove irrelevant articles. Papers that do not actually focus on KM and construction management education were excluded since the aim was to review articles on KM and construction management education. A total of 76 papers

were deemed to be valid based on these selection criteria. Table 2.1 summarizes the initial search results.

Table 2.1: Search Results of papers on Knowledge Management and Construction Management Education in selected journals

Journal Title	**Number of papers retrieved from search engine**	**Number of papers relevant to this study**
Journal of Professional Issues in Engineering Education and Practice	20	19
International Journal of Construction Education and Research	13	12
Studies in Higher Education	12	4
Journal of Construction Engineering and Management	10	5
Journal of Management in Engineering	10	3
Electronic Journal of Information Technology in Construction	9	4
International Journal of Engineering Education	9	4
Engineering Construction and Architectural Management	8	2
Architectural Engineering and Design Management	6	4
Construction Management and Economics	6	1
Journal of Construction Education	6	3
Journal of Engineering Design and Technology	6	2
Teaching in Higher Education	5	2
Journal of Information Technology in Construction	4	3
International Journal of Construction Management	3	2
International Journal of Emerging Technologies in Learning	3	2
International Journal of Sustainability in Higher Education	3	1
Automation in Construction	2	1
Journal of Knowledge Management	8	1
Journal of Knowledge Economy	2	1
Total	145	76

2.1.3.3 Assessment of research contributions

Many authors (e.g. Cohen et al., 2002; Miller, Taylor and Bedeian, 2011; Colpaert, 2012) and academic institutions view research publications as a significant means of imparting industrial practices. Hong et al. (2012) are of the view that the number of published research works in a country on a said subject has an influence on the relevance of the geographical distribution of the research publication and thus serves as an indication to the extent of industrial practice as well as innovations advancement in that subject area in that region. Hence, identifying active contributors is paramount in order to appreciate the mainstream of research in that discipline across different regions (Yuan and Shen, 2011). This identification aids researchers to keep track of the contributions from previous researchers.

The research contribution from each researcher, research institute/university, and country were analyzed and ranked quantitatively using a method by Howard et al. (1987). According to Al-Sharif and Kaka (2004), it was assumed that the contribution of each author in a multi-authored publication is indiscriminately the same as if the paper is written by a single author. Nevertheless, Howard et al. (1987) opined that a more accurate approach should be adopted to reproduce the real contribution of each individual writer in a multi-authored publication. Howard et al. (1987) therefore assumed that the first author has contributed more than the second author, the third, and so on. Howard et al. (1987)'s proposed formula was adopted as there existed a clear differentiation of the contribution of each individual author in a multi-authored publication. This formula was adopted by Li et al. (2014) in their research trend in management of prefabricated construction, Osei-Kyei and Chan (2015) in their review of critical success factors for PPP projects, Tsai and Wen (2005) to identify the research trend of science education, and Yi and Chan (2014) in their research trend in construction labor productivity,. This widespread usage guarantees its reliability

and suitability for articles and hence its adoption in this review. The proposed formula is shown below:

Score= $\frac{1.5^{n-i}}{\sum_{i=1}^{n} 1.5^{n-i}}$ where n=number of writers/authors of the paper and

i=order of the specific writer/author.

This proportionately divides the credits of authors in a multi-authored paper after applying the formula. Given each paper a score of one point, a detailed score matrix for authors is presented in Table 2.2. It should be noted that the order of authorship may not always reflect the actual contribution difference. Take for example, the lead researcher taking the last position and leaving previous positions to other researchers. Thus, this study considered both the number of times that the writer's name occurred and the contribution score. This study does not aim to examine the entire population of KM articles but only look at the trend of KM research in the construction management education arena.

Table 2.2: Score Matrix for Multi-author Papers

No. of writers	**Order of specific writer**				
	1	2	3	4	5
1	1.00				
2	0.60	0.40			
3	0.47	0.32	0.21		
4	0.42	0.28	0.18	0.12	
5	0.38	0.26	0.17	0.11	0.08

2.1.4. Analysis and Discussion

2.1.4.1 Annual publications on Knowledge Management and Construction Management Education from 1990 to 2018

The preliminary search resulted in a total of 768 publications identified from 92 different journals signified the growing concept of KM in construction management education since its evolution (Yu and Yang, 2018). 145 papers were worth giving a closer look to reveal how many of these publications had "Knowledge Management" and "Construction Management Education" as their core keywords resulting in 76 publications been identified for further analysis. Nonetheless, the research methodology section of this study revealed that construction management journals such as Journal of Construction Engineering and Management (JCEM), Journal of Management in Engineering (JME), Engineering, Construction and Architectural Management (ECAM), Construction Management and Economics (CME), and Automation in Construction (AIC) which also falls within the top ten ranked construction management journals according to Chau (1997) were settled on with at least two papers on the subject matter aside from other journals (please refer to Table 2.1).

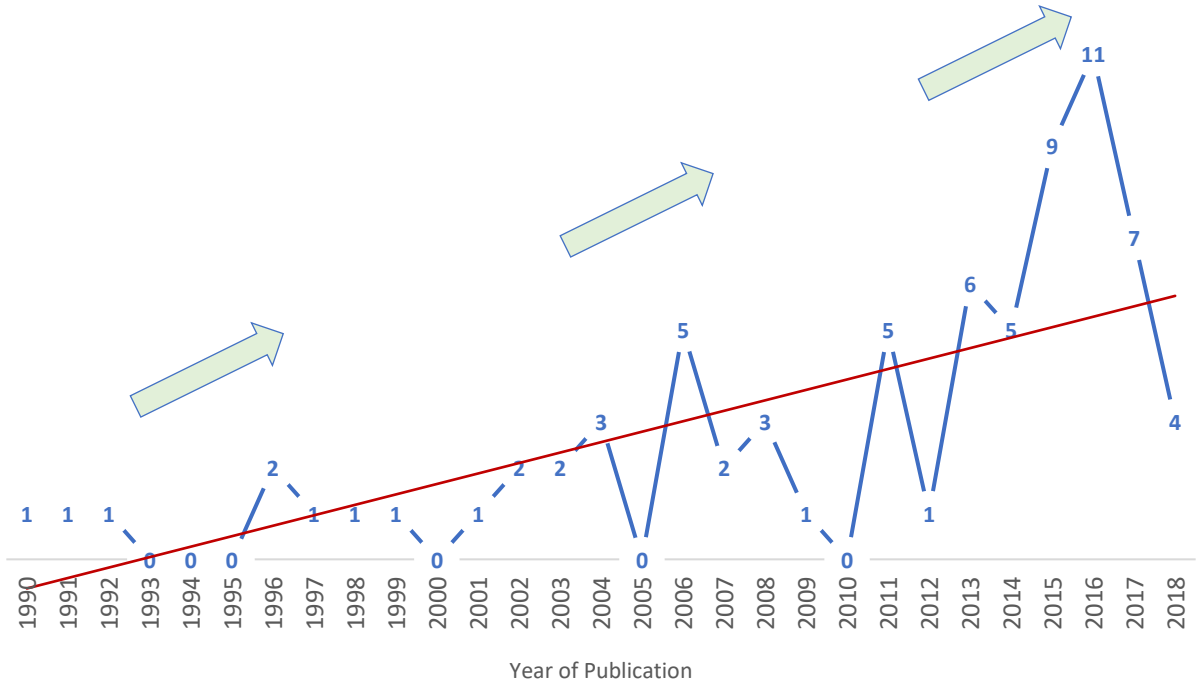

Figure 2.4: Number of publications per year

From the period of 1990 to 2018, presented in Figure 2.4 above, is the annual number of publications from the final collection of journals chosen. With an increasing trend of one publication in 1990 to 11 and 7 in 2016 and 2017 respectively, the total number of published papers from these selected journals constituted seventy-six (76). There was a rapid increase in 2006 and then saw a gradual increase with 5 publications from the year 2011 onwards. The peak was witnessed in 2016 with 11 publications, indicating the gradual rising of interest in exploring what KM has to offer in Construction Management Education.

According to Figure 2.4, the first decade (1990-2000) only saw the publication of 8 papers depicting the infant stage of the concept of KM with regards to construction management education. Few countries such as the US, UK, and Japan had begun with a scratch at the surface of this concept. The second decade thus from 2001-2010 according to the search results indicated

a total number of 21 publications with still the US leading the number of publication chart with the aim of improving construction management education through the effective management of knowledge. The period between 2010 and 2018 gave rise to 50 publications looking at the dynamisms of KM in the sense of skills and competencies, pedagogies, learning strategies, and ICTs in construction education (BIM, Virtual and Augmented reality, and simulations).

It must be stressed that the increasing trend as depicted by the trend line of research of KM in Construction Management Education would linger on as knowledge (acquisition, transfer, storage, and usage) as a resource is the core theme of any educational scheme especially in this era of globalization and technological advancement.

2.1.4.2 Contribution of Countries of Authors to KM and Construction Management Education Research

The score matrix as presented in Table 2.2 above was used in determining the researcher country's contribution towards publication. Each author's score either as a sole-authored or multi-authored publication was put together for each country based on the score matrix and hence produced their contribution. To demonstrate an example, Ahmed, Yaris and Saqib from the US collaborated with Farooqui from Pakistan to publish an article which brings the score for each author to 0.42, 0.28, 0.12 (4th author) and 0.18 (3rd author from Pakistan) respectively. Therefore, in measuring the contribution in terms of the author's country of origin, a score of 0.82 (0.42 + 0.28 + 0.12) is awarded to the US while Pakistan receives 0.18. This approach is also applied to single-authored publications. Table 2.3 presents the contribution by way of country/origin of researchers thus also showing the number of universities/institutions and researchers, identified papers as well as their scores.

Table 2.3: Location of Selected KM and CM Education papers

Country	**Institutions/Universities**	**Researchers**	**Papers**	**Score**
USA	*30*	*73*	*34*	*32.61*
UK	*13*	*15*	*11*	*10.08*
China	*3*	*9*	*4*	*3.68*
Australia	*4*	*11*	*5*	*3.44*
Hong Kong[#]	*2*	*12*	*3*	*3.00*
Israel	*1*	*4*	*3*	*3.00*
Singapore	*2*	*5*	*2*	*2.00*
South Africa	*3*	*4*	*2*	*2.00*
Pakistan	*3*	*5*	*2*	*1.18*
Germany	*2*	*3*	*2*	*1.12*
Spain	*1*	*2*	*1*	*1.00*
Japan	*1*	*3*	*1*	*1.00*
New Zealand	*1*	*1*	*1*	*1.00*
Greece	*1*	*2*	*1*	*1.00*
Switzerland	*1*	*1*	*1*	*1.00*
Canada	*1*	*5*	*1*	*1.00*
Denmark	*1*	*3*	*1*	*1.00*
Kuwait	*1*	*2*	*1*	*1.00*
Malaysia	*1*	*4*	*1*	*1.00*
Egypt	*1*	*1*	*1*	*1.00*
Colombia	*1*	*5*	*1*	*1.00*
Finland	*1*	*3*	*1*	*0.88*
Netherlands	*1*	*3*	*1*	*0.88*

- Hong Kong is a special administrative region of China but is cataloged separately for comparison purpose.

From the past 28 years as depicted in Table 2.3 above, the USA and the UK with scores of 32.61 and 10.08 respectively had the highest number of researchers devoted to exploring the concept of KM and Construction Management Education. Countries such as China, Australia, Hong Kong# and Israel also had a contribution score of 3.68, 3.44, 3.00 and 3.00 respectively. In the USA alone, as seen in Figure 2.5 below, 73 researchers from 30 different universities/institutions have contributed to 34 publications while in the UK, 15 researchers from 13 universities have published 11 papers on KM and Construction Management Education. This emphasizes the degree of

relevance attached to improving Construction Management Education in these countries through KM. Thus, these countries are doing their possible best to bridge the gap between the industry's expectations and academia's perception via the delivery of knowledge needed for knowledge-based economies the world has known of lately. Likewise, 9 researchers from 3 Chinese universities have published 4 papers, 11 researchers from 4 Australian universities have to their credit 5 publications, 12 researchers from 2 universities in Hong Kong have produced 3 articles and in Israel, 4 researchers from Technion - Israel Institute of Technology have contributed to 3 publications.

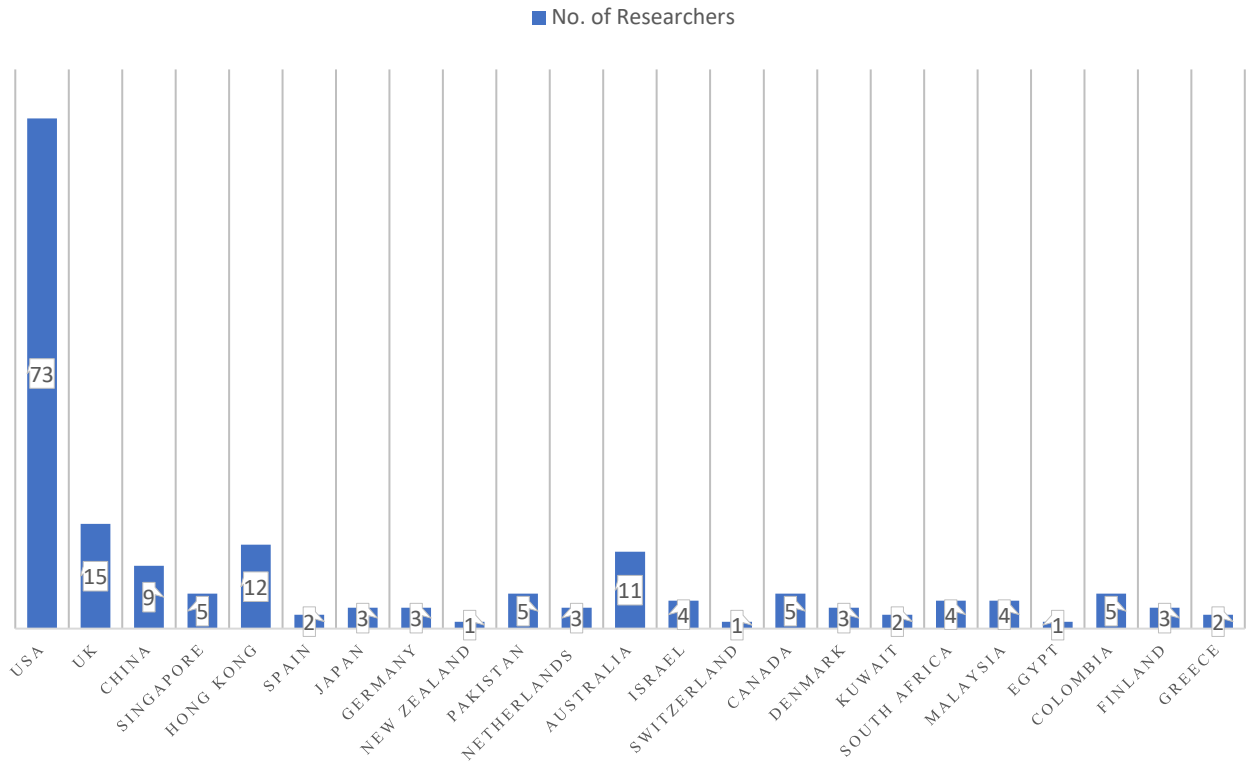

Figure 2.5: Number of Researchers per Country

The statistics above have proved how developed and widespread the concept of KM and Construction Management Education has been for the past 28 years as more researchers from

different parts of the world have shown interests. However, not much is witnessed by developing countries as they have a low contribution to this growing phenomenon. This could be accounted to the fact that the KM concept and Construction Management Education is at its infancy stage and yet to be fully explored hence limited publications as seen in these selected construction management and related journals. Not to discredit the fact that developing countries might also have published in other journals not looked at as far as this study is concerned thus the usage of the twenty-one (21) identified journals on the subject matter which could be considered, can be a limitation to this study.

As indicated geographically in Figure 2.6 below, the continent of America (North and South) had done the most research on this subject matter with 44% of publications arising from this continent. This proves that much can be learned from this continent as they have and still are exploring the concept of KM and its applicability in construction management education ensuring improvement in this field. As far back as 1990, the USA has started to look closely at the dilemmas facing construction education and research and concluded that construction management has evolved from a trade to a profession and thus this complex industry demands diversity in curricula to accommodate this transition (Oglesby, 1990). The European continent has also played a major role in promulgating the concept of KM and construction management education with 24% (19 papers) of publications. With 17 publications, the Asian continent shares lessons learned and are moving on a fast pace on advancing the knowledge-based construction industry. Few studies have been conducted on the continents of Australia and Africa with 7% and 4% of publications towards this phenomenon respectively. This goes to show that these continents can benefit from the insights of America and Europe as they are advanced in this concept of KM and construction management education.

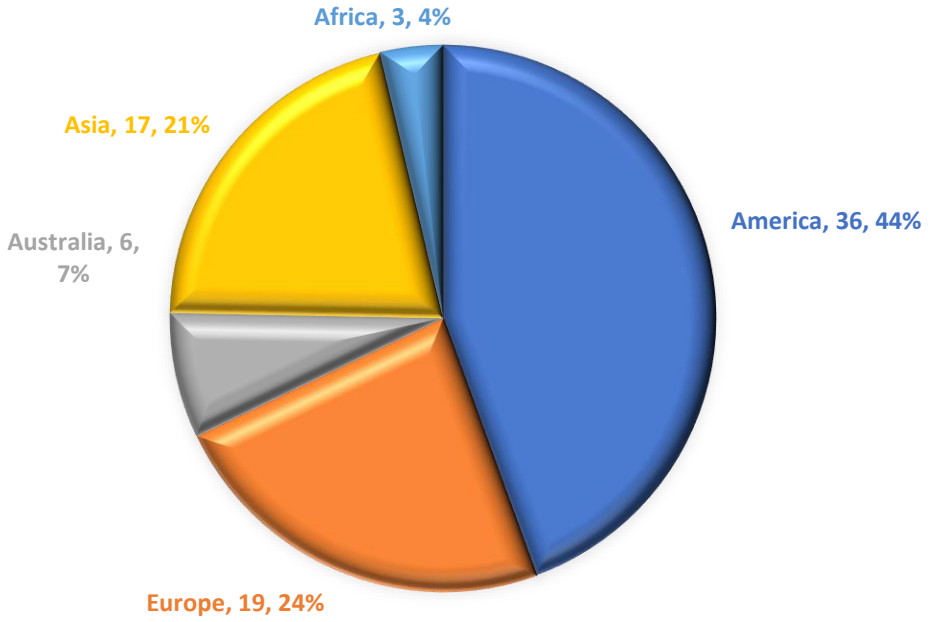

Figure 2.6: Geographical focus of Studies

2.1.4.3 Contribution of Institutions and Research Institutes to the Research

As depicted in Table 2.4, with regards to the construction management education field, the top 15 institutions/universities publishing papers on KM are presented. Moreover, properly presented are the countries of origin of the Research Institutions/Universities, the number of researchers as well as publications. Research institutions/universities that have paid most contribution to KM research on Construction Management Education include but not limited to Israel Institute of Technology (Israel), University of Nebraska-Lincoln (USA), Georgia Institute of Technology (USA), Arizona State University (USA), Pennsylvania State University (USA), Queensland University of Technology (Australia) and the Hong Kong Polytechnic University (Hong Kong), with a contribution score of 3.00, 2.81, 2.42, 2.40, 2.00, 2.00, 2.00 and 2.00 respectively. All these institutions/universities exceeded one-point score in their contribution to KM and CM education research. Once again, pioneering the course of KM in CM education research is the USA where

most of their institutions/universities have published the most papers. Almost all the research institutions/universities contributing most to this research were from developed countries hence the need for developing countries to take a cue from these developed nations in coming to speed with this phenomenon.

Table 2.4: Top 15 Research Institutions/Universities publishing KM papers on CM Education (using the score matrix)

Institution/University	**Country**	**Researchers**	**Papers**	**Score**
Israel Institute of Technology	Israel	4	3	3.00
University of Nebraska-Lincoln	USA	5	4	2.81
Georgia Institute of Technology	USA	6	3	2.42
Arizona State University	USA	7	3	2.40
Pennsylvania State University	USA	3	2	2.00
University of Florida	USA	5	2	2.00
Auburn University	USA	4	2	2.00
University of Texas, Austin	USA	2	2	2.00
Stanford University	USA	3	2	2.00
Queensland University of Technology	Australia	7	2	2.00
The Hong Kong Polytechnic University	Hong Kong	7	2	2.00
Chang' an University	China	3	2	1.68
East Carolina University	USA	3	3	1.63
Leeds Metropolitan University	UK	4	2	1.47
Colorado State University	USA	3	2	1.21

2.1.4.4 Contribution of Authors to the Research

Table 2.5 shows those active contributors with their respective affiliations to the research on KM and CM education from 1990 to 2018. Using the score matrix, eleven (11) researchers scored at least 0.5 in their contribution towards this field of research. Notable among researchers with at least one score included Charles Egbu from London South Bank University (UK) who published 2 sole-authored papers and 1 with other researchers, Paul Chinowsky from University of Colorado

(USA), and Fernanda Leite from University of Texas (USA), all of whom contributed to a score of 2.40, 1.82 and 1.40 respectively. These contributions from these researchers pretty much explain the highest scores of their respective affiliations and countries of origin. It can be noted that even though countries such as Hong Kong#, China, and Australia have contributed to quite several publications, yet the contribution of their individual researchers is low. This can be explained as most of their researchers partnering up in contributing towards single publications and thus have few sole-authored papers to their credits. Notwithstanding this also depicts the widespread nature of the knowledge of KM and CM education research among researchers within these countries.

Table 2.5: Authors contributions to KM and CM education publications (with at least a 0.5 score point)

Researchers	**Papers**	**Affiliation**	**Country**	**Score**
Egbu, Charles	3	London South Bank University	UK	2.40
Chinowsky, Paul	3	University of Colorado	USA	1.82
Leite, Fernanda	2	University of Texas	USA	1.40
Zhang, Jingxiao	2	Chang' an University	China	0.94
Solnosky, Ryan	2	Pennsylvania State University	USA	0.94
Goedert, James D.	2	University of Nebraska-Lincoln	USA	0.92
Sacks, Rafael	2	Israel Institute of Technology	Israel	0.92
Pikas, Ergo	2	Israel Institute of Technology	Israel	0.87
Rokooei, Saeed	2	University of Nebraska-Lincoln	USA	0.87
Parfitt, M. Kevin	2	Pennsylvania State University	USA	0.64
Xia, Bo	2	Queensland University of Technology	Australia	0.54

2.1.4.5 Methodologies adopted for studies in KM and CM education.

Various studies use different methods to explore the concept of KM on CM education. An examination of those selected publications from selected journals was shown in Table 2.6. Eight (8) research methods were identified to include Case Study, Comparative Study, Quantitative Study, Qualitative Study, Mixed-Method Study, Experimental Study, Exploratory Study and Conceptual Study as depicted in Table 2.6. The most favored approach in exploring KM on CM

education was case studies with twenty-three (23) publications accounting for 29% of the total publications during the 28-year period (1990-2018) considered for this review. According to Ridder (2012), case study research is an empirical inquiry that investigates a contemporary phenomenon within its real-life context. Ghosh, Parrish, and Chasey (2015) posited that despite the criticism this method faced for the reason that results are often not easily reproducible; it is a preferred strategy when creating and extending theory from real-world observations hence its widespread usage in KM and CM education research comes as no surprise. Followed suit as another favorable research method for studies on this field was quantitative study via the use of a structured questionnaire survey. Producing 12 publications, this research method gave rise to 15% of the total publications. According to Holt (2010), a questionnaire survey has been a preferred choice in construction management research as it gives room for experts to partake in a sensitive study such as that of KM and CM education research. Mixed method was the third frequently adopted research method for studies in this domain. Involved as part of the mixed-method approach were combinations of questionnaire surveys, interviews, case studies, and action-based studies. For instance, Opoku and Egbu (2018) in their study on "Students' Perspectives on the Relevance of Sustainability Literacy in a Postgraduate Built Environment Program" employed mixed-method research approach via the utilization of both interviews (qualitative) and questionnaire survey (quantitative). As posited by Johnson and Onwuegbuzie (2004), this method draws from the strengths as well as reduces the weaknesses of any one of the approaches should they have stood alone in any study. Other studies on the concept of KM and CM education as presented in this paper also adopted research methods such as qualitative approach, comparative study, exploratory study, experimental study, and conceptual study approach. Notwithstanding, it

must be stated emphatically that the usage of a particular research method to explore KM and CM education was dependent on the locality and time of that study.

Table 2.6: Cross-tabulation of study type (Methodology) per publishing year

Year Published	Case Study	Mixed study	Comparative Study	Quantitative study	Qualitative study	Experimental Study	Exploratory Study	Conceptual Study
1990					x			
1991	x							
1992								x
1993								
1994								
1995								
1996	x							
1997							x	
1998	x							
1999		x						
2000								
2001					x			
2002	x			x				
2003	x							
2004	x	x		x				
2005								
2006	x		x	x			x	
2007	x				x			
2008		x	x		x			
2009	x							
2010								
2011	x			x	x	x		
2012				x				
2013	x	x		x		x		
2014	x			x				
2015	x	x		x	x			
2016	x	x	x	x	x	x	x	
2017	x	x	x	x	x		x	
2018	x	x		x				

2.1.5 Key Research Areas and Sub-Focus Captured in KM and CM Education Studies

Based on the selected publications from construction management and related journals, five (5) major themes were identified. They include:

1. Skill Development.
2. Teaching and Learning Strategies.
3. Information and Communication Technologies in Construction Management Education.
4. Curricula Development; and
5. Sustainability in Construction Management Education.

2.1.5.1 Skill Development

In this era of globalization, reference can be given to the transformative power of a revolution by information (explicit knowledge) just as the industrial revolutions back in the 18th and 19th centuries transformed most parts of the world (Brynjolfsson and Mcafee, 2016). This information revolution came about as a result of the availabilities of information and communication technologies (ICTs) coupled with a restructuring of the general economy towards that of human capital, technology and service orientation of which the construction industry is no exception (Ojanperä, Graham and Zook, 2019).

The construction industry's peculiar characteristics such as dynamism, complexity of projects, more sophisticated usage of construction equipment requiring advanced IT skills, 3D computer-aided modelling, management techniques, competition among stakeholders, and higher expectations from clients required the need of highly skilled and educated professionals (Goodman and Chinowsky, 1997; Leifer, O'Connor, and Rice, 2001; Atalah and Muchemedzi, 2006; Christodoulou, 2004). To prepare future construction professionals, Oglesby and Hicks (1982) and Tatum (1987) in their studies posited that universities, especially those in the USA which initiated Construction Management programs with some schools introducing master's degree programs to

accommodate the forecasted increasing demand in subsequent years hence the enhancement of skill development evolved. Christodoulou (2004) further supported this assertion that engineering institutions must educate architectural, engineering and construction professionals of tomorrow via the fusion of process automation concepts and information technologies in addition to the usual traditional educational curricula.

For the long-term survival of the construction industry, there is a need to attract fresh talents (Ling and Ho, 2013). Concerns are raised as to whether the decline in skills variety will have an impact on the long-term sustainability of the more complex construction industry, productivity, technology-driven as well as cross-functional building domain. In a bid to attract fresh talent to the construction industry, Singapore expresses much concern in these talents in meeting future needs (Lim and Alum, 1995) while the UK experiences decline in their graduates seeking for and accepting offers in construction-related jobs (Dainty and Edwards, 2003) as a result of higher learning institutions' slow pace in adjusting to the ever-changing needs as well as the dynamics of the construction industry (Atalah and Muchemedzi, 2006). As a result of new challenges prevalent in the construction industry on a daily basis, construction professionals being positioned at the epicenter are deemed to acquire skill variety to handle these challenges (Styhre and Josephson, 2006). Many researchers deem skill sets to take the form of technical and non-technical skills, leadership, motivation, communication, decision making, innovative, managerial, life-long learning, digital literacy, personal attributes, professional attributes, legal and contractual skills, etc. which are vital to the overall progress of the construction industry (Goodman and Chinowsky, 1997; Egbu, 1999; Leifer, O'Connor, and Rice, 2001; Thomas and Mengel, 2008; Zaharim et al., 2010; Ahmed et al., 2014; Zhao et al., 2015; Naveed et al., 2017). Site managers, in particular, are expected to incorporate a variety of skills to take control of the series of construction activities on

sites (Styhre and Josephson, 2006) since these skills and competencies largely enhance performance in the construction industry (Naveed et al., 2017). The findings of the study by Ling and Ho (2013) confirmed that of Arciszewski and Harrison (2010), that the construction industry gives room for practitioners to solve problems without strict adherence to the well-known routine solutions from traditional engineering analysis and hence the benefits of skill varieties at play here. Therefore, construction jobs now look more attractive to young adults.

Few researchers (Christodoulou, 2004; Goh, 2007; Domal and Trevelyan, 2009; Zhao, et al., 2015; Naveed et al., 2017) have attributed the unpreparedness of graduates from construction institutions to rigid academic content of curricula, limited electives offered as an extension of compulsory courses, curricula lacking multidisciplinary collaboration with other relevant skill areas and the gap surrounding the expectations of the construction industry as against the perceptions of higher learning institutions (academia) as having a negative toll on the performance of the industry and hence demanding prompt pragmatic solutions.

Christodoulou (2004) in his provision of a solution, is of the view that the new generation of students in this era should be able to blend traditional engineering knowledge with that of information technology, financial concepts, and management as a result of the dynamic needs of the construction industry today to tackle challenges of those professions thrown at them. Naveed et al., (2017) add to the submissions of Christodoulou (2004) study's and argue that there needs to be constant revamping and enhancing of construction management programs (curricula) which seems inevitable if this dynamic industry's needs are to be met. Hence the onus falls on the stakeholders such as students, employers, and institutions of higher learning (academia) to contribute their effort in ensuring this transition becomes fruitful.

2.1.5.2 Teaching and Learning Strategies

Being criticized as insufficient by many researchers, the traditional methods of teaching and learning in construction management education have failed in providing all the requisite skillsets and competencies in an effective way (Ahmed et al., 2007; Park et al., 2003; Schmidt, 1993). Accounting for this phenomenon is the incompatibility between teaching styles of most lecturers and learning strategies of most students (Lam et al., 2016). Passive learning environment known to the typical traditional Architectural, Engineering and Construction (AEC) pedagogies seems less of a productive means to foster knowledge dissemination and learning (ElZomor et al., 2018). These teaching strategies have long been proven by many researchers and a sizable number of national reports as ineffective in knowledge sharing and transfer, hence an advocacy been raised to the adoption of dynamic techniques that actively engages students and enhance their learning experience (American Association for the Advancement of Science, 2002; Kenny, 2002; National Research Council, 2003). Frank (2005) opined that learning and teaching strategies that will prepare Generation Z students for the future work while developing key skills needed to tackle real-world challenges are now the main concerns of most universities. Novel pedagogies such as inverted/flipped classroom, problem-based learning (PBL), service learning, peer-reviewing, vertical integration etc. have been settled on by many scholars (Felder 2012; Cooper and Robinson 2000; Sheppard et al. 2008; Mason et al. 2013; El-adaway, Pierrakos and Truax 2014), as the way forward if expectations of the current architectural, engineering and construction profession are to meet future need. Hence, the shift of focus recently to the development and testing of these new pedagogies that actively involves/engages and supports students' learning as graduates need to acquire information on their own whiles known knowledge becomes easily outdated. Lazerson et al. (2000) however were of the view that faculties of AEC although are interested in these new

pedagogical methods, they were also slow in embracing such collaborative methods for reasons such as low rate in its implementation and financial implications.

As a proof of success that new and engaging pedagogies improves students' performance while encouraging development of a variety of skills, the findings of ElZomor et al. (2018) indicated that fifty-four (54) students who participated in the vertically integrated PBL framework program at Arizona State University saw an improvement in their academic performance and confidence level and in their self-reported skills such as interactional competency skill and confidence in leadership, collaboration, and management skills.

Vertical integration as a learning strategy has been an effective and successful strategy for learning, particularly in medical education thus given students an opportunity to gain an early appreciation for the relevance of particular knowledge and skills in their future professional/academic life (Barrows and Tamblyn 1980; Rosenthal et al. 2004). Within the medical field of education, Vidic and Weitlauf (2002) referred to vertical integration as actively connecting and engaging groups of students at different levels within medical education for retention and learning in each group to be encouraged. Construction management's field of education has also utilized this strategy with fruitful and effective outcome as seen in Ghosh et al. (2015) study on implementation of vertical integration for upper and lower division students working on Building Information Modelling assignment and Benning and Shearer (2016) on their study on vertical integration sustainability program between lower and higher-division Civil and Environmental Engineering courses.

Developed in 1969 by Postman and Weingartner (1969), problem-based learning (PBL) at that time was a teaching model that was unconventional as it only introduced students to open-ended problems and questions development (Forcael et al. 2014). PBL, as defined by Barrows (1986), is a learning strategy where the premise for acquiring as well as integrating new knowledge hinges

on defining the problems, to begin with. Tomkinson et al. (2008) and Prieto (2006) posit that PBL represents an appropriate, flexible and effective strategy enhancing students complex problem-solving ability and thus exposing students to real-world problems. Capon and Kuhn (2004) added that apart from PBL encourages critical thinking while exposing students to real-world problems, more importantly, it also fosters collaboration among students, supports the development of students' self-learning techniques as well as promotes research (Allen et al., 2011). PBL in the modern era has promoted active student engagement with the positive and promising outcome, hence, its suitability in preparing future construction management graduates for the knowledge-based economy.

According to (Lovelace, 2005; Fine, 2003; Favre, 2007; SheaDoolan, 2004), lecturers in construction management courses adopt various teaching methods in addressing individual differences among construction management students' learning abilities as they have diverse impacts on students' performance. In a bid to better prepare students for the knowledge-based economy, attention should be focused on not only the learning ability of the students but also the teaching strategies of the educators as well. This will ensure improvement in overall learning and academic performance.

2.1.5.3 Information and Communication Technologies in Construction Management Education

The construction industry as we have it today is experiencing a major institutional and technical transformation which the adoption of various fast-growing and emerging innovations is addressing the challenges this industry faces. To benefit from safer construction environments, improved productivity, reduced cost, improved coordination of construction documents, etc., the construction industry has adopted concepts and technologies such as Building Information

Modelling (BIM) (Ahn, Cho, and Lee, 2013). Apparently, the understanding of how best to utilize these technologies and attain higher proficiency in their usage is paramount. Advancement in technologies as well as rapid changes in construction industry's practices have pushed technologies such as BIM (Solnosky, Parfitt, and Holland, 2015), Simulation and Modelling tools such as virtual reality (VR) and augmented reality (AR) (Rokooei, Goedert, and Najjar, 2017), Serious Game (Van den Berg et al., 2017) and Integrated Project Delivery (IPD) to the forefront in the industry, and construction education is taking advantage of such an opportunity through knowledge management. Hence, to equip construction management students with relevant technical knowledge and skills, construction management programs for the past decades have introduced courses, such as BIM, Simulation and Modelling, to prepare students for future careers in the construction industry (Ahn et al., 2013). As an in-vogue management initiative, Knowledge management has been around for a number of years but except for the use of web-delivered information, the obvious link to construction education has not been connected yet (Boyd, 2006). Educators and field practitioners alike see BIM-based technologies changing the fundamental way buildings are designed, constructed and ultimately delivered to the client (Solnosky et al., 2015).

According to Wu and Issa (2014) and Wang and Leite (2014), though BIM has gained wide-spread integration into post-secondary education curricula, recent trends show a shift from technology-centric to process based with an emphasis on project execution-oriented BIM competency. In addition, Abdirad and Dossick (2016) hinted on a great deal of now inculcating not only technical skills but also soft skills for instance communication, collaboration, teamwork, etc. into BIM curricula design.

Duplicating best industry's practice in an academic environment can be expected to seem near impossible. However, according to Solnosky et al. (2015), by implementing a focused practice-

based environment around these ICT's topics, attention can be created on developing specialized skillsets and knowledge for construction management students. The emergence of Generation Z students makes this assertion close to realization as this generation of students as we have now been immersed in technologies and gaming, hence imparting them with these sophisticated technical skills are now easier than ever before.

2.1.5.4 Curricula Development

Now more than ever, the pressure on academia keeps mounting as the construction industry requires job-ready and highly knowledgeable graduates (Benhart and Shaurette, 2011). To this effect, construction management education has been doing its best in integrating new knowledge and technologies of the industry into their curricula as a technique to meet industry's expectations (Azhar, Grau, Burt and Gibson, 2013). Becker et al. (2011) placed the responsibility of construction education programs into two, thus re-modification of academic curricula to reflect future needs of the industry, and forecasting requisite skills and competencies needed for successful construction professionals. With these best practices and technologies of the industry being exposed to young students who according to Solnosky et al. (2013) need to be skilled in managing information and knowledge flow. Azhar at al. (2013) were of the view that through the incorporation of requisite skill in curricula, construction projects managed by graduates will be delivered in a more efficient way as well as bridge the knowledge gap between junior and senior employees in Architectural, Engineering, and Construction (AEC) firms.

In the United States, for instance, publications from the Construction Industry Institute (CII) on research products for industry's best practices have helped in boosting sharper skills, management and engineering capabilities, and strong collaborations among firms utilizing these practices (CII,

2013; Peters, 2011). Other benefits realized from these publications were enhanced productivity, reduction in project time, improvement in quality and safety, rise in overall profit and improved customers' satisfaction (CII, 2010). A growing evidence rather depicts a slow adoption by higher academic institutions to these best practices and technologies into their curricula for reasons such as constraint by the requirements of academic accreditation bodies, such as American Council for Construction Education (ACCE) in the US, poor integration of teaching and research, non-involvement of industry experts and curricula requirements of various universities (Turrell, 2003; Amaratunga and Senaratne, 2009; Jestrab et al., 2009; Olsen and Burt, 2011; Solnosky et al., 2013; Azhar at al., 2013).

According to Park et al. (2003), there exists a huge gap between what is taught in curricula of construction institutions and recent industry's practices. This, therefore, calls for the adoption of a more holistic approach in integrating these best practices into curricula of higher academic institutions.

2.1.5.5 Sustainability in Construction Management Education

Education for Sustainable development is defined by Environmental Association for Universities and Colleges (EAUC) (2009) as making use of opportunities to embed economic, environmental and social issues in curricula either by full integration into courses or embedding them in a particular module of a course. Recent studies (Opoku and Egbu, 2018; Higham and Thompson, 2015; RIBA, 2014; CIOB, 2013) have still shown the low level of understanding and awareness of sustainability-related issues in construction management education, despite its importance to the built environment. According to Hanover Research (2011), fresh graduates possessing decent values on sustainable development are believed to be what most employers want to employ, hence

the need for its teaching in universities. To better prepare construction management graduates with vast knowledge and dynamic mentality for the knowledge-based Economy, the incorporation of principles of sustainability in construction management education curricula has become very vital to charting this course. This is as a result of the rising need for professionals that are sustainability literate and interdisciplinary challenges that the knowledge-based economy presents in the 21st century (El-adaway, Pierrakos, and Truax, 2014; Xia et al., 2016; Opoku and Egbu, 2018).

Several professional organizations were in support of this move by their inclusion of sustainability policies in their statements such as the one given by the American Society for Engineering Education (ASEE, 1999) on preparing engineering graduates to use sustainable engineering techniques and serving as leaders facilitating sustainable development in their communities. The American Society of Civil Engineers (ASCE, 2004a & 2004b) in their policy statement 418 states that "sustainable development requires strengthening and broadening the education of engineers and finding innovative ways to achieve needed development while conserving and preserving natural resources". The World Federation of Engineering Organizations (WFEO, 2006), as part of its objectives, states that via education and suitable engineering activities, organizations want to see development and commitment to sustainable development. This, therefore, places the task on institutions of higher learning to incorporate sustainability in their curricula to enhance graduate employability (Sayce et al., 2009; Opoku and Egbu, 2018). Stelmack et al. (2005) had reported a triple in the number of universities in Canada offering sustainability-related course since the late 1980s while Geli De Ciurana and Filho (2006) reported most European universities initiated a strategic plan to push forward sustainability course as well as promoting international collaborations among universities in a bid to promote sustainability frameworks in their education.

Wang (2009) opined that many institutions of higher learning are embracing and providing sustainable development courses using diverse approaches. However, every construction management program the world over, boast in their own sustainability courses which in fact are not all embracing and could use a generic world standard. In the end, the ultimate goal of incorporating principles of sustainability in construction management education is the attainment of sustainability literacy. Higher Education Funding Council for England (HEFCE, 2009) rightly puts it as "Education for Sustainable Development" (ESD) deals with the provision of students with the requisite skills to think critically and creatively, acting in a positive manner while working with others. All these can be achieved via the development of pedagogy and curricula by higher education institutions providing students with the said knowledge and skills for a more sustainable behavior.

2.1.6 Research Gap and Directions for Future Research

Based on the goal of identifying current trends of KM in CM education, this study has provided a systematic review of what has been done and what remains to be uncovered with regards to these subject areas. Thematic analysis gave rise to potential research gaps identified from previous selected scholarly works.

Table 2.7: Research focus, data retrieval and Analytical tools in KM and CM Studies

S/N	Research Focus	Data Retrieval method	Analytical Tools Employed	No. of Papers	Percent (%)
1	Skill Development (Acquisition)	Survey, Case Study, Mixed method	Relative Importance Index, mean score, t-test, content analysis	17	20
2	Teaching and Learning Strategies	Case Study/Interview	Content Analysis, mean score, Exploratory factor analysis, Structural equation modelling	20	24
3	Information and Communication Technologies	Case Study/Interview, Mixed method, Literature Review	Content analysis, Percentages, mean score, standard deviation, Wilcoxon test	23	27
4	Curricula Development	Survey, Mixed method, focus group	Percentages, mean score, content analysis	14	17
5	Sustainability in Construction Management Education	Mixed method, case study	Mean score, standard deviation, frequency, concept map	10	12
	Total			84*	100

*Total No. of papers thus 84 exceeds the publications used for this review (76) as some papers overlap with other research areas

The first identified gap surrounds the expectations of the construction industry as against perceptions of higher education institutions with regards to skills acquisition popularly known as skill gap. According to Park et al. (2003) and Benhart and Shaurette (2011), there exists a huge gap between what is taught in curricula of construction institutions and recent industry's practices. While the industry is looking for young graduates with particularly soft skills, such as effective communication and collaboration, higher education institutions are busy passing on technical skills to these graduating students. Existing studies have made effort in bridging this gap, however, an important step in doing so will be the forging of collaboration between industry and academia for a holistic integration of perceived industrial skills into curricula of higher education institutions.

This, therefore, calls for the adoption of a more holistic approach in integrating these best industry credentials into degree programs of higher academic institutions in the extension of existing literature. As seen in Table 2.7, future studies can make use of artificial intelligence tools such as social network analysis, neural networks (Artificial Neural Networks) in data analytics to predict the trend of future desirable skill set in the construction management domain so as to develop better curricula to address these issues.

The development of better lecture contents by educators which are appropriate to include sustainability and effective techniques for teaching is another gap that was identified. Although many researchers (e.g. Wang, 2009) opine that many institutions of higher learning are embracing and providing sustainable development courses using diverse approaches, however, there exists no general consensus on the constituents of the body of knowledge on sustainability and its delivery in construction management education. This makes it practically impossible for universally incorporated sustainability principles into construction management curricula as sustainability has almost always been taught as a standalone course neglecting the interdisciplinary nature of the construction industry. As a direction for future studies, a framework can be generated to reach a general consensus on what actually constitutes sustainability as well as modeling on the techniques needed to pass on these sustainability principles to students.

Another hurdle to effective KM in CM education is the environment created around digital proficiency in CM education. For construction management students to develop specialized skill sets and knowledge, (Solnosky et al., 2015) opined that an attention needs to be created by implementing a focused practice-based environment around ICT topics. Recent trends show a shift from technology centric to process based with emphasis on project execution-oriented BIM competency, even though BIM has gained wide-spread integration into postsecondary education

curricula (Wang and Leite, 2014). Quite aside from BIM, other technology-based products such as simulation and modelling tools, vision and sensory based tools and artificial intelligence tools are all looked at from a standalone point of view instead of tackling them from an interdisciplinary viewpoint since construction only forms part of the Architectural, Engineering and Construction (AEC) industry. This, therefore, calls for an environment where ICTs are thought of as an interdisciplinary curriculum rather than technology centric curricula to bridge this gap. Further studies can be extended to facilitate how to integrate practical experience from the ICT's environment into course content to better prepare students to adapt to the emerging trends of today's hiring landscape.

Individual differences among construction management students' learning abilities create an impression for instructors to also adopt various teaching styles to accommodate the difference as different styles of learning have diverse impact on students' performance (Lovelace, 2005; Favre, 2007). To address the gap of catering for individual student's learning abilities, it is therefore, recommended for instructors in construction management education to adopt novel teaching techniques that better suit their students' strength so as improve their learning attitude towards construction education while increasing their academic performance. Further studies can be extended to develop comprehensive teaching strategy framework to cater for the needs of the diverse student body.

As presented above with regards to the identified research gaps, critical attention is needed to ensure Knowledge is effectively managed in Construction Management education to produce future-ready graduates with the desirable industrial skillset and competencies needed in this era of 4th Industrial Revolution.

2.1.7 Limitation

As with any review, the sampling procedure employed puts a limitation on the number of publications chosen for the review. This review used 76 publications from different journals and therefore the outcome is subjected to the sampling approach but however expected to reflect the general trends of Knowledge Management in Construction Management Education. To justify this limitation mention can be made of the inapplicability of considering all possible research keywords in a single review study.

Furthermore, as this review was restricted to CM and related journals and lacking empirical proof except as reported in those selected papers, the findings emphasizing the impact of the thematic categories cannot be explicitly generalized to other educational sectors other than Construction Management Education.

By employing a different research review process, future studies can increase the sample size. The results give rise to an in-depth understanding of KM and CM education research to practitioners, higher education institutions and researchers and thus stimulate future research based on the identified gaps.

2.1.8 Sector One Conclusion

For the past three decades as shown in this review, research on construction management education with the grasping of in-depth knowledge of the knowledge management aspects of construction management education has increased tremendously. With the massive evolvement of construction management education came new trends that seek to bridge the gap among educational stakeholders such as industry practitioners, higher educational institutions, teachers, students, and policy makers. However, since no studies has been conducted to review this phenomenon, the

authors identified these gaps and filled it via a comprehensive review from selected publication within construction management and related journal. The three principal issues addressed by this review were the annual trend of publications on these subject areas, contributions of authors, research institutions and countries and thematic categorization that construction management education covers.

Research trends and development were systematically analyzed in globally renowned construction management (CM) and related journals. From 22 selected CM and related journals based on the methodology adopted, 76 KM and CM education-related papers were systematically analyzed in this study from the years 1990 to 2018. Increasing attention to research as depicted by the results was highlighted within the 28-year period considered for the review. Contributions made by both developed and developing countries as shown in summary tables were presented. Researchers and their various institutions alike have made a great impact in these fields. Key research themes identified from these selected literatures, included Skill Development; Teaching and Learning Strategies; Information and Communication Technologies in Construction Management Education; Curricula Development; and Sustainability in Construction Management Education.

Through the identification of research gaps notable among them being the skill gap, directions for future studies such as holistically incorporating identified industrial soft skills such as communication and critical thinking into curricula of higher education institutions were proposed by the authors. To further unearth other clandestine knowledge areas not yet identified as well as bridging other gaps directed towards the 5 themes identified, this study advocates for further studies to be conducted as CM education has been tremendously evolving. This review forms part of very essential information of need by industry and academic researchers especially in the education sector to initiate further research works.

2.2 DESIRABLE SKILL-SET ACQUISITION OF CONSTRUCTION MANAGEMENT STUDENTS.

2.2.1 Introduction

During the 18th, 19th and 20th centuries, most parts of the world were transformed through the industrial revolution. However, this era of globalization (21st century) is characterized by information (Knowledge) as the transformative power of revolution (Brynjolfsson and Mcafee, 2016; Unger, Stanley, Gabriel and Mulgan, 2019). According to Ojanperä, Graham and Zook (2019), the availability of a number of information and communication technologies (ICTs) as well as movement towards human capital, technology and service-oriented economy triggered this information revolution. Consequently, the construction industry finds itself in this knowledge-based economy.

There has always been the need for educated and highly skilled professionals as a result of the construction industry's peculiar characteristics such as complexity of projects, dynamism, 3D computer aided modelling, sophisticated usage of construction equipment requiring advanced IT skills, competition among stakeholders, management techniques and higher expectations from clients (Goodman and Chinowsky, 1997; Leifer, O'Connor, and Rice, 2001; Christodoulou, 2004; Atalah and Muchemedzi, 2006). New challenges prevalent in the construction industry daily, places emphasis on construction professionals to acquire variety of skills and competencies to handle these challenges (Styhre and Josephson, 2006). Many scholarly works classify skill sets in the form of technical and non-technical skills, managerial, leadership, professional attributes, communication, digital literacy, decision making, innovative, life-long learning, legal and contractual skills, etc. deemed vital to the overall progress of the construction industry (Goodman

and Chinowsky, 1997; Egbu, 1999; Leifer, O'Connor, and Rice, 2001; Thomas and Mengel, 2008; Zaharim et al., 2010; Ahmed et al., 2014; Zhao et al., 2015; Naveed et al., 2017).

According to Ling and Ho (2013), for the construction industry to survive in the long-term, there is the need to attract fresh talent. This raises a lot of concerns as to whether decline in these desirable skill set will have an impact on long-term sustainability of the more complex construction domain. As Singapore wraps her head with much concern in these fresh talents meeting the future industrial needs (Lim and Alim, 1995), the United Kingdom also experiences decrease in the number of graduates looking for and accepting offers in construction-related jobs (Dainty and Edwards, 2003). This phenomenon according to Atalah and Muchemedzi (2006) could better be explained by Higher Education Institution's slow pace in adjusting to the dynamism of the 21st century's construction industry.

The technological insurgency which characterizes this era of Knowledge-based economy makes the future of the construction industry very promising especially for the prepared. The onus therefore lies on construction management students who are expected to show forth these desirable skills set in order to thrive in this knowledge-based economy without been rendered redundant. However, an apropos systematic assessment of both current and past studies on the subject matter needful for future endeavor is lacking. This paper puts forward a comprehensive systematic review of the desirable skill sets of future construction management students to address this gap. The following objectives were put forward:

1. To identify the annual trends of publication of desirable skill sets of Construction Management (CM) students from 1990 to 2018.

2. To identify contributions of the authors and countries in their exploration of desirable skill set for CM students from 1990 to 2018; and
3. To identify, categorize and discuss skill sets under different constructs.

This section begins with the need for desirable skill set acquisition of CM students, presents the methodology adopted, selects academic journals based on which appropriate publications are chosen. Findings are presented and discussed. This review ends with the conclusion.

2.2.2 The Need for Desirable Skill Set Acquisition among Construction Management Students

According to Becker et al. (2011), the responsibilities of construction education programs can be classified into two to include imparting the desirable skills and competencies for successful construction professionals and re-modification of academic curricula to reflect future construction industrial needs. To prepare future construction professionals, (Oglesby and Hicks, 1982; Tatum, 1987) in their studies posited that Universities especially those in the USA initiated Construction Management programs that saw the enhancement of skill development evolve. A number of Universities across the world took advantage of the evolvement and initiated postgraduate degree programs in Construction Management to accommodate the forecasted increasing demand in subsequent years. Christodoulou (2004) supported this assertion and added that engineering institutions must educate Architectural, Engineering and Construction (AEC) professionals of tomorrow through the fusion of process automation concepts and information technologies in addition to the usual traditional educational curricula.

Although considerable efforts to develop desirable skill set by Higher education institutions have been forthcoming in the construction domain, other prominent international organizations such as the World Bank, the United Nations, the Organization for Economic Co-operation and Development, the World Economic Forum among others have played active roles either directly or indirectly in promoting the development of desirable skills. Seldomly reported in studies are these international organization's efforts and as such this study puts forward their efforts. Due to wording limit, major contribution of the various organizations is summarized in Table 2.8.

Table 2.8: Overview of Selected International Organizational initiatives for Skill development

Organization	Effort	Origin	Year of Effect	References
World Bank Group (Higher Education)	Supports Higher Education reforms and innovation using the systems approach for better education results via (SABER) tool	USA	2001	World Bank. (2018)
United Nations (UNESCO)	TVET aims to address economic, social and environmental demands by helping youth and adults develop the skills they need for employment, decent work and entrepreneurship	France	1945	UNESCO (2015)
Organization for Economic Cooperation and Development (OECD)	The OECD's work on education helps individuals and nations to identify and develop the knowledge and skills that drive better jobs and better lives	France	1961	OECD (2016)
ASCE	Construction Institute promote the construction industry to attract and develop the current and next generation of construction professionals	USA	1852	ASCE (2019)
World Economic Forum	Seeks to ensure that talent is developed and deployed for maximum benefit to the economy and society	Switzerland	1971	WEF (2016), Bakhshi et al. (2017)
Islamic Educational, Scientific and Cultural Organization (ISESCO)	Division of Higher Education aids in improving university educational curricula and directing them towards the knowledge economy,	Morocco	1979	ISESCO (2019), Ismail (2019)
The International Association of Universities (IAU)	Advocates for higher education policies and practices that respect diverse perspectives and promote social responsibility	France	1950	IAU (2019)
Association for the Development of Education in Africa (ADEA)	Advocates for quality African education and training geared towards the promotion of critical knowledge and skills for accelerated and sustainable development in Africa	Tunis	1988	Banga and te Velde (2018)

The findings of the study by Ling and Ho (2013) confirmed that of Arciszewski and Harrison (2010), that the construction industry gives room for practitioners to solve problems without strict adherence to the well-known routine solutions from traditional engineering analysis. This therefore calls for the need of skill variety as a construction professional attribute.

A number of researchers (Christodoulou, 2004; Goh, 2007; Domal and Trevelyan, 2009; Zhao, et al., 2015; Naveed et al., 2017) have attributed the unpreparedness of graduates from construction management backgrounds to rigid academic content of curricula, limited electives offered as an extension of the compulsory courses, curricula lacking multidisciplinary collaboration with other relevant skill areas and the gap surrounding the expectations of the construction industry as against the perceptions of Higher Education Institutions (academia). These attributes have a negative toll on the performance of the industry and hence demands prompt pragmatic solutions.

Christodoulou (2004) in his provision of a solution is of the view that the new generation of students (Gen Z) in this era should be able to blend traditional engineering knowledge with that of information technology, financial concepts and management as a result of the dynamic needs of the construction industry today to tackle the challenges of the profession thrown at them. Naveed et al., (2017) adds to the submissions of Christodoulou (2004) study's and argues that there need to be constant revamping and enhancing of the construction management programs (curricula) which is inevitable if this dynamic industry's needs are to be met. Hence the onus falls on the stakeholders such as the government bodies, students, employers and institutions of higher learning (academia) to contribute their quota in ensuring this transition becomes fruitful.

2.2.3 Research Methodology

Methodological analysis of manuscripts published in refereed journals is of much importance to the research community as other researchers and practitioners alike gain much insight of the trends happening in that particular field (Tsai and Wen (2005). According to Easterby-Smith et al. (2012), to conduct a systematic review, one must first define the review protocol and map the subject area through the assessment, retrieval and judgment of the essence of studies in the research field under examination. After which one elaborates on the identified gaps contingent on the existing body knowledge.

Ke et al. (2009), Yu and Yang (2016) and Yi and Yang (2014) have conducted scholarly works on Knowledge Management in the construction industry in three-phase literature reviews. The three-phase review of Yu and Yang (2016), however failed to include the assessment of contributions in terms of countries, universities and authors. This study eliminates this failure by the inclusion of these parameters. With the aim of doing away with subjectivity as seen in the conduct of literature reviews, certain procedures in the selection and investigation of publications based on keywords search were employed (Creswell 2014). Skill set research papers published in construction management journals from 1990-2018 using the three-stage search process were systematically analyzed upon retrieval to gain insights into the trends as well as identify key and potential areas for further research as presented in Figure 2.7.

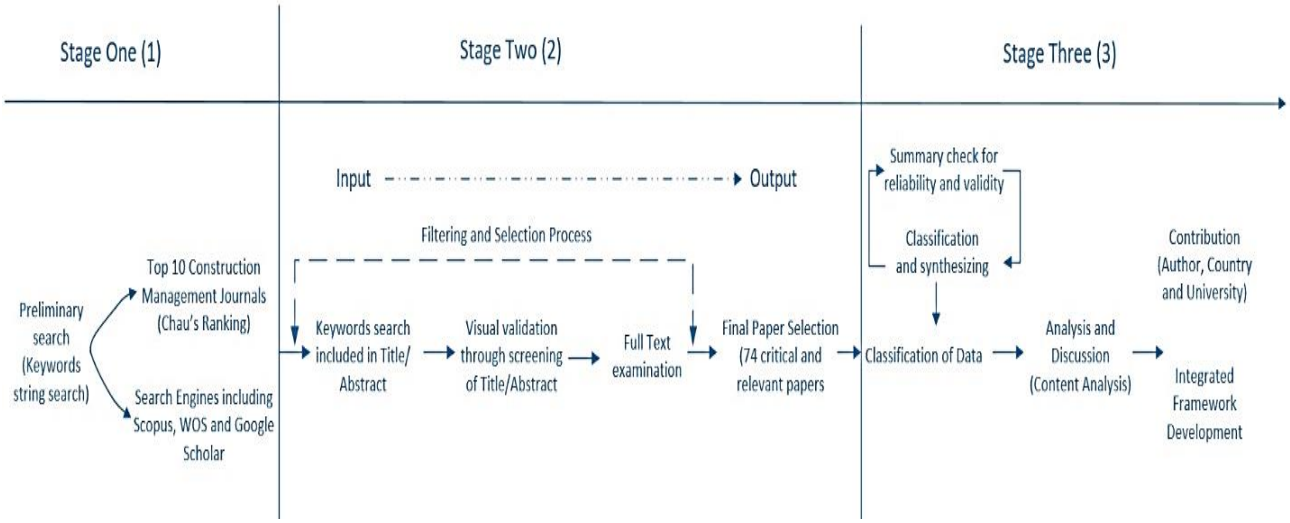

Figure 2.7: Research Framework for the Study

The three-stage literature review were put forward to include:

1. identifying the academic journals (Preliminary Search).
2. critical selection of relevant papers to ensure valid representations (Selection Process) and
3. Assessment of contributions in terms of authors, and countries and discussion.

2.2.3.1 Identification of academic journals

Scopus search engine was used to obtain a list of publications in academic journals on skill-set development related papers in construction education. The adoption of Scopus was based on three reasons: 1) a source of archive for most research publications in the engineering, management, accounting and business fields (Hong and Chan, 2014), 2) Scopus performs better as compared to other search engines, such as Web of Science, Google Scholar and PubMed with regards to coverage and accuracy (Falagas et al., 2008) and, 3) similar review of literature studies in construction management using Scopus (Darko and Chan, 2016).

A number of researchers employ Keywords in searching for relevant papers for review studies (Darko et al., 2018; Owusu et al., 2017). Similarly, this study adopts this approach in identifying and selecting construction journals and papers. Not a single study can capture all the complexities related to the selection of Skill-set keywords, the challenge in getting a workable number of desirable skill-set papers was therefore minimized by the assumption that common keywords in Construction management Skill acquisition research included “Desirable skill set”, “desirable competencies”, “construction management students”, “higher education” and “construction management education”. These keywords were therefore used in this study.

A pilot desktop search under the “article title/abstract/keywords” field of Scopus was conducted choosing document type as “article or review”. The search was limited to “construction management” or “construction engineering and management” and “construction education” domain. Additionally, the search was further restricted to subject areas of “social sciences”, “engineering”, “business”, “computer science”, “arts”, “environmental sciences”, “economics”, “decision sciences” and “multi-disciplinary”. The full code for searching is as follows:

TITLE-ABS-KEY ("desirable skills" OR "desirable competencies" OR "construction management students" OR "construction management education") AND DOCTYPE (ar OR re) AND PUBYEAR > 1989 AND PUBYEAR < 2019 AND (LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ENGI") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "ARTS") OR LIMIT-TO (SUBJAREA , "ENVI") OR LIMIT-TO (SUBJAREA , "DECI") OR LIMIT-TO (SUBJAREA , "ECON")). (Search results: 120 documents)

Many attempts were made to rid the search of non-construction journals, however, a number of them showed up. As a general rule to ensure that only papers limited to Skill-set coverage in

construction journals are used, journals, such as "Nurse Education Today" and "Sociology of Health and Illness", which are not deemed as construction journals, were taken out. Therefore, either one of the following criteria was employed in selecting the construction journals:

1. The showing of at least two papers of the journal (via the search).
2. The ranking of the journals within the top ten of Chau (1997) ranking of Construction Management journals based on its wide acceptance in the construction field.
3. Other essential journals of international organizations that were not captured in the desktop search.

The criteria above resulted in a total of twenty-five identified journals. These journals (i.e. Journal of Management in Engineering (JME), Journal of Construction Engineering and Management (JCEM), Automation in Construction (AIC), and Engineering, Construction and Architectural Management (ECAM)) could also be found within the top 10 ranked construction management journals by Chau (1997). This clearly indicates that the targeted journals for this study are of good quality and reliable. The outcome of the search indicated that the top targeted journals identified were also ranked as top-tier construction journals that have published the most Skill Development related papers as can be seen in Table 2.9.

2.2.3.2 Critical selection of relevant papers

The selected journals resulted in 96 documents out of the initial search results of 120. The keywords appeared in either the article title, abstract or keyword of these documents and thus satisfies the initial requirement for analysis. There however still existed the possibility of irrelevant documents showing up. Phase two was therefore initiated to include scanning thus reading the abstract of each of the 96 documents in a bid to remove irrelevant articles. Papers that do not

actually focus on skill development and construction management education were excluded since the aim was to review articles on KM and construction management education. A total of 41 papers were deem valid owing to this selection criteria. Table 2.9 summarizes the initial search results.

Table 2.9: Search Results of papers on Desirable skill set of Construction Management Students in selected journals

Name of Journal	No of papers retrieved from search engine	No of papers relevant to the study
Journal of Professional Issues in Engineering Education and Practice	14	3
International Journal of Construction Education and Research	24	10
Journal of Construction Engineering and Management	4	1
Journal of Management in Engineering	3	1
International Journal of Engineering Education	6	2
Engineering Construction and Architectural Management	3	1
Architectural Engineering and Design Management	4	1
Journal of Construction Education	13	3
Journal of Engineering Science and Technology	3	1
Sustainability (United States)	2	1
Automation in Construction	4	1
Ubiquitous Learning	3	1
European Journal of Engineering Education	5	2
Proceedings of Institution of Civil Engineers: Management, Procurement and Law	2	1
Assessment and Evaluation in Higher Education	3	2
International Journal of Construction Management	3	1

Leadership and Management in Engineering	4	1
Journal of Vocational Education and Training	3	1
Journal of Applied Research in Higher Education	2	1
Research in Post-Compulsory Education	4	1
International Journal of Environmental Technology and Management	2	1
Human Resource Development Quarterly	3	1
Research in Science and Technological Education	2	1
International Journal of Phytoremediation	2	1
Automatica	2	1
Total	120	41

2.2.3.3 Assessment of research contributions

Research publications have been deemed by academic institutions and researchers as significant means of imparting industrial practice (Taylor et al, 2012; Colpaert, 2012). Hence, identifying active contributors is paramount in order to appreciate the mainstream of research in that discipline across different regions (Yuan and Shen, 2011). The research contribution from each researcher, research institute and country were analyzed and ranked quantitatively

Howard et al. (1987)'s proposed formula was adopted as there existed a clear differentiation of the contribution of each individual writer in a multi-authored paper. This formula was adopted by Yi and Chan (2014) in their research trend in construction labor productivity, and Osei-Kyei and Chan (2015) in their review of critical success factors for public-private partnership projects. This widespread usage guarantees its reliability and suitability for articles and hence its adoption in this review. The proposed formula is shown below:

Score= $\frac{1.5^{n-i}}{\sum_{i=1}^{n} 1.5^{n-i}}$ where n=number of writers/authors of the paper and

i=order of the specific writer/author

This proportionately divides the credits of authors in a multi-authored paper after applying the formula. Given that each paper has a score of one point, a detailed score matrix for writers is shown in Table 2.10.

Table 2.10: Score Matrix for Multi-author Papers

No. of writers	Order of specific writer				
	1	2	3	4	5
1	1.00				
2	0.60	0.40			
3	0.47	0.32	0.21		
4	0.42	0.28	0.18	0.12	
5	0.38	0.26	0.17	0.11	0.08

2.2.4 Analysis and Discussion

2.2.4.1 Annual publications on Skill Development of Construction Management Students from 1990 to 2018

120 papers were given a closer look resulting in 41 publications been identified for further analysis. Presented in Figure 2.8 is the annual publications from the final collection of journals chosen from 1990 to 2018. With an increasing trend of one publication in 1991 to 4 and 7 in 2011 and 2016 respectively, the total number of published papers from these selected journals constituted forty-one (41). There was a rapid increase in 2006 with 3 papers published. The peak was witnessed in 2016 with 7 publications indicating the gradual rising of interest in exploring what skill set development has to offer in Construction Management Education.

The period between 2010 and 2018 gave rise to 29 publications. It must be stressed that the increasing trend of research of Skill development in Construction Management Education would linger on as knowledge (acquisition, transfer, storage and usage of soft and hard skill) as a resource is the core theme of any educational scheme especially in this era of globalization and technological advancement.

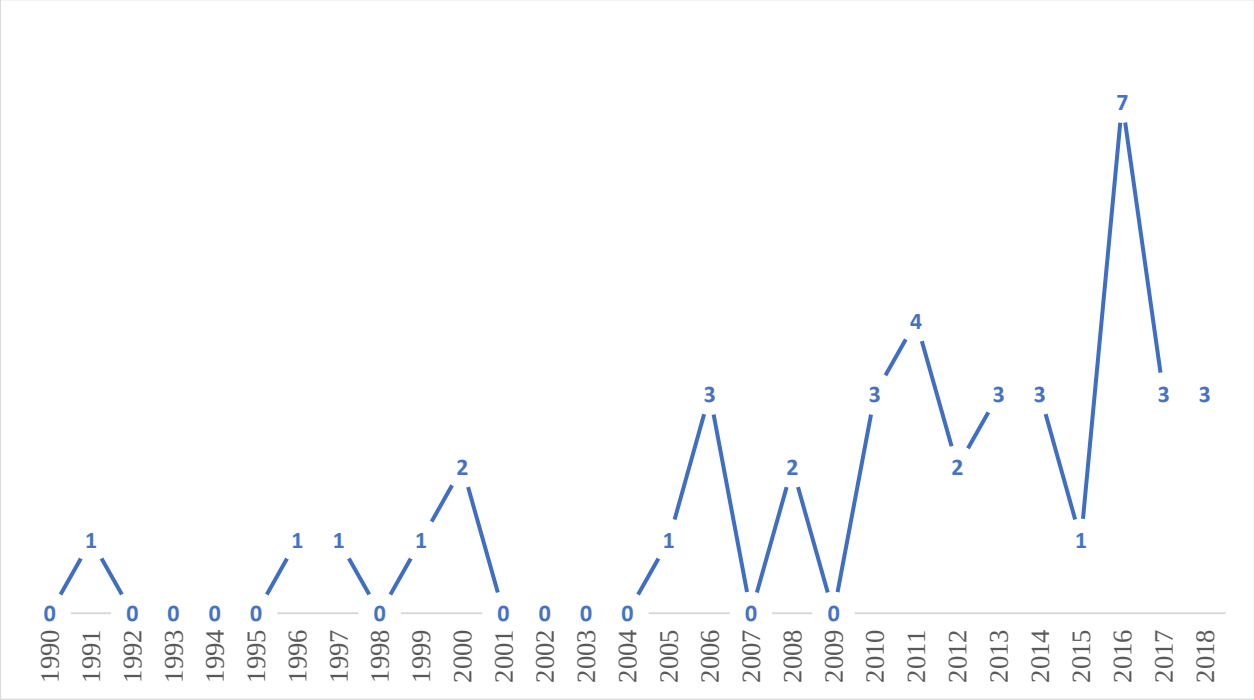

Figure 2.8: Number of publications per year

2.2.4.2 Contribution of Countries to Skill set development of Construction Management Students

As presented in Table 2.10 above, the score matrix was used in the determination of researcher country's contribution towards publication. Each author's score either as a sole-authored or multi-authored publication was put together for each country based on the score matrix and hence produced their contribution. To demonstrate an example, Ahmed, Yaris and Saqib from the US

collaborated with Farooqui from Pakistan to publish an article which brings the score for each author to 0.42, 0.28, 0.12 (4th author) and 0.18 (3rd author from Pakistan) respectively. Therefore, in measuring the contribution in terms of author's country of origin, a score of 0.82 (0.42 + 0.28 + 0.12) is awarded to the US while Pakistan receives 0.18. This approach is also applied to single-authored publications. Table 2.11 presents the contribution by way of countries thus also showing the number of universities/institutions and researchers, identified papers as well as their scores.

Table 2.11: Geographical Scope of Selected Skill set development papers of CM Students

Countries	**Institutions/Universities**	**Researchers**	**Papers**	**Score**
USA	*22*	*54*	*19*	*17.12*
Australia	*6*	*11*	*7*	*6.4*
UK	*3*	*5*	*3*	*2.21*
Hong Kong[#]	*2*	*5*	*2*	*2*
New Zealand	*2*	*3*	*2*	*1.49*
Mexico	*2*	*8*	*2*	*1.26*
Malaysia	*4*	*5*	*1*	*1*
Taiwan	*2*	*2*	*1*	*1*
Brazil	*1*	*2*	*1*	*1*
Canada	*1*	*3*	*1*	*1*
Denmark	*1*	*3*	*1*	*1*
Egypt	*1*	*1*	*1*	*1*
Netherlands	*1*	*3*	*1*	*0.88*
Trinidad and Tobago	*1*	*1*	*1*	*0.6*
Germany	*2*	*2*	*2*	*0.52*
Sweden	*1*	*1*	*1*	*0.26*
Pakistan	*1*	*1*	*1*	*0.18*
Chile	*1*	*2*	*1*	*0.08*

[#] - Hong Kong is a special administrative region of China but is catalogued separately for comparison purpose

The USA with scores of 17.12 had the highest number of researchers delving into the concept of skill set development in the construction management student context. From figure 2.9, 54 researchers from 22 different Universities contributed to 19 publications thus placing emphasis on the relevance they attached to improving the skill of their future professionals. This can also be seen as an appreciative effort in bridging the industry academic skill gap. Countries like Australia, UK and Hong Kong had scores of 6.4, 2.21 and 2 respectively with 7, 3 and 2 publications on the subject matter respectively. These statistics shows the widespread development of the future skill set from two decades ago as more researchers have shown keen interest. A peculiar feature of the data was the significantly low contribution from developing countries which could be due to the infant stage this concept is at their level or perhaps publications made by the developing countries might not have been indexed in Scopus and thus not captured under this study which can be considered a limitation for this study.

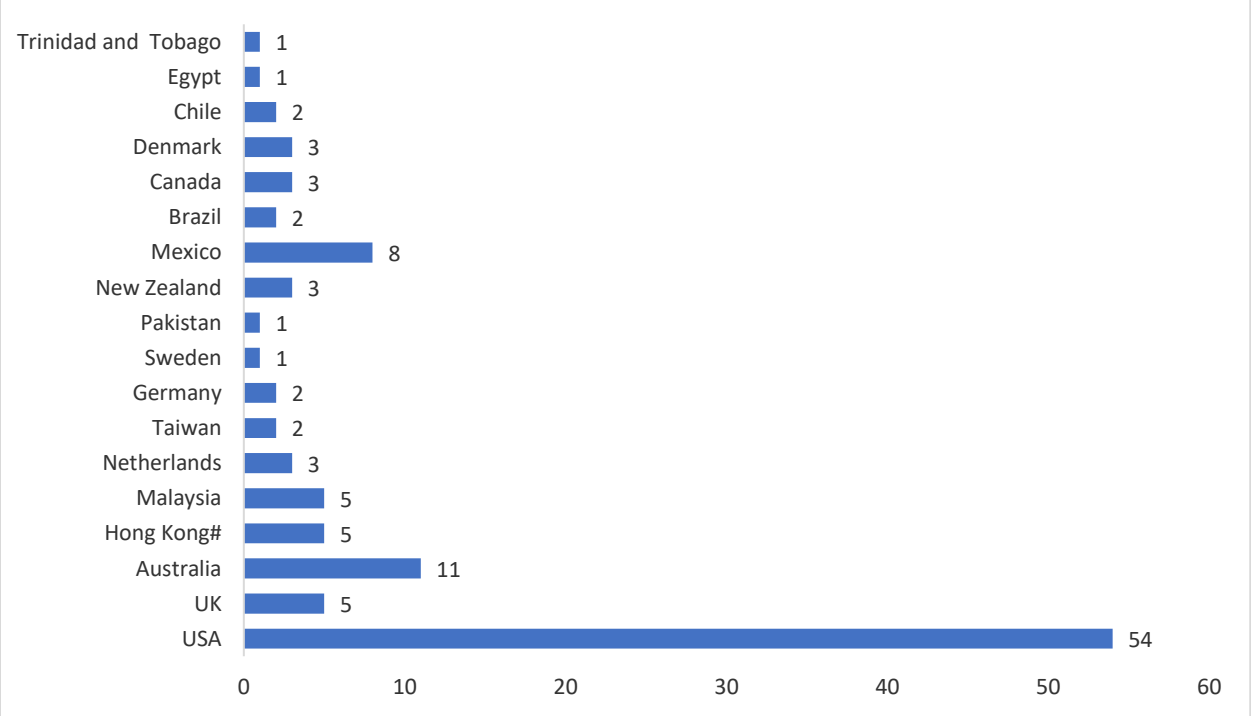

Figure 2.9: Number of Researchers per Country

The America continent (North and South) is seen to have conducted most research on this subject matter with 80.72% of publications (67 papers) arising from this continent (As shown in figure 2.10). This proves that much can be learnt from this continent as they have and still are exploring the concept of future skill development. As far back as 1990, the USA started to look closely at the dilemmas facing construction education and research and concluded that construction management has evolved from a trade to a profession and thus this complex industry demands diversity in curricula to accommodate this transition (Oglesby, 1990). Other areas such as Australia (13.25% representing 11 publications) and Europe (8.43% representing 7 publications) have produced studies towards this concept.

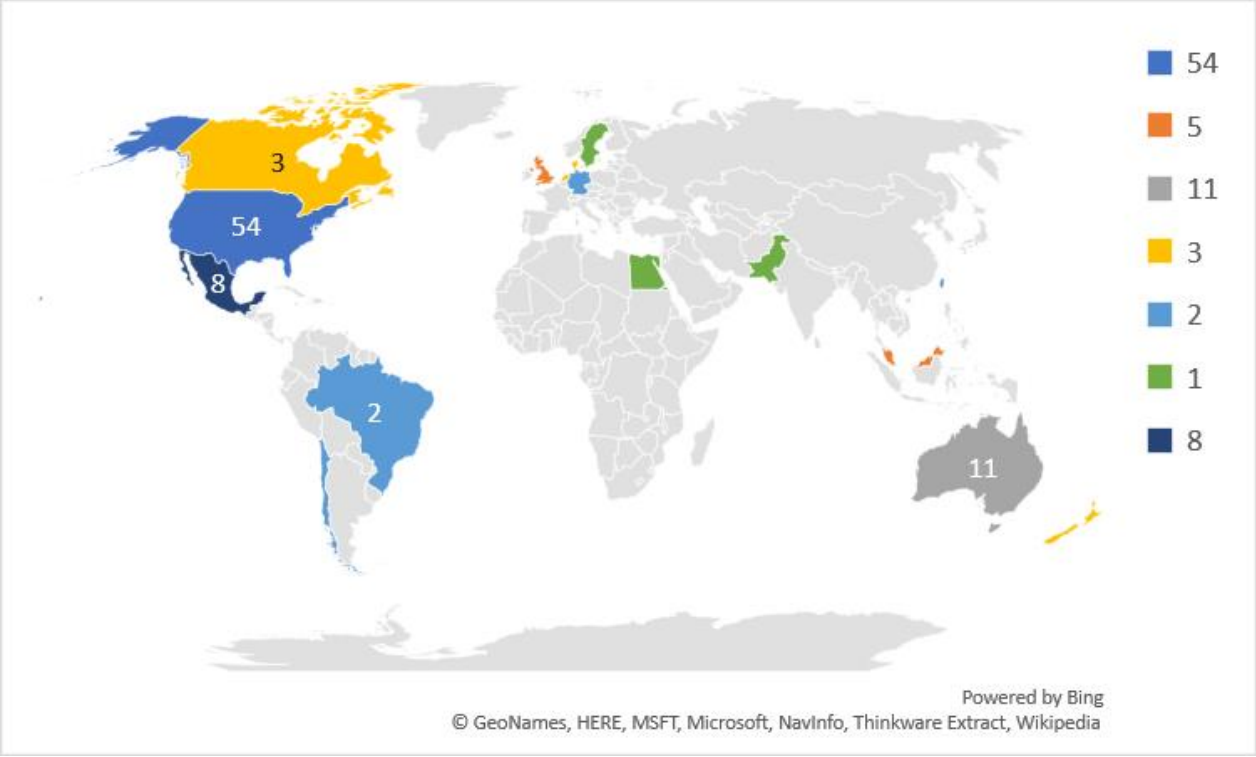

Figure 2.10: Geographical distribution of Studies

2.2.4.3 Contribution of Institutions and Research Institutes to the Research

As shown in Table 3.12 below, the top 10 institutions/universities publishing papers on skill sets are presented. Additionally, presented are the number of researchers, countries of origin of the Research Institutions/Universities, and the total papers. Research institutions/universities that have paid most contribution to this research area include but not limited to Colorado State University (USA), RMIT University (Australia), Deakin University (Australia), University of New South Wales (Australia), and East Carolina University (USA) with contribution scores of 3.10, 2.00, 2.00, 1.40, and 1.39 respectively. All these institutions/universities exceeded one-point score in their contribution CM student's skill set development research. Again, pioneering the course of skill development research is the USA where most of their institutions/universities have published the most papers. Almost all the research institutions/universities contributing most to this research were from developed countries hence the need for developing countries to take a cue from these developed nations in coming to speed with this phenomenon.

Table 2.12: Top 18 Research Institutions/Universities publishing Skill set development of CM Students (using the score matrix)

Rank	Institution/University	Country	Researchers	Papers	Score
1	Colorado State University	USA	12	8	3.10
2	RMIT University	Australia	4	2	2
3	Deakin University	Australia	2	2	2
4	University of New South Wales	Australia	2	2	1.40
5	East Carolina University	USA	4	1	1.39
6	The Hong Kong Polytechnic University	Hong Kong	4	1	1
7	University of Alberta	Canada	3	1	1.00
8	University of Florida	USA	3	1	1

9	Auburn University	USA	3	1	1
10	Central Connecticut State University	USA	3	1	1
11	Mississippi State University	USA	3	1	1
12	Aalborg University	Denmark	3	1	1
13	Queen's University of Belfast	UK	3	1	1
14	Georgia Institute of Technology	USA	2	1	1.00
15	University of Waikato	New Zealand	2	1	1
16	Heriot-Watt University	UK	1	1	1
17	Curtin University of Technology	Australia	1	1	1
18	University of Twente	Netherlands	3	1	0.88

2.2.5 Categorization of Desirable Skillsets of Future CM Professionals

Based on the selected publications from construction management journals, seven (7) major categorize desirable skill sets were identified as shown in Table 3.13 below. They include:

1. Technical Skills.
2. Digital Literacy Skills.
3. Industry and Business Skills.
4. Managerial Skills.
5. Legal and contractual Skills.
6. Professional attributes; and
7. Personal attributes

Table 2.13: Skill set, Attributes and Competence of CM Students

TECHNICAL SKILLS	**PROFESSIONAL ATTRIBUTES**
Plans interpretation/ Blueprint reading/Understanding construction & shop Drawings	Hands-on project experience prior to graduation/ Internship
Knowledge of construction operations	Teamwork capabilities
Knowledge of green and sustainable construction/ LEED	High regards to values/ Work ethics
Scheduling	Planning and goal setting
Knowledge of project closeout and handover procedures	Long term commitment
Estimating	Problem solving/ Analytical skills
Cost accounting	Result orientation
Knowledge of construction materials	Critical thinking
Knowledge of construction equipment	Decision making skills
Economic and financial analysis	Forecasting
Knowledge of design	Ability to follow up
Value engineering/Constructability analysis/ Design Review	Risk taking
Scope review	Multi-tasking
MANAGERIAL SKILLS	**INDUSTRY AND BUSINESS SKILLS**
Health and Safety management	Knowledge of health and safety regulations
Quality assurance/ Total Quality Management	Knowledge of building codes and regulations
Inspection/ Quality control	Knowledge of environment impact assessments
Document control	Marketing with clients/ Developing client relations
Project management/ administration	Knowledge of the permitting process
Cost control	Construction trade knowledge
Leadership	Understanding procedural issues
Team building	Understanding cultural issues
Site planning and management	Understanding complementary fields/disciplines
Personnel/ Resource management	Awareness of industry trends
Risk planning, assessment and control	Appreciation of construction industry supply chain
Productivity management	Understanding geographical issues
Managing labor issues	Construction organization management/Business Management
Knowledge and information management	Entrepreneurship
Financial management	Partnering
	Understanding global construction Environment
	Understanding lean culture

PERSONAL ATTRIBUTES	**LEGAL AND CONTRACTUAL SKILLS**
Listening ability/ Giving attention to details	Interpreting contract documents
Time Management	Knowledge of construction law and legal environment
Dependability	Contract administration skills
Personal adaptability/Flexibility	Knowledge of bidding procedures
Desire to learn	Dispute avoidance and resolution skills
Assertive attitude	Knowledge of project delivery and contracting strategies
Promptness in actions	Change management
Comprehension ability	Understanding labor laws
Ability to learn	Claims preparation and presentation Skills
Innovative mindset/ Creativity	Claims defense skills
Willingness to travel (when required)	
Ability to speak different languages / Multilingual	
DIGITAL LITERACY SKILLS	
General computer proficiency	
Proficiency in construction information technology	
Knowledge of construction data analytics	
Proficiency in BIM technology software	
Knowledge of construction simulation and modelling tools such as Web cyclone	
Knowledge of big data applications in construction	
Knowledge of Augmented/Virtual reality software applications in construction	
Knowledge of Artificial Intelligence Application in Construction Management	

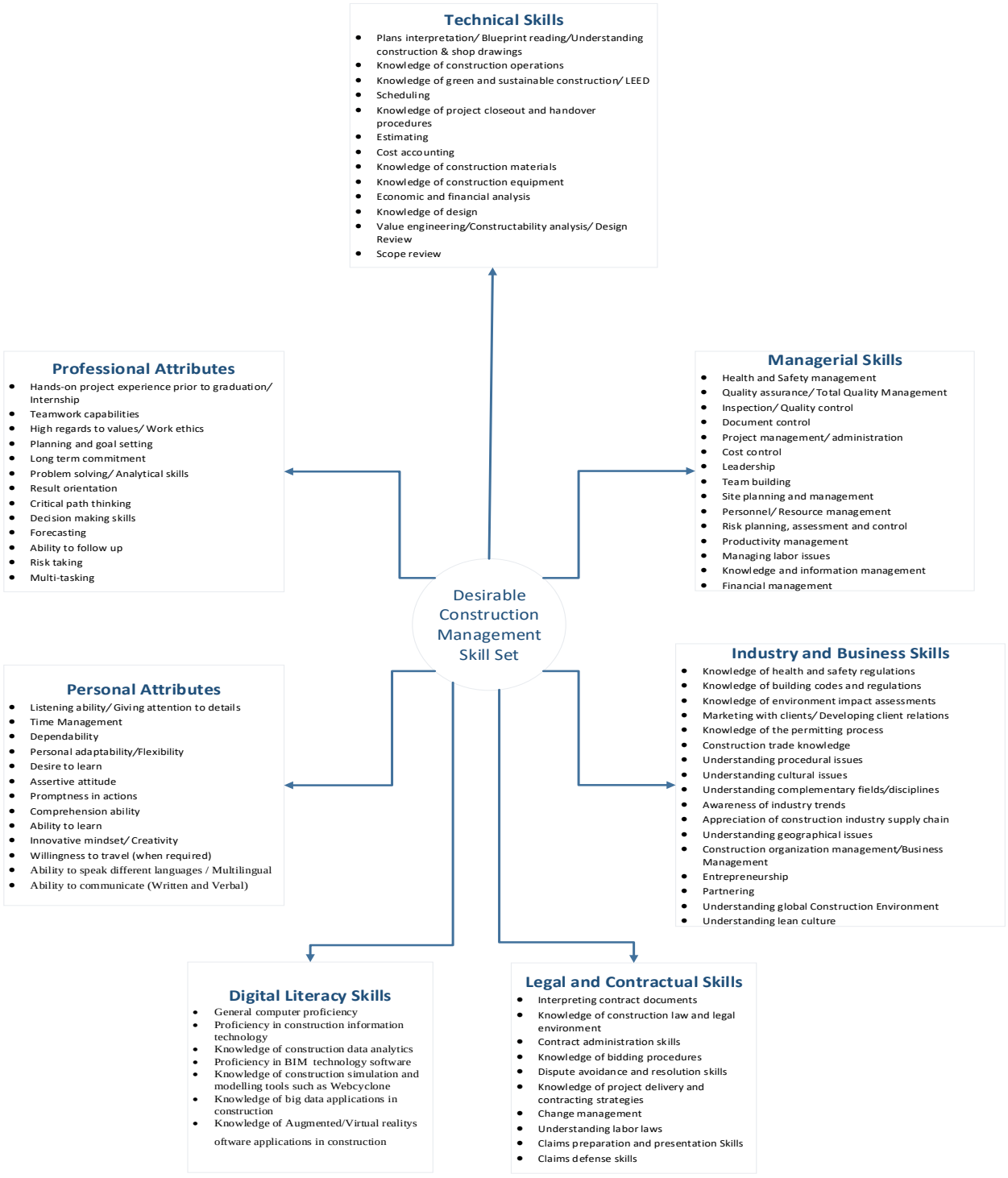

Figure 2.11: Desirable CM Skill Set Model

Source: Adapted from Farooqui, Ahmed, and Saqib (2010).

2.2.6 Sector Two Conclusion

Novel challenges prevalent in the construction industry daily places emphasis on construction professionals to display a variety of skills and competencies to handle these challenges. This places much emphasis on the acquisition of desirable skill set needful for a successful future construction career. However, little scholarly attention has been given to the need to provide systematic review studies on this variety of skill sets as present in this era. Several studies have been published by researchers reporting various hard and soft skills construction industry practitioners need. This paper reports a review of the existing body of knowledge of desirable skillset of CM students. By reviewing carefully chosen publication in peer-reviewed CM journals from 1990 to 2018 (years inclusive), this study identified a total of 87 different skills as shown in Figure 3.10 and further categorized them into 7 constructs. Based on the annual publication trend on the subject matter, the peak was witnessed in 2016 with 7 publications indicating the gradual rising of interest in exploring what skill set development has to offer Construction Management Education. The period between 2010 and 2018 gave rise to 29 publications. The increasing trend of research on Skill development in Construction Management Education would linger on as knowledge (acquisition, transfer, storage, and usage of soft and hard skill) as a resource is the core theme of any educational scheme especially in this era of globalization and technological advancement. In terms of contribution, country wise, the USA had the highest contribution placing emphasis on the relevance they attached to improving the skill of their future professionals which was also seen as an appreciative effort in bridging the industry-academic skill gap. Almost all the research institutions/universities contributing most to this research were from developed countries such as USA, Australia, Canada, and the UK, hence the need for developing countries to take a cue from these developed nations in coming to speed with developing the skillset of their students.

Based on the selected publications from construction management journals, seven (7) major categorize desirable skill sets were identified to include Technical skills, Digital literacy skills, Industry and Business skills, Managerial skills, Legal and contractual skills, Professional attributes; and Personal attributes (as shown in figure 2.11). All the 7 major constructs in the CM skill set model had sustainability incorporated in them and hence its sole exclusion not deemed fit. Take for instance, a construct such as Technical skill with Estimating as its variable, sustainability principles such as cost effectiveness, reduction of waste and time, as well as elimination of human biases are taught by way of the use of technology-oriented estimating software's such as excel, Navisworks, planswift etc.

This study presented some limitations. Although the number of academic studies relevant to skills development reviewed in this paper could provide a general overview of the future skill requirement of CM students, it is deemed that the number of reviewed publications is relatively small. To this effect, a future review should increase the sample size probably by employing different literature search engines. Such a review is needed for futureproofing of the findings reported in this paper. This study provides deepened understanding and valuable information to industry practitioners, policymakers as well as Institutions of Higher Learning in the inculcation of these desirable skill sets in their curricula. This study propels further research, especially among construction management education researchers

2.3 EFFECTIVE TEACHING AND LEARNING STRATEGIES IN PREPARING STUDENTS FOR THE KNOWLEDGE-BASED ECONOMY

2.3.1 Traditional Instructional Method

Instructional methods according to Akdemir and Koszalka (2008) can be referred to as activities that instructors adopt that engages learners in the process of learning. Learning styles on one hand has to deal with the integration of learners' motivation, perceptions, information processing and activity engagement (Aragon et al., 2002). On the other hand, various forms of instructional strategies should therefore be employed so as to engage different learners in different ways as individual learners have varying preference with regards to reception of information. For instance, Meyer (2003) posits that the traditional lecture format is characterized by direct and simple explanations whiles Akdemir and Koszalka (2008) postulates that group-discussion instructional method combines collaborative efforts of individual learners in arriving at a common understanding.

In construction management education for instance, the traditional instructional method has been criticized as inadequate in the provision of students with all the desirable skills and knowledge in an efficient manner (Vian et al. 2007; Park et al. 2003). This according to Felder and Silverman (1988) could be attributed to the differences between the teaching and learning styles of lecturers and most students respectively.

2.3.1.1 Challenges to the Traditional Instructional Method (Lecture)

Within the university setting, lecture is arguably the oldest instructional method as it has become indispensable part of teaching that has received considerable favor from universities the world

over (Mariya and Olga, 2008). Lectures are efficient in dealing with large chunks of materials in a faster manner which can be adapted to suit the needs of the audience (McKeachie 1969). Furthermore, lectures are less costly in the sense that one instructor can teach a large student group. The strength of Lecture' thus "fast teaching and learning," also presents as one of its major weaknesses as this type of presentation leaves little room for fostering important intellectual virtues (Paul 1999). According to Nandi et al. (2000), the only learning outcome that has been ascribed to lecture is the transfer of basic knowledge or the memorization of information that is that lecture is an effective method to disseminate factual knowledge.

Recently, the presence of active instructional techniques has rendered the traditional instructional methods incapable of fostering higher order attitudinal and cognitive goals (Cashin 1985; Renner 1993; Frederick 1999). This can also be attributed to the efforts been made by active instructional techniques that provides students with an opportunity to interact, talk meaningfully, read, write as well as reflect on issues and ideas of an academic subject (Meyers and Jones 1993). Lectures also do not excel in fostering the skills of application, evaluation and analysis. Students are considered passive learners in a lecture class and are involved in extensive note taking. This format of instruction enhances students' ability to memorize and reproduce the presented information directly without examining and analyzing it. Table 2.14 below presents the barriers to the traditional instructional strategies.

Table 2.14: Barriers to Traditional Teaching and Learning (Instructional) Method (Lecture)

No.	Barriers to Traditional Teaching and Learning (Instructional) Method (Lecture)	Source
1	Inability to foster higher order cognitive and attitudinal goals	Cashin (1985), Day (1980), Frederick (1999), Renner (1993)
2	Ineffectiveness as a method for student learning	Mariya and Olga (2008)
3	Speed teaching and learning leaving little room for fostering important intellectual virtues	Paul (1999)
4	Short term memorization of content/information	Green and Dorn (1999), Nandi et al. (2000)
5	Maximum control over flow of information by lecturers	Mariya and Olga (2008)
6	Low student engagement (often seen taken notes)	Renner (1993), Ruyle (1995)
7	Inability to foster the skills of application, analysis and evaluation	Mariya and Olga (2008)
8	Lecture experiences are boring and sometimes irrelevant	Renner (1993), Nandi et al. (2000)
9	Influence of educational tradition	Bonwell and Eison (1991)
10	Lack of needed materials or resources	Bonwell and Eison (1991)
11	Poor interpersonal skills	Prince (2004)
12	Increase course failure	Prince (2004), Freeman et al. (2014)
13	Low level of student achievement	Kuh, O'Donnell, and Schneider, (2017)

2.3.2 Active Instructional Methods

Active learning is an approach to instruction that involves actively engaging students with the course material through problem solving, discussions, case studies, role plays and other methods. Many scholars emphasize that all learning is inherently active and that students are therefore actively involved while listening to formal presentations in the lecture room. As posited by Chickering and Gamson (1987), students must however do more than just listen. They must write, read, discuss, or be engaged in problem solving. Most important, to be actively involved, students

must engage in such higher-order thinking tasks as analyzing, synthesizing, as well as evaluation. Contextually, it is recommended that strategies that promotes active learning be referred to as instructional activities involving students in doing and thinking about things as they do it.

A greater degree of responsibility is placed on the learner in active learning approaches than passive approaches like lectures, but the guidance of instructors is still vital in the active learning classroom. Active learning activities may range in length from a couple of minutes to whole class sessions or may take place over multiple class sessions.

As posited by Lovelace (2005), different learning styles have different impacts on learners. For this reason, instructors must use various strategies to accommodate individual differences (Favre 2007; Fine 2003; SheaDoolan 2004). Nelson et al. (2015) observed that engagement of engineering students in a particular course is difficult to quantify via the lens of only one motivator, such as course grades. Thus, it is recommended that instructors eliminate the so-called one-size-fits-all approach in a concerted effort by modifying classroom settings and instructional practices (Fine 2003). To increase academic performance and improve learners' attitudes toward education, instructors must employ strategies that better match learners' strengths (Lovelace 2005).

Use of these active instructional techniques is essential because of their powerful impact upon students' learning. For instance, several scholarly works have shown that students prefer strategies promoting active learning to traditional lectures. Other research studies evaluating the achievement of students have proven that many approaches promoting active learning are similar to lectures in fostering the mastery of content but superior to lectures in boosting the development of students' skills in writing and thinking. Additionally, some cognitive research has shown that a significant number of individuals have learning styles best served by pedagogical techniques other than lecturing. Therefore, a thoughtful and scholarly approach to skillful teaching requires that faculty

become knowledgeable about the many way's strategies promoting active learning have been successfully used across the disciplines. Table 2.15 shows the description of some active instructional methods although the list remains inexhaustive.

Table 2.15: Description of Active Instructional Methods

No	Active Instructional Methods	Description
1	Problem-based Learning (PBL)	Instructional strategy in which students confront contextualized, ill-structured problems and strive to find meaningful solutions thereby enhancing their complex problem-solving ability with exposure to real-world problems.
2	Peer-reviewing	A process in which students constructively evaluate the work of other students thus students submit their work (e.g., written papers, homework) to peers, who review it and give feedback but who do not assign grades
3	Vertical integration	Actively connecting and engaging groups of students at different levels within education for retention and learning in each group to be encouraged
4	Inverted/flipped classroom	Lessons are 'flipped' means that most of the work like reading and research are all done outside of class
5	Service learning	Pedagogical technique by which a student completes the objectives of a course while fulfilling a community need in a coordinated effort between the school and client
6	Cooperative learning	Instructional use of small groups through which students work together to maximize their own and each other's learning thus an approach in which high-ability and low-ability students work together to solve a problem.
7	Educational Debate	An active learning strategy designed to engage students in the practice of important cognitive skills, such as critical thinking and deliberation and shaping learners' attitudes toward divisive topics
8	Collaborative virtual classroom	Aside from the usual audio-video conferencing and chat features, virtual classrooms also provide synchronous and asynchronous annotation, communication, and resource sharing for facilitators and participants
9	Game-based learning (Gamification)	Turning a certain aspect of learning into a game
10	The Jigsaw Technique	learners are given a "piece of the puzzle" that they need to solve on their own. After this, they need to collaborate with other learners to finally complete the puzzle

11	Learning by teaching	Learners are allowed to prepare and teach the lessons (or part of them) to their fellow students through media such as webinar and online discussion boards
12	Role Playing	Simulates real-life situation that requires problem-solving skills.
13	Mind Mapping/Brainstorming	Here, learners come up with ideas and post them on a board. As a group, the students then select the best ones and use those to come up with a solution.

Although popular recently, some faculties have not fully embraced the recent calls for educational reform in incorporating active instructional strategies. This therefore calls for the need to understand and identify common challenges to instructional change thus from traditional passive to active techniques. Among the stated reasons includes faculty self-definition and self-perceptions of roles; the powerful influence of educational tradition; the limited incentives for faculty to change; and the anxiety and discomfort created by change. The use of active learning techniques itself also presents certain specific obstacles such as a possible increase in preparation time; limited class time; the probable difficulty of using active learning in classes with large numbers; and a lack of needed equipment, materials, or resources.

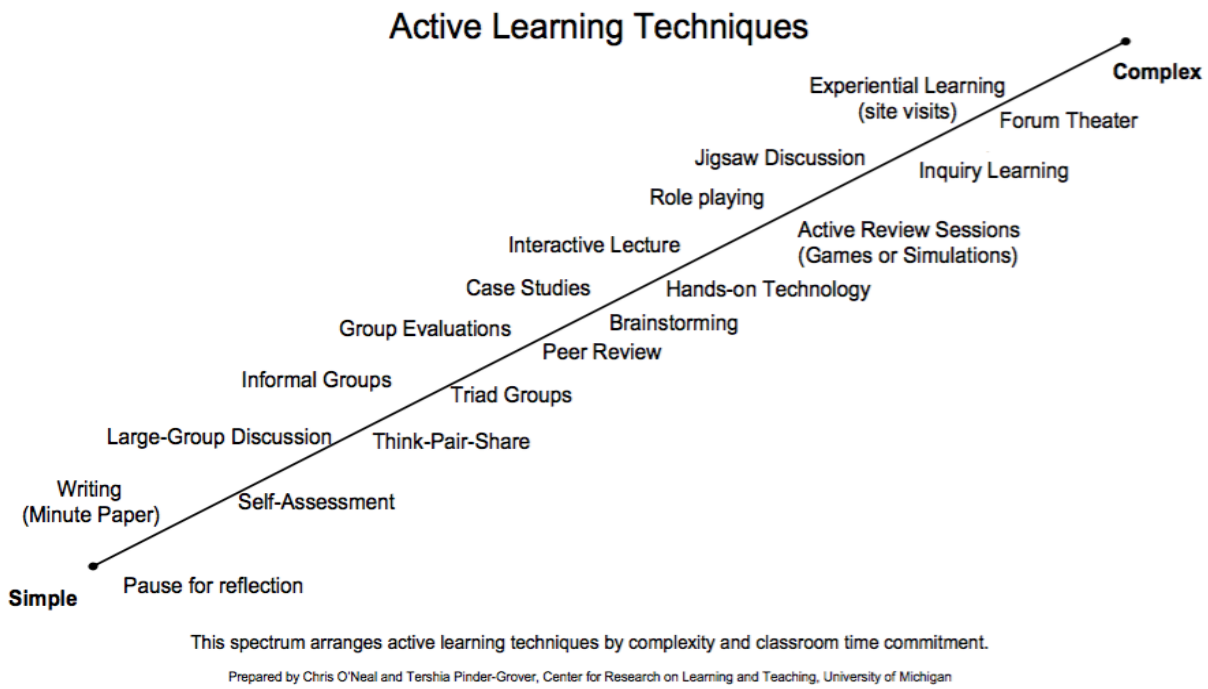

Figure 2.12: Active Learning Techniques by complexity and classroom time commitment
Source: Chris and Tershia, Centre for Research on Learning and Teaching (University of Michigan)

2.3.3 Active Teaching and Learning Strategies

According to Kim et al. (2002), the choice of suitable teaching and learning styles is equally important in addition to the significance of course content to construction practice. Most university students are concerned with teaching and learning strategies that will help prepare them for the workplace and allow them to develop specific skills to tackle real-life challenges (Frank 2005). Balancing teacher centered and student-centered styles to teaching requires that the students reveal their preferences for active participation of students to be realized in the learning activities designed by their teachers (Milton and Lyons 2003). However, Frank (2005), posits that enhancing

the student learning experience requires an analysis of students' opinions and actual learning processes. Providing students with the best possible education requires educational administrators to allocate available resources appropriately to ensure that students acquire necessary experiences through an effective learning instructional approach.

Novel pedagogies such as inverted/flipped classroom, problem-based learning (PBL), service learning, peer-reviewing, vertical integration etc. have been settled on by many scholars (Felder 2012; Mason et al. 2013; El-adaway, Pierrakos and Truax 2014), as the way forward if expectations of the current architectural, engineering and construction profession are to meet future need. Hence, the shift of focus recently to the development and testing of these new pedagogies that actively involves/engages and supports students' learning. In an effort to place a quantity on students' preferred learning strategies, Lam et al. (2015) derived twenty-two diverse active instructional strategies having the potential to improve the learning performance of students. Table 2.16 below depicts the active instructional strategies as found from literature.

Table 2.16: Active Teaching and Learning Strategies (ATLS)

No	Active Teaching and Learning Strategies (ATLS)	Source
1	Using case study method teaching	Levin (1995)
2	Making use of in-class contests	Rohrer and Pashler (2010), Attle and Baker (2007)
3	Tutorial	Valiathan (2002), Dolmans et al. (2001)
4	Effective guest speaker's invitation	Mullins (2001)
5	Employing classroom demonstrations	Felder and Silverman (1988)
6	Group discussion	Felder and Silverman (1988), Akdemir and Koszalka (2008)
7	Using advanced online teaching tool (e.g., Blackboard)	Sims (2003), Landry et al. (2006)
8	Embarking on field trips (real, simulated or virtual)	Akdemir and Koszalka (2008), DeWitt and Storksdieck (2008)
9	Having short student presentations	Michlitscha and Sidleb (2002)

10	Presenting brainstorming questions	Case (2005)
11	Associating course content to current events	Meyer (2003)
12	Using Wiki	Valiathan (2002), Cole (2009)
13	Using popular video vignettes and films to stimulate critical thinking	Fine (2003), Krammer et al. (2006)
14	Lecture	Felder and Silverman (1988), Meyer (2003), Akdemir and Koszalka (2008)
15	Conducting experiments	Krammer et al. (2006)
16	Use of Laboratories and observations	Krammer et al. (2006)
17	Simulations	DeWitt and Storksdieck (2008)
18	Using cooperative learning strategies such as interleaving	Slavin (1996), Rohrer and Pashler (2010)
19	Using mobile live video learning system	Fine (2003), Ullrich et al. (2010)
20	Humor creation in class lectures	Valiathan (2002), Chabeli (2008)
21	Using blogs to support teaching and learning	Churchill (2009)
22	Employing in-class role plays by students	Aubusson et al. (1997)
23	Integrating website use into course assignments	Hotchkiss (2002), Sims (2003)
24	Creating classroom versions of television game shows	Rosas et al. (2003)
25	Assigning short in-class writings	Leki (1995)

2.3.4 Sector Three Conclusion

According to (Lovelace, 2005; Favre, 2007; SheaDoolan, 2004), lecturers in construction management courses should therefore adopt various teaching methods in addressing individual differences among construction management students' learning abilities as they have diverse impacts on students' performance. In a bid to better prepare students for the knowledge-based economy, attention should be focused on not only the learning ability of the students but also the teaching strategies of the educators as well. This will ensure improvement in overall learning and academic performance.

CHAPTER THREE-RESEARCH METHODOLOGY[3]

3.1 INTRODUCTION

An appropriate research methodology is expedient to effectively realize the aim and research objectives of a study as well as validating the findings. The Chapter three puts forward a detailed method to be employed in realizing the set aim and objectives of the research. Discussions will further include methods for required data acquisition, tools for the analysis of collected data and the methods of proposed model development for the study. As also with the construction management field, the selection of and application of rigorous methodology to identified problems results in the attainment of credible results which contributes enormously to the body of knowledge as well as practice (Ameyaw, 2014).

Many researchers in this direction have employed popular research methods such as extant literature review, case studies, expert interviews and questionnaire survey in their studies (Elzomor et al, 2018; Zhao et al, 2015; Farrow et al, 2011 and Kumaraswamy et al, 2006). Similar to previous methods adopted in past studies will be this study's research method to include expert interviews and questionnaire survey for the primary data collection. The tools to be used for this study would aid in the investigation of the desirable skillset acquisition of construction management students, and effective teaching and learning strategies.

[3]This Chapter is largely based upon:

Yamoah Agyemang D.*, Fong, P. S. W., & Kissi, E (2022). Operationalization of desirable skill sets in novice construction management professionals. Conference Proceedings in ASCE Construction Research Congress (CRC). 9-12 March 2022, Virginia, USA

Yamoah Agyemang D.*, & Fong, P. S. W. (2019). Towards desirable skill set acquisition of Construction Management Students in a Knowledge-based economy: A systematic review and trend analysis. Conference Proceedings in 16th International Conference on Intellectual Capital, Knowledge Management and Organizational Learning. 9-12 December, Sydney, Australia

Yamoah Agyemang, D.*, Fong, P. S. W., & Yi, Z.(2023). Education For the Knowledge Economy: Towards Operationalizing Desirable Skillsets For Future Construction Professionals. Journal of Engineering Education, Ref: Ms COEE 18462 (under review)

With the aid of software packages such as Statistical Package for Social Science (SPSS 25.0 for Windows), Smart PLS 3.0, R Studio and recommended software by experts, the gathered data will be analyzed. The fuzzy synthetic evaluation method (Ameyaw, 2014) will be used in the prioritization and modelling of the desirable skillset acquisition of construction management students as well as the assessment of the effective teaching and learning strategies. The PLS-SEM will be used in modelling all the constructs from desirable skillset, and effective teaching and learning strategies. The subsequent sections of this chapter highlight the justifications behind the application and adoption of these techniques in the realization of the study's aim and objectives.

3.2 RESEARCH DESIGN

A research design may be defined as a systematic and logical sequence addressing a research topic under consideration (Creswell, 2003) and thus the entire process is composed of four distinct parameters for achieving the study's aim and objectives (Shan et al., 2015a). The four distinct parameters include the questions guiding the study, the requisite and appropriate data needed in answering the questions, the data retrieval methods and the techniques of analyzing the gathered data. According to Pandey and Pandey (2015), research design has to do with the framework of the study as it guides the collection as well as analysis of data thus serving as the blueprint for the research. Other dependent factors of a research design include but not limited to the topic under investigation, the researcher's experience and the intended audience the author wants to reach. Therefore, for a comprehensive research design to be achieve, the above-mentioned strategies must be integrated into the study (Creswell, 2003; Shan et al., 2015a).

Table 3.1 puts together the summary of the research design procedure adopted for this study. In undertaking this study, the proposed research methods are used to undertake the procedures mentioned in the research design as the research design typically acts as a general framework for the achievement of the targeted goals. Research methods basically comes in three forms to include mixed, qualitative and quantitative methods. Quantitative method employs the use of close-ended or instrument-based questions for data solicitation which requires statistical analysis and interpretations, a contrast to qualitative method. Qualitative method, on the other hand, mainly makes use of responses from views solicited via open-ended questions. According to (Patton, 2005; Shank, 2002). techniques such as interview conducting, participant observation and focus groups are used to collect such data. Mixed methods or triangulation combines both the qualitative and the quantitative methods in data retrieval and processing which ensures validity of findings (Bryman, 2017).

This study, however, adopts the mixed methods approach based on the strengths it takes from both the qualitative and the quantitative methods as mentioned in previous studies (Bryman, 2017), to define clearly and explicitly the characteristics of knowledge management in construction management education especially in developing countries. The mixed method as has been employed by several studies (Moffatt et al., 2006; Creswell, 2014) considers the advantages of the single methods combined which makes it more powerful. Table 3.1 presents the entire research design with its methods adopted to achieve each objective and subsequently the overall aim of the study. Segmented into two parts are thus the data collection methods and data analysis methods. Methods employed in the data collection include extant literature review, reports from international organizations, experts' interview and questionnaire survey whereas that of data

analysis are mean score ranking, human resource theory, and fuzzy synthetic approach. The justification for use in each method is well explained in following sections

Table 3.1 Research Design Process

RESEARCH OBJECTIVE	RESEARCH DESIGN (RD)									
	METHODS OF DATA COLLECTION					DATA ANALYSIS TOOLS				
	LR	QS	EI	TA	CA	MS	FA	SEM	DS	FSE
1. Identify the past and current trends on existing literature on the concepts and themes of knowledge management and construction management education	√			√	√				√	
2. Identify and model the desirable skillsets and competencies of construction management students needed to prepare them for the knowledge-based economy	√	√		√	√	√	√		√	
3. Identify and model the barriers inhibiting active instructional methods by Institutions of Higher Learning	√	√				√	√		√	
4. Investigate the effectiveness and the barriers to effective teaching and learning strategies by Institutions of Higher Learning in preparing students for the knowledge-based economy in developing economies	√	√							√	√
5. Develop a comprehensive framework needed to prepare construction management students for the knowledge-based economy			√	√	√			√	√	
	To establish a theoretical underpinning for the research	General survey which is also the first-round survey to solicit for expert views using questionnaires.	To verify the findings and developed models of the study	Qualitative technique that focuses on identifying, assessing and recording patterns in data	Adopted to make valid and replicable inferences by coding and interpreting textual material by evaluating texts systematically (eg. Reports, papers, graphics, etc.	Appropriate for determining the significance of factors (Cheng and Li, 2002)	Used to express observed data values as a function of some possible causes to determine the most significant	An effective means for assessing relationships that exist among IVs and their effects on DVs	An inductive methodology of rigorous research procedures leading to the emergence of conceptual categories.	A precise tool for handling complex and ill-defined fuzzy phenomena resulting from vague and incomplete data that characterize real-world problems

KEYS: LR – Literature Review, QS – Questionnaire survey; EI – Expert Interviews; TA – Thematic Analysis; CA – Content Analysis; MS – Mean Score; FA – Factor Analysis; SEM – Structural Equation Modelling; DS – Descriptive Statistics; FSE – Fuzzy Synthetic Evaluation;

3.3 METHODS OF DATA COLLECTION

Based on a perceived depth and scope of a study, an appropriate choice of research methods is employed which may take the form of review of literature, questionnaire survey, case study etc. (Fellows and Liu, 2012). Case studies are considered deep examination, questionnaire surveys – a far reaching study as well as interviews serving as middle ground of the two with regards to the depth and width (Ameyaw and Chan, 2015). Highlighting existing gaps in literature, literature reviews again give great insight of known practices as well as knowledge. This study examines a spectrum of characteristics with regards to knowledge management and construction management education and as such the selected modes of acquiring data are considered appropriate.

A combination of literature review, experts' interview as well as questionnaire survey are deemed the right mix for this study as a result of the exploratory nature and the scope (contextual and geographical) this research finds itself in. That is while questionnaire survey is purported to gather quantitative data, experts' interview aims to collate qualitative data. Thus, making use of the mixed methods approach as explained in the previous section as this method improves validity and reliability of research findings (Creswell, 2014).

3.3.1 Literature Review

Literature review according to Yi and Wang (2013) refers to the systematic and comprehensive examination of previous scholarly works by researchers from materials such as academic and professional journals, conference proceedings, doctoral theses, published and unpublished reports, textbooks as well as important information from the internet. Previous and recent essential background knowledge on knowledge management in the construction management education domain were made known via the extensive review of relevant literature. In the realization of the

research aim and objectives and addressing the research problems, the literature review formed the foundation based on which a theoretical framework was established.

Furthermore, the literature review aided the establishment of a theoretical framework which helped in the understanding of topical issues in this study; understand the concept and principles of knowledge management and its association with construction management education; explain the desirable skill set acquisition of construction management students in a knowledge-based economy; examine the effective teaching and learning strategies in the preparation of construction management students; identify barriers to the effective adoption of and application of the effective teaching and learning strategies; identify the geographical stance of emerging economies using Ghana as the case study and that of the established economies in terms of progress in the educational policies; identify the potential methodological approached for the study and finally, aid in the development of the questionnaire for the field survey.

Five distinct and comprehensive reviews were performed and put forward in two chapters. The third Chapter of this study contained four of the reviews as explicated under four sub-sections. Section one of Chapter three composed of the first review which reflected the trends and gaps in knowledge management and construction management education research. In section two, a comprehensive review of desirable skill set of construction management towards a knowledge-based economy was conducted. Section three addressed the effective teaching and learning strategies by Institutions of Higher Learning in preparing students for the knowledge-based economy. The fourth and final section of the Chapter three, review literature on the determination of sustainability principles deemed worthy of inclusion in construction management curricula and model its applicability in construction education. Lastly, Chapter four presented the development of theoretical framework for the study.

3.3.2 Questionnaire Development

Questionnaire survey will be employed to solicit the opinion from targeted respondents hence this calls for the need for questionnaire development. According to Shan et al. (2015a), this instrument has proven effective for large sample sized quantitative analysis as well as high probability of results generalization from this method of data solicitation.

3.3.2.1 Ranking Scales

The ranking scales adopted in construction management (CM) research vary in odd numbers ranging from five to eleven. This enables researchers to solicit for the views of respondents concerning an issue with a number of variables. The five-point Likert scale ranking system was adopted in formulating the questionnaire. Several CM based research works on CM education have adopted this system (Lam et al., 2016; Ahmed et al., 2014). As compared to other ranking systems such as the 7-point and the 9-point ranking systems which according to Pitt et al. (2009) is complicated and has the potency of putting some respondents off from responding to all the questions, the five-point ranking system was employed on a number the reasons such as: ability to eliminate the problems common to ordinal measurement scale such as central tendency (Chan and Tam, 2000; Cronbach, 1951), ease of presenting items and speedy administration and provision of explicit diversities of probable opinions to the respondents that can facilitate the structural analysis (Pallant, 2005). Although, the five-point Likert scale provide quality data as compared to the other higher point systems such as 7 and 9, this rating system is also vulnerable to response bias (Revilla et al., 2014). Table 3.2 illustrates the scale definitions used in this study.

Table 3.2: Ranking Scores Definitions

Ranking Scores (RS) Definition				
RS	DSC(Importance)	DSC(Satisfaction)	ETLS	BTL,
1	Not Important	Not Satisfied	Not Effective	Not Probable
2	Less Important	Less Satisfied	Less Effective	Less Probable
3	Neutral	Neutral	Neutral	Neutral
4	Important	Satisfied	Effective	Probable
5	Very Important	Very Satisfied	Very Effective	Highly Probable
DSC: Desirable Skillset and Competencies			***BTL:*** Barriers to traditional teaching and learning forms	
ETLS: Effective Teaching and Learning Strategies				

3.3.2.2 Questionnaire Pilot Study

After the initial development of the questionnaire, a pilot study was conducted to assess the entire comprehensiveness and relevance and reliability before been disseminated to the targeted respondents for their valuable responses. Due to the non-specificity of the required number of experts needed for the pilot study, and per Ameyaw and Chan (2015) study where a pilot study with three experts sought, the researcher thought it expedient to employ a number above three. A total of 7 experts from world-renowned institutions and academics were therefore selected based on their knowledge and experience in the subject matter, as revealed by their publications and their positions within their various institutions as well as their availability and willingness to respond to the survey. Specifically, they were consulted to examine the questionnaire's appositeness with regards to the lucidity of the questions, wordings, definitions, coherence, structure, length, factors' relevance, the level of complexity as well as the use of technical terms (Ameyaw and Chan, 2015; Oyedele, 2010). The experts for the pilot study were considered. Per the feedbacks of the experts, the questionnaire was reviewed and thoroughly revised to enhance its quality and appropriateness, thus making it more suitable for the main survey.

3.3.3 Sampling Size and Technique

Sampling according to Strydom and Venter (2005) is simply the act of taking a part of the entire population to represent that exact population. Naoum (2012) stated that when considering a larger population, the percentage of the sample size needs to be smaller and vice versa, that is if the entire population is smaller, the sample size should encompass of a relatively larger proportion of the population. In order to attain an accurate conclusion and a more concrete prediction, the researcher should consider using a larger sample than a relatively smaller sample (Polit and Hungler, 1999).

3.3.3.1 Sampling Design

Sampling is an essential and necessary aspect of any research study as a result of cost and time posing as constraint factors (Patton, 2005). Kothari (2004) emphasized that for a researcher to develop a suitable sample for the study, he must take into consideration the following essentials: the sampling unit, the demographical pattern for the study, the source list, budgetary constraints, the sample size, sampling procedure and parameters of interest.

The sample selected for this study will comprise of stakeholders involved in construction management education. Categorically, they consist of professionals (Human Resource Managers) from the construction industry and the students and lecturers from Institutions of Higher Learning in Ghana. There is a well-defined or comprehensive population to randomly draw out a sample from. Therefore, a random sampling approach can be adopted in this survey. In this situation, the best approach to adopt will, therefore, have to be a combination of probability and non-probability sampling where the respondents targeted are selected based on their expert knowledge on the subject matter as well as their willingness to participate in the survey (Teddlie and Yu, 2007). However, regarding the technique for identifying the experts with adequate expertise and thorough knowledge on the subject matter, purposive sampling methods, which are regarded as part of the

key non-probability sampling methods were adopted. Although only one of these two approaches can be suitable for the entire research, the two sampling techniques were adopted to increase the sample size.

3.3.3.2 Purposive and Simple Random Sampling

Purposive sampling is a type of non-probability sampling technique whereby the researcher takes decisions that concern the individuals to be added to the sample and the decisions are mostly based on a multiplicity of measures of which includes the capacity and willingness to take part in the research and also the specialist knowledge one may have on the research issue (Lewis and Sheppard, 2006; Tongco, 2007). To warrant the consistency and quality of questionnaire survey, the researcher adopted the purposive approach to select participants. Polit and Hungler (1999) also delineate purposive sampling technique to be a type of non-probability sampling technique which involves the mindful selection of certain subjects to be included in the study. According to Bernard (2002), most types of research design compel the researcher to take decisions concerning the individual participants who would stand in a position to give the appropriate and needed data, in terms of depth and relevance. This type of sampling technique was adopted based on the research design, purpose, and practical implications of the study. In simple terms, the researcher agrees on what he needs to know, and seek to find people who are willing and can provide the needed information by their experience or knowledge (Lewis and Sheppard, 2006; Tongco, 2007).

Teddlie and Yu (2007), explains purposive sampling, as a technique that involves the selection of certain cases or units, normally based on a specific purpose rather than randomization. Therefore, with regards to the purposive sampling methods, a combination of multiple approaches which include direct request of information from the public institutions and industry organizations as well as internet related and internet publications and related relevant information will be consulted to

identify and retrieve list of targeted public and private organizations, potential respondents or departments within the targeted institutions. After the generation of the list of potential institutions, invitation letters will be sent officially to the human resource managers, directors, students and educators of those institutions to participate in the survey. This process is aimed at helping solicit a potential list of expert individuals (Moglia et al., 2009). The potential respondents that will be suggested at this level will also be invited and requested to participate in the survey.

Simple Random sampling technique is that method of drawing a portion (sample) of a population or universe so that each member of the population or universe has an equal chance of being selected. That is, this type of sampling gives all units of the target population an equal chance to be selected. According to Amin (2005) randomization is effective in creating equivalent representative groups that are essentially the same on all relevant variables thought of by the researcher.

3.4 DATA PROCESSING AND ANALYSIS

After the collection of field data, there is therefore the need for data processing and analysis aimed at developing the initial stage of framework of the research. Data processing according to Kothari (2004) refers to the process of data coding, editing, categorization and tabulation of the collated data rendering the data responsive to further analysis. Analysis, conversely, refers to the calculations or simulations of measures as well as looking for relational patterns that exist among the variables or constructs of the data gathered. It relates to the means whereby answers are found by way of interpreting the collected data (Strydom and Venter, 2005). According to Strydom and Venter (2005), data description and analysis must be done followed by the interpretation of the analyzed results as a result of impossibility or difficulty in explaining the raw data. Analysis also

simply means ordering, categorizing, and manipulating data to get answers to the posed research questions.

The statistical methods employed for data analysis will include a mix of both parametric (t-test) and non-parametric (such as mean score ranking, factor analysis, ANOVA test, Kendall's coefficient of concordance (W), Mann Whitney U Statistics).

3.4.1 Mean Score (MS) Ranking Technique

The MS ranking technique has been recognized as one of the most important and critical tools employed by many researchers to determine the significance or the relative importance individual factors to enable the easy identification of important factors. In most CM research papers on construction management education, Ahmed et al. (2014) used it to determine the key attributes and skills for curriculum improvement for undergraduate construction management programs. Zhao et al. (2015) on the other hand employed the MS ranking technique to assess collaborative construction skills through BIM-integrated learning environment. Several studies reviewed in this research study also employed the MS technique in addressing and determining various factors across diverse topics on the subject matter. The mean score is calculated using the formula below:

$$MSn = \frac{5n_5+4n_4+3n_3+2n_2+1n_1}{N} \quad (2.1)$$

Where *MSn* = The MS for nth factor, *n* = respondents' scores based on 5-point scale (from 1-5) and *N*= the total number of expert respondents.

The MS ranking technique will, therefore, be employed to rank the identified variables within their respective constructs.

3.4.2 Mann Whitney U (MWU) Statistics

Given that the responses to be obtained from the survey are from two diverse respondents with different ideologies, socio-political setting as well as socioeconomic backgrounds towards construction management education and skill development, it is critical and very relevant to examine the significant difference in respondents' perceptions on factors ranking. The Mann-Whitney U test will, therefore, be conducted to analyze and identify the significant differentials that exist among the factors ranked by the respondents from the two different backgrounds (Academia and Industry). Chan et al. (2011) emphasized that, as a non-parametric test, the Mann-Whitney U test is employed to observe the relationship of ordinal data with two independent samples. A predefined significance level of 0.05 will be established for the MWU test to be performed. A significant perception between academia and construction industry respondents will, therefore, be identified in the case where the p-value or the predefined significance level is less than 0.05 and vice versa situation.

3.4.3 Kendall's Coefficient of Concordance (W)

According to Kendall and Gibbon (1990), Kendall's Coefficient of Concordance (W) is primarily employed to measure the degree of agreement between the rankings or ratings by experts. It can also be employed to determine the level of consensus or if there will be any level of agreement among or within the ratings of a group as well as their relative consensus strength (Schmidt, 1997). The following advantages had extended the application of this tool. This method is reported by several studies to be easy and simple to use, and interpret as well (Agyemang et al., 2019; Osei-Kyei and Chan, 2015). The degree or range of Kendall's *W* begins from 0 to 1, where 0 symbolizes

no agreement and 1 represents perfect agreement or concordance. According to Siegel and Castella (1988), the formula for Kendall's *W* computation is given below:

$$W = 12 \frac{\sum_{i=1}^{n}(R_n+R)}{p^2(n^3-n)-pT} \quad (2.2)$$

Where *n* represents the number of factors, *Ri* represents the ratings assigned to the *i*th variable or factor; *R* denotes the *Ri* mean values; *p* signifies the number of respondents and *T* stands for correction variable or factor for the tied ratings.

Siegel and Castellan (1988) indicated that the applicability of Kendall's *W* test is only feasible and possible when the number of attributes or factors is below 7. The chi-square (x^2) test value is therefore employed any time the number of attributes is greater than 7.

3.4.4 Reliability Test

Memon et al. (2014) posited that reliability test measures the consistency in the data collected. A leading reliability tool employed by many researchers today is the Cronbach (coefficient) alpha, even though there exist previous tools such as Kuder-Richardson estimate and Split-Half Reliability estimate which have been adopted in the past with the former still being employed till date. Cronbach's Alpha is a popular tool used in the estimation of internal consistency and assessment of reliability and consistency of scales. It is used to determine the interrelations or the average internal consistency of variables in survey instruments to measure the reliability. According to Santos (1999), the reliability of survey instruments and scales employed to gather responses from experts on a set of variables or factors is very vital for researchers to identify whether the factors in a survey instrument will continually yield stable and reliable results over a repeated number of times. The Cronbach alpha will be employed in this study to examine whether

the general statements and the variables within the various constructs in the questionnaire are reliable to measure the primary constructs.

The Cronbach's alpha coefficient is designated by the symbol (α) and its value, ranges from 0.00 to 1.00. The range values represent lowest and highest respectively and have direct relationships with the degree of reliability. Meaning, the higher the value of α, the higher the scale's reliability (Cronbach, 1951; Santos, 1999). The reliability of the data set is considered low if the Cronbach's Alpha (α) coefficient is below 0.3, which makes the data unreliable. The reliability of the data set is however considered high if the α coefficient is above 0.7, which is also an indication of high internal consistency and therefore highly reliable and acceptable (Memon et al., 2014). A reliability coefficient of 0.5 to 0.6 range or more is very desirable and considered adequate for any form of analysis (Meeampol and Ogunlan, 2006). The value of (α) is calculated using the formula below:

$$(\alpha) = \frac{k\ cov/var}{1 + (k-1)cov/var} \tag{2.3}$$

Where (α) = Cronbach's alpha coefficient, *k* represents the number of scale items; *var* = scale items average variance and *cov* = average covariance between scale items.

Moreover, when there are standardization and common variance among the factors, the formula can be simplified as shown below:

$$(\alpha) = \frac{kr}{1 + (k-1)r} \tag{2.4}$$

where *r* represents the average correlation among the scale items.

3.4.5 Factor Analysis

Factor analysis (FA) is a set of methods used to examine how fundamental constructs influence the responses on a number of measured variables (Kim and Mueller, 1978) and with the aim of using a few hypothetical constructs to stand in place of a larger set of variables (Chan et al., 2010). Exploratory and confirmatory factor analysis are the two known types. Confirmatory factor analysis (CFA) tests whether a specified set of constructs is influencing responses in a predicted way whiles exploratory factor analysis (EFA) attempts to discover the nature of the constructs influencing a set of responses. Factor analyses are performed by examining the pattern of correlations (or covariances) between the observed measures. Measures that are highly correlated either negatively or positively are likely influenced by the same factors, while different factors likely influence those that are relatively uncorrelated. It is commonly employed to examine the relationship among a given collection of observed variables and establish the probable variables capable of measuring or determining characteristics of the same underlying principles (Hair et al., 1998; Field, 2005). Therefore, the key factors/constructs are developed out of the large number of variables been reduced to smaller components. The developed key construct can be used to explicate the entire data or elaborate trends adequately. As a result, Ameyaw and Chan (2015) posited that FA has been one of the statistical tools developed to become widely accepted and commonly employed in construction management research. Furthermore, the principal component factor analysis (PCFA) is considered an appropriate option among the various types of FA for data reduction.

With the specified strength of PCFA, this research will make use PCFA to analyze and develop the fundamental categories of the desirable CM skillsets, the barriers and effective teaching and learning strategies of preparing CM students for the Knowledge-based economy. Also, the factor-

solutions evolving from PCFA lay a very strong underpinning for additional complicated analysis, and this adds on to the significant merits possessed by PCFA. Chan et al. (2004) stipulates four necessary steps involved in carrying out FA. They include: (i) establishment of the significant variables (e.g. Desirable Skillset) of Construction management education curricula, (ii) compute the correlational matrix for the variables, (iii) extract and rotate every component and lastly, (iv) name and interpret the principal components as the foundational constructs.

Before carrying out the FA process, several tests need to be performed to establish the suitability of FA for factor rotation. These tests include Bartlett's Test of Sphericity and Kaiser-Meyer-Olkin (KMO) (Fox and Skitmore, 2007). According to Hair et al. (1998), Bartlett's Test of Sphericity is used to ascertain the existence of relationships among the variables which helps in the determination of whether the correlation matrix of the population is an identity matrix whereas the KMO measures the sample adequacy. An appropriate dataset for factor analysis should have a p-value less than 0.05, which means that Bartlett's Test of Sphericity is significant and KMO index should exceed 0.5. Mallery and George (2003) opined that these suggestions are widely accepted and adopted in construction management research.

3.4.5.1 Extractions and Rotation of Factors

Extraction and rotation of factors are the two major procedures involved in FA (Norusis, 1993). The extraction of factors is deemed necessary to develop variables by factor solution (principal component analysis), whiles factor rotation is performed to boost how well to interpret the variables. Typically, the first factor-solution explains the largest amount or degree of the sample variance while the variance-explained that is remaining, is shared across the other factor solutions. Varimax rotation, which is one of the most employed rotation methods in construction management research will be used in this study to enable interconnections and easy clarification

among the variables of both observed and latent variables (Oyedele, 2010). Furthermore, according to Norusis (1993), eigenvalues representing the sum of squared factor loading of the factors represents the degree of variance explained by a factor. This research will only retain factors with eigenvalues greater than one, based on the Kaiser criterion.

3.4.6 Partial Least Square-Structural Equation Modelling (PLS-SEM)

Principal component analysis, path analysis, and regression analysis are the techniques PLS combines to simultaneously examine data and theory (Shan et al., 2016b). PLS is made up of two types of variables namely observed variables and latent variables. Observed variables can be measured directly while latent variables are theoretical or hypothetical variables that are inferred from observed variables. The results attained from performing PLS analysis are made up of outer models called measurement set and inner models, known as structural models. The measurement models examine the correlation among the observed variables, for example, desirable skill set of CM students and their associated latent variables (the formed constructs or underlying groupings of skillset of construction management students). The inner models or structural models assess the interconnections between the latent variables, which are under examination.

The PLS process is made up of multiple stages that involve three prominent steps thus: specification of models; inner model evaluation; and outer model evaluation. The study of Hair et al. (2014) conducts an in-depth clarification. As a multipurpose and multivariate analytical method in statistics, the PLS-SEM technique is used to simultaneously examine the relationships for correlational mappings among factors in a theoretical model (Le et al., 2014). This technique has become a very common and vital analytical technique in construction management research used to examine complete and emerging concepts and theories. The application of SEM in CM research

has been successful because of these basic underpinnings: its potency to measure the cause-and-effect relationships among latent variables and it can also be used to examine the measured latent variables (Chan et al., 2010). There are two primary types of SEM namely Covariance-Based SEM and Partial Least Squares SEM developed by Chin (1998).

The PLS technique is adopted in this study as a result of the following motives. The most prominent justifications made by researchers who adopt the use of PLS are the ability to use a small sample size, data distribution and the use of formative indicators (Hair et al. 2011; Afthanorhan, 2013). Although this study does not look forward to a small sample size, PLS is still adopted as the case maybe if a lower rate of the targeted respondents responds to the questionnaire due to the nature and sensitivity of the topic. As posited by Le et al. (2014) and Shan et al. (2015a), these benefits have paved way for PLS to be embraced in current years and used extensively in construction management research.

3.4.6.1 The application procedures of PLS-SEM

These exist five procedures in conducting the PLS analysis namely: examination of the data attributes, model specification, model estimation, interpretation of the model and finally validation of the developed model.

3.4.6.1.1 Data attribute examination

The first stage deals with the examination of the data distribution and sample size. According to Shan et al. (2015a), due to PLS-SEM ability to handle very skewed data distribution, there is no need for distributional requirements. As discussed earlier this tool is capable of realizing very robust and accurate results even with a very small sample of as low as 20 as was used in the study of Chin and Newsted (1999).

3.4.6.1.2 Model Specification

This stage looks at the development of measurement and structural models. The development of the measurement and structural models are usually based on one's knowledge and experience in their respective fields being researched, theoretical as well as literature review (Aibinu and Al-Lawati, 2010; Shan et al., 2015a).

3.4.6.1.3 Model Estimation

The estimation of the theoretical model parameters is conducted at this stage. The SEM analysis performs the parameters estimation for the relationships between the measurement items and their respective loadings, which are the latent variables and paths coefficient which represents the mappings between the various/different latent variables (Kline, 2010). However, since PLS SEM takes every single latent variable as an approximate of its measurement items block, the first phase of the estimation consists of iterative dimensions of simple and different regressions that is contingent on the specific model. This is conducted until there is an answer that converges on a set of weights used for calculating the latent variables scores (Shan et al., 2015a). As soon as the outcomes for all the latent variables are achieved, the stages that follow consist of simple non-iterative applications of ordinary least squares regressions for obtaining mean scores, location parameters, path coefficients and loadings for the measurement items and latent variables (Chin 1998).

3.4.7 Fuzzy Set Theory (Fuzzy Synthetic Evaluation)

Fuzzy set refers to a set that has different or changing degree of membership, which varies in a defined interval of 0 and 1. This signifies that if an element has a membership grade which falls on the level of 0, it cannot be considered as a member of the set. On the other hand, any element

with grade membership in the degree of one possesses an absolute relationship to the set (Hadipriono,1988).

As a contemporary mathematical tool, it is employed to solve complex and ill-defined fuzzy situation with the condition that incomplete and vague data characterize problems of the real world. Introduced by Zadeh (1965), this method was to address the issues of subjectivities and uncertainties. The values of the membership function describe the level of belongingness of an individual element to a set. In other words, an element may belong to a fuzzy set either by a greater or lesser degree represented by either a larger or smaller membership value. Fuzzy concepts offer a suitable technique for analyzing intricate systems when the indeterminacy pattern is inferable to inherent vagueness and variability. Additionally, it is employed to model the processes involved in decision-making (Boussabaine, 2013).

Previous studies assert that FSE is deemed to be one of the most suitable approaches to the assessment of multi-criteria decision-making as well as multi-criteria synthetic (Xu et al., 2010; Wu et al., 2010). For instance, decision and policy makers in project management such as project managers, regulators, stakeholders and engineers usually view the level of project risk regarding linguistics determinants as very low, low, moderate, high, very high, etc. (Sadiq and Rodriguez, 2004; Tah and Carr, 2000). FSE is therefore known to be effective in dealing with such vague, linguistic and uncertain variables that can be used for approximate reasoning.

3.4.7.1 FSE Procedure

The FSE decision-making model comprises the following stages (Wu et al., 2010; Liu et al., 2013; Ameyaw and Chan, 2015):

1. Establishing a set of factors or basic criteria, U= {u_1, u_2, u_3 …., u_m} where u_i = (*i=1,2, 3,..m*) represents the i^{th} factor estimation;

2. Create a set of grade substitutes which are detailed in linguistic terms for the variables V= {v_1, v_2, v_3 …., v_m} where = (*j=1,2, 3,.....m*) represents the evaluation grade *j*.

In simple terms, the grade substitute represents the employed measurement scale. For instance, the 5-point grades that will be used to evaluate.

3. Create a set of weightings by evaluating the weight vectors of the evaluation variables as: W= { w_1, w_2, w_3 ….., w_m } where = (*j=1,2,3,.....m*) signifies an evaluation factor *I* weighting and (0 ≤ w_1 ≤ 1);

4. Determination of a fuzzy evaluation matrix R= $(r_{ij})_{mxn}$ where (r_{ij}) expresses the degree to which an alternative v_j satisfy the basic criterion u_i in a fuzzy situation. The matrix of the fuzzy function R can be expressed as:

$$R = \begin{bmatrix} r_{11} & r_{12} & & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & & r_{mm} \end{bmatrix} \quad (2.5)$$

5. Estimate the final results of the fuzzy evaluation by taking into consideration the weightings determined in step 3 and the matrix in step 4 using the equation given below:

$$D = W \bullet R = (d_1, d_2, \dots d_n) \quad (2.6)$$

Where *D* stands for the final evaluation matrix; *W*=weighting vector; *R*= fuzzy evaluation matrix and ● represents the fuzzy composition operator.

3.4.7.1.1 Mathematical Functions of FSE

The effective application of the FSE technique demands the selection of an appropriate function that passably analyses the contents (that is, membership functions and weightings) of the final

evaluation matrix equation (see above, D). According to Lo et al., (1999) and Lai and Hwang (1994), there are four primary functions of FSE.

$$M(\wedge, V), b_j = \bigvee_{i=1}^{m} (w_i \wedge r_{ij}) \forall b_j \in B \quad (2.7)$$

$$M(\bullet, V), b_j = \bigvee_{i=1}^{n} (w_i x\, r_{ij}) \forall b_j \in B \quad (2.8)$$

The equations listed above (2.7 and 2.8) are regarded to be more applicable to single-items conditions due to their consideration of key attributes and ignore or disregard minor attributes. For instance, in assessing project risks, both equations are deemed unsuitable for processing the contents of Eq. D, because each attribute should pose an effect on the whole index or level or risk.

$$M(\bullet, \oplus), b_j = \min\left(1, \sum_{i=1}^{m} w_i r_{ij}\right) \forall b_j \in B \quad (2.9)$$

$$M(\wedge, +), b_j = \sum_{i=1}^{m} (w_i \wedge r_{ij}) \forall b_j \in B \quad (2.10)$$

According to Lo (1999), some of the data with leaser weightings are ignored by the min-operation in Eq. (2.7) and hence produces a similar output as in the cases of equations (2.9) and (2.10).

3.5 QUALITATIVE RESEARCH CONCEPT

Qualitative research methods (QRM) according to Banister (2011) refer to the interpretive study of a specific research problem where researchers who are the central point of this methodology make sense from the participants of the study's contributions. Some school of thought posit that there exists no single recognized approach to applying this methodology. However, many scholars adopting this method acknowledge that its adoptions and application are influenced by numerous

factors including but not limited to the following: the scope of knowledge and characteristics and its means of acquiring (the epistemology of the researcher); the ontology of beliefs of the researcher concerning the nature of the social world and what a researcher is able to know from it; the objectives and aim of the study; the research audience for example, industry practitioners; the characteristics of the participants, the position and environment undertaken by the researchers.

Formal to informal interviews, focus groups, personal documents analysis and participant observation describes some of the methods of collecting data in a typical qualitative study. The data collection methods are designed to assist researchers to understand the connotations people assign to social phenomena and to clarify the psychological processes underlying the behaviors of the participants. An advantage of qualitative approach is its ability of generating rich and detailed data that allows the participants perspectives to be articulated whiles at the same time providing a context for deepening the understanding of human behavior. Time-consuming and labor intensive are the two prominent disadvantages associated with this method. According to Webb and Auriacombe (2006), this approach offers social scientist the freedom to explore unexpectedly substantial subject matters that may have been still concealed had they taken the path of employing structured and rigid quantitative method. Typical examples of qualitative research design include case studies, phenomenological approach, conversational and discourse analysis, grounded theory, content analysis, and life history studies (Bryman, 2017; Webb and Auriacombe, 2006). However, due to the nature of this study, two qualitative tools namely content analysis and human capital theory approach are going to be employed for this study. The application process for the two tools is explained below:

3.5.1 Content Analysis

Content analysis refers to a set of both qualitative and quantitative techniques for gathering and examining data from electronic, print, and verbal communications with extensive applications in different fields of research ranging from education, construction to nutrition. Textual data from open-ended questions focus groups and interviews can be analyzed using content analysis. However, the selection of methods is largely dependent on the type and length of data to be studied, researcher's preferences, technological capabilities, and the anticipated results (Kondracki et al., 2002). In CM research, content analysis has been extensively employed to analyze textual information and data in both empirical research as well as literature review studies. For instance, Agyemang and Fong (2020) employed this technique to assess and analyze papers selected for a review study on Knowledge Management and Construction Management Education research.

3.5.1.1 Processes and Usage

Four distinct phases characterize qualitative content analysis process model (Mayring, 2008) which includes:

1. Material Collection: The material or data to be analysed is determined, and the analysis unit is defined.

2. Descriptive analysis: An assessment of the features of materials/data which provides a background for the content analysis.

3. Category selection: The selection of structural as well as associated analytic categories which are needed to be applied to the gathered material.

4. Material Evaluation: The gathered materials are evaluated based on their analytic scopes.

The divisions into different process phases are deemed very crucial aspects of qualitative content analysis because they allow inter-subjective verifiability and traceability which makes it different from most or other hermeneutic or qualitative assessment techniques (Duriau et al., 2007; Mayring, 2008).

3.5.1.2 Reliability and Validity Concerns of CA

As with other analytical techniques, this technique is underlined by its validity and reliability concerns. As posited by Neuendorf (2016), this is done to determine and record at least inter-subjective or relatively objective features of messages. By this, if the outcome of CA is founded on multiple of different judgments of a sole researcher, then it is clear that the results are rather contestable. However, by including more than just a few numbers of researchers into the CA technique, reliability and validity of sampling (literature) as well as the analysis of the data may be improved (Neuendorf, 2016; Duriau et al., 2007). Particularly, with regards to text analysis, one may differentiate the exploration for latent or explicit content. Whereas the former relies on the interpretations of researchers (mental schemes), indicating a pressing challenge, the latter can easily be assisted by software tools. As a suitable tool for analysis, CA was employed to analyze the literature review and will also be used to analyze data that will be gathered from semi-structured interviews.

3.6 THEORITICAL AND CONCEPTUAL FRAMEWORK

3.6.1 Human Capital Theory (HCT) Approach

The Knowledge-based economy which characterizes the 21st Century thus a shift from production economy has changed the perception of how assets are looked at within an organization. A long-held belief was that a firm's economic success was directed attributed to its physical assets,

however, according to Becker (1964) the physical resources only accounted for a relatively small part of the income growth of the said firm. In a knowledge-based economy, it is the intangible skills and abilities of the workforce and the knowledge inherent within the organization's systems, structures, processes and routines, which can contribute towards the knowledge capital of the organization (Grant 1996a, Mahoney and Kor, 2015). This knowledge capital is commonly referred to as a firm's intellectual capital (IC) which comprises of human, structural (innovation and process capital) and social/relational capital as shown in Figure 3.1 below (Edvinsson and Malone, 1997).

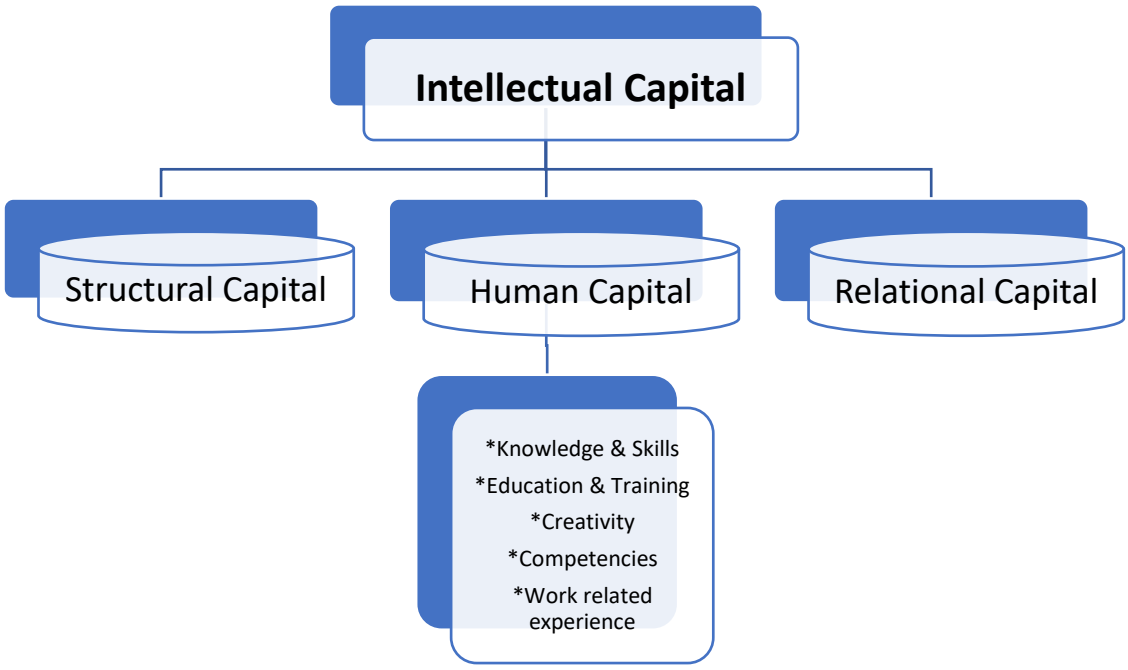

Figure 3.1: Intellectual Capital components
Source: Edvinsson and Malone (1997)

Human Capital (HC) as a component of IC dates back to the early 1960's and was referred to as the composition of skills, knowledge and abilities of the people working in an organization (Schultz, 1961). This definition was in the year 1981 revamped by the same author to reflect the

concept of value and the importance of investment in human capital and thus defined as "all human abilities to be either innate or acquired such that these attributes are valuable and can be augmented by appropriate investment' (Schultz, 1981, p21). Human capital (HC) is deemed to represent the foundational level of IC. HC not only facilitates social capital and the sharing of knowledge and ideas through internal relationships but also plays a vital role in creating and developing new ideas and knowledge (Han et al 2014). HC also complements a firm's structural and innovation capital, creating unique and new knowledge (Mahoney and Kor 2015).

In the Organizational context, HC theory puts forward that individual who invest in education and training has a high chance of increasing their level of skill, hence rendering them more productive than their counterparts and thus justifies a higher earnings and productivity mainly as a result of the provision of skills, knowledge and a means of analyzing problems. Among others, human capital theory (HCT) strongly supports the view of the developing human resources.

According to Gillies (2015) promoting education as an "investment" which yields returns in due course to the individual in terms of pay and to the state in terms of employment and economic growth, HCT provides a captivating model for the governance of state education. The growth of the concept of the "knowledge economy" in the past 2 decades has also afforded the HCT a further degree of importance because of the strong connections it sees between education and training and economic growth (Gillies, 2015). Human Capital Theory does present a central role for teachers/lecturers as those who help create and develop human capital and in this study's case, construction management lecturers.

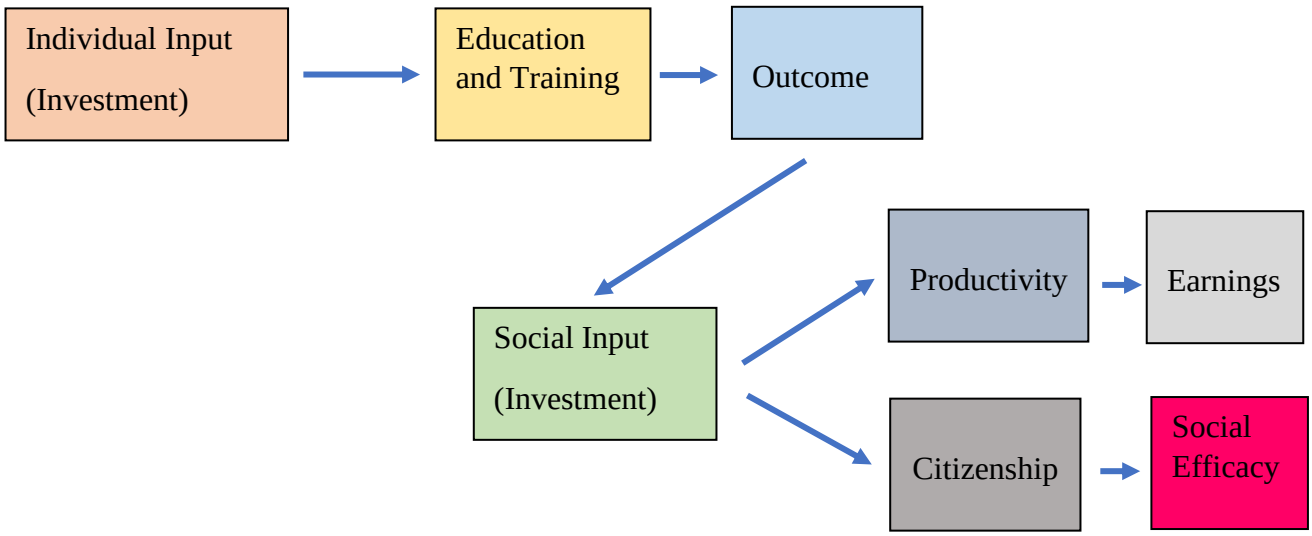

Figure 3.2: Model of Human capital theory

Source: Adapted from Swanson and Holton (2001)

Adapting from Swanson and Holton (2001) as shown in fig. 3.2, this study intends to elaborate on the individual investment by way of appropriate and desirable skills set acquisition of construction management students through formal education, where Higher Education Institutions oversee this transition. The main proposition of the theory is that human resources (people) are being treated as a form of capital for development. From that, the human development in terms of education and training is considered as a direct and deliberate investment in the labour force with yielding benefits.

3.6.2 Conceptual Framework

As with the human capital theory, the triple helix model was also adopted for this study's conceptual framework. The HCT served as a foundational theory where the emphasis was laid on the investment (education) on the individual and in this case the student. This further propelled the

discussion for the introduction of the triple helix model, where three (3) actors thus government, industry practitioners and academia play massive role in churning out novices into professionals.

This model accounts for dynamic interactions between the three spheres through "taking the role of the other" in contexts where one or more of these triple helix actors that is university, industry, and government are weak or constrained from acting (Etzkowitz 2008). The unique contribution of the triple helix model (Etzkowitz and Leydesdorff 1995) to innovation studies is its attention to the heightened role of the university in the transition to a knowledge-based society. This focus contrasts to previous innovation approaches that focus on the firm or government-firm interactions. The university's enhanced relevance to technology transfer, firm-formation and regional renewal places it in a primary position in knowledge-based society in contrast to its secondary role in industrial society. Although most innovation approaches consider firms or the industry sector as a key element in innovation analysis (Foray 2014), all acknowledge the importance of university, industry and government and their interactions in fostering innovation and entrepreneurship.

With the three (3) major construction management and engineering education stakeholders (government/accreditation bodies, industry practitioners and academia) coming together, figure 3.3 presents the conceptual framework where much emphasis is place on the innovative role of institutions of higher learning in the preparation of CM students to become professionals after their initial training in school. After their educational training, these students as shown in figure 3.4 become a T-Shape CM professionals exhibiting 21st century skills and competencies such as time management, creativity, team player, critical thinking, effective communication etc. through proper technical content, and industry driven curricular development which academics are experts in their delivery aided by active instructional methods (blended learning, flipped classroom etc.).

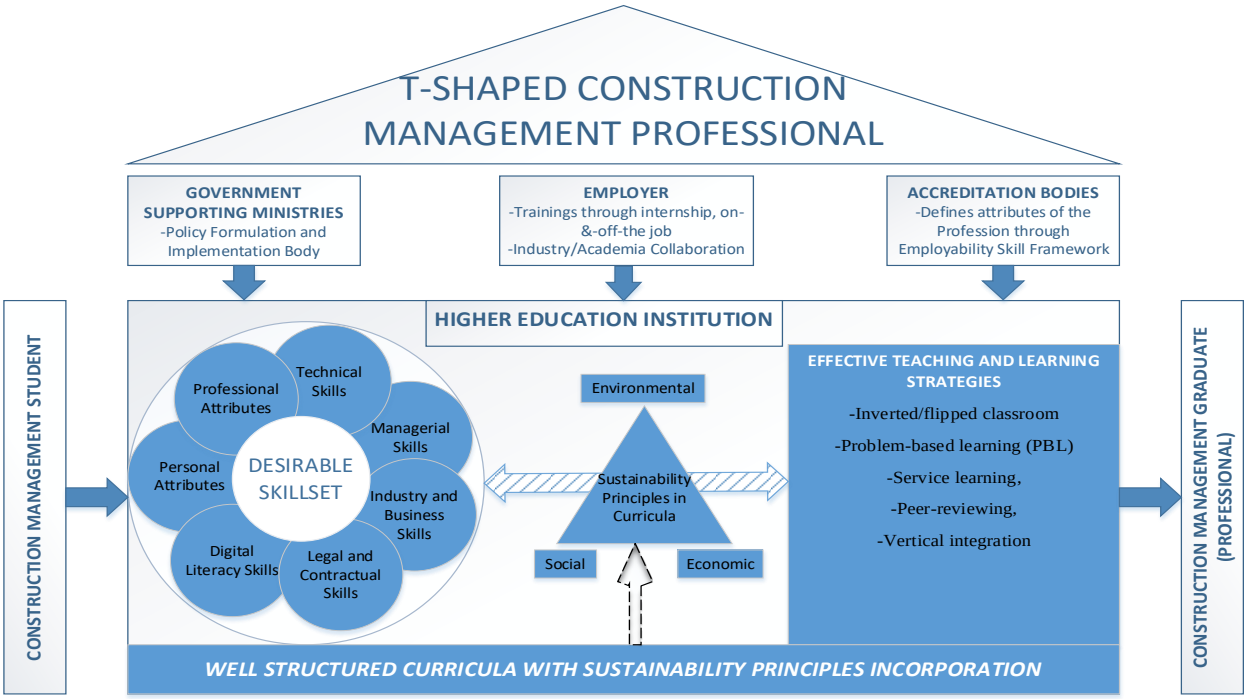

Figure 3.3: Conceptual Framework

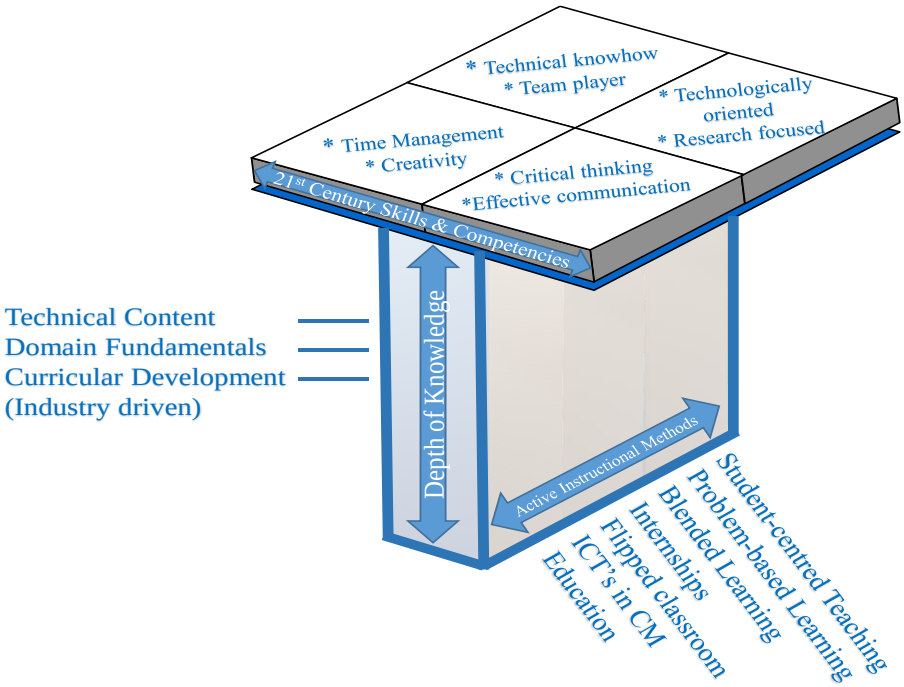

Figure 3.4: T-Shaped Construction Professional Model

3.7 CHAPTER SUMMARY

Chapter two spelt out the methodology that will be adopted to achieve the aim of the research. It expounded into detail all the qualitative and quantitative research methods employed throughout the research journey. They included extant literature review, structured interviews, Descriptive analysis, Factor analysis, Partial least squares Structural equation modeling, Fuzzy set theory Human Capital theory and Triple Helix theory. The theory behind the adoption and application of these techniques to achieve the stipulated aim and the objectives have been explained in this chapter

CHAPTER FOUR[4]

OPERATIONALIZATION OF DESIRABLE SKILL SETS IN NOVICE CONSTRUCTION PROFESSIONALS

4.1 INTRODUCTION

Dubey, Tewari, and Pandiya (2017) puts forward that the successes or failures of construction organizations as also seen in other firms in the service industry, relies mainly on human capital which require careful management in such a dynamic environment. Although, many studies assert that professionals with relevant skillset remain scarce, however, graduation rate of students each year is on the rise (Gupta and Pandit, 2010). Technical and non-technical skills have been deemed as the widely identified skill sets required by construction professionals as posited in several studies. According to Litecky et al (2004) and Gallagher et al (2010), skills that are non-technical in nature are needed for survival and growth which are generally called organizational skills, people skills, or soft skills. Technical skills on the other hand, comprise skillsets that relates to the technically oriented parts of a job. As stressed by Litecky et al. (2004), exhibited as a threshold, these skills distinguish undesirable from desirable professionals and sometimes linked to a person's intelligence quotient (IQ).

Several scholarly works have been done on desirable skill sets of construction professionals. On one hand, many authors have prioritized non-technical over technical skills, thus placing emphasis on the importance of non-technical skills increasing with more complex projects (Hazzan and Har-Shai, 2013; Agrawal and Thite, 2006). The gap found in technical or hard skills has been widened

[4]This Chapter is largely based upon:

Yamoah Agyemang D.*, Fong, P. S. W., & Kissi, E (2022). Operationalization of desirable skill sets in novice construction management professionals. Conference Proceedings in ASCE Construction Research Congress (CRC). 9-12 March 2022, Virginia, USA

Yamoah Agyemang D.*, & Fong, P. S. W. (2019). Towards desirable skill set acquisition of Construction Management Students in a Knowledge-based economy: A systematic review and trend analysis. Conference Proceedings in 16th International Conference on Intellectual Capital, Knowledge Management and Organizational Learning. 9-12 December, Sydney, Australia

as reported by many authors (Ahmed, Yaris, Farooqui and Saqib, 2014), although many studies have also pinpointed the existence of skill gaps to both non-technical and technical skills (Trauth et al, 1993; Lee and Lee, 2006). The gap between possessed and desired technical skillsets motivated this research on the skill gap in the construction industry.

This study, therefore, is in three-fold. First, to identify the significant attributes/factors of desirable skill sets among construction professionals. Secondly, the study intends to ascertain the perceived expectancy gap in skillset existing between practitioners and students. Thirdly, the factors that influence the perceived expectancy gap with emphasis on effect of backgrounds such as experience and gender of practitioners and students on perception of desirable skill sets are put forward.

The study follows in this order: the ensuing section thus literature review expunges on employability theories thus settling on a theory to explain the perception of expectancy of desirable skillsets and its impact on employability and performance. The development of hypothesis follows. The next section explains the research methods employed. The results of data analysis are displayed followed by presentation of discussion related to key elements of the study with theoretical and practical implications highlighted. Lastly, the conclusion with future recommendations and limitations are presented.

4.2 LITERATURE REVIEW

4.2.1 Employability

Employability according to (Lee et al., 2002; Yorke and Knight, 2004) refers to the ability of an individual to be offered an employment, maintain that work as well as get new employment when the need be. This pertains to one's skills, knowledge, abilities and attributes and thus leads to job

satisfaction (Finch et al, 2013). Viewed from 3 perspectives, employability can be differentiated by organizations, individuals, and governmental institutions (Dubey and Tiwari, 2020). Whiles government institutions seek to maximize overall employment, organizations on the other hand benefiting directly from exploiting skills and competencies from employees employ suitable candidates who best fit their needs given their resources availability (Wye and Lim, 2009). Employability has been difficult and tricky to understand let alone measure as a result of rapid changing nature of work as evidenced in the 21st century. Given the right blend of attributes, skillset (hard and soft), and competencies, employability is greatly enhanced.

4.2.2 Employability and Skillset Classification

Skill is related to the knowledge, ability and competence of an individual to make use of specific tools for an intended purpose either in one's role or relating to other roles within the work environment (Carroll and Boutall, 2011; Skills, 2007; CBI, 2013). In a wider spectrum, literature presents two skill classes to include "specialist" as against "generic" and "existing" vs "new" although some skills may belong to both as boundaries with these classifications are not definite. Specialist skills as part of the first classification are in relation to activities that are linked to persons in a specific field who are highly skilled (Edum-Fotwe and McCaffer, 2000). In comparison, UKCES (2009) captures generic skills as not specific to a subject domain (e.g manufacturing sector) and thus covers vast area of diverse skills. For instance, generic skills include but not limited to problem solving skills, computer use skills, professional communication skills (Felstead et al., 2013), employability skills (teamwork, negotiating ability, communication) (UKCES, 2009). To reduce the skill gap as evidenced in the construction sector, CIOB education framework (CIOB, 2010) has specified the need to improve education which fails in many ways

of teaching generic skills, as well as employability skills of graduates in construction management (Rawlins and Marasini, 2011). In the second classification, existing skills are primarily related as those that a worker already possesses or perhaps that skill linked with the requirement for training enhancement whereas new skills are described as those connected to an up-skilling of a worker to assume new roles within the organization as well as the use of more advanced equipment (HM Government, 2010)

Although considerable efforts to develop desirable skill set by higher education institutions have been forthcoming especially in the construction technology and management education domain, other prominent international organizations such as the United Nations, the World Bank, the World Economic Forum, the Organization for Economic Co-operation and Development, among others have played active roles either directly or indirectly in promoting the development of desirable skills. Seldomly reported in studies are these international organization's efforts and as such this study puts forward their efforts. Major contribution of the various organizations is summarized in Table 4.1.

Table 4.1: Overview of Selected International Organizational initiatives for Skill development

Organization	Effort	Origin	Year of Effect	References
World Bank Group (Higher Education)	Supports Higher Education reforms and innovation using the systems approach for better education results via (SABER) tool	USA	2001	World Bank. (2018)
United Nations (UNESCO)	TVET aims to address economic, social and environmental demands by helping youth and adults develop the skills they need for employment, decent work and entrepreneurship	France	1945	UNESCO (2015)
Organization for Economic Cooperation and	The OECD's work on education helps individuals and nations to identify and develop the	France	1961	OECD (2016)

Development (OECD)	knowledge and skills that drive better jobs and better lives			
ASCE	Construction Institute promote the construction industry to attract and develop the current and next generation of construction professionals	USA	1852	ASCE (2019)
World Economic Forum	Seeks to ensure that talent is developed and deployed for maximum benefit to the economy and society	Switzerland	1971	WEF (2016), Bakhshi et al. (2017)
Islamic Educational, Scientific and Cultural Organization (ISESCO)	Division of Higher Education aids in improving university educational curricula and directing them towards the knowledge economy,	Morocco	1979	ISESCO (2019)
The International Association of Universities (IAU)	Advocates for higher education policies and practices that respect diverse perspectives and promote social responsibility	France	1950	UNESCO (2015)
Association for the Development of Education in Africa (ADEA)	Advocates for quality African education and training geared towards the promotion of critical knowledge and skills for accelerated and sustainable development in Africa	Tunis	1988	Banga and te Velde (2018)

A right amount of skill set (hard and soft), competence and attributes enhance employability. A number of researchers (Trauth et al., 1993; Christodoulou, 2004; Goh, 2007; Domal and Trevelyan, 2009; Zhao et al., 2015; Naveed et al., 2017) have attributed the unpreparedness of graduates from construction management backgrounds to rigid academic content of curricula, limited electives offered as an extension of the compulsory courses, curricula lacking multidisciplinary collaboration with other relevant skill areas and the gap surrounding the expectations of the construction industry as against the perceptions of Higher Education Institutions (academia) termed as “expectation gap”.

4.3 THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

4.3.1 Employability theories

USEM is an acronym for understanding (subject), skills (generic and subject-specific), efficacy (personal qualities including self-theories) and metacognition (including reflection). The model states the interconnection among all the components where personal quality influences the rest of the three components which are mutually supportive of each other. The importance of generic skills for employability is also reinforced by the career edge model (Pool and Sewell, 2007). The mnemonic career edge describes five essential and mutually overlapping components, namely career development learning, life and work experience, subject knowledge and skills, generic skills, and emotional intelligence. Reflection through these experiences results in the development of self-efficacy, self-esteem and self-confidence which leads to enhancement of employability. Two components of the low tier - generic skills and emotional intelligence – and all the three upper-tier components (career development learning, life and work experience, subject knowledge, and skills) of this model form part of skills. These theories state the importance of skills (personal attributes and generic skills) to the development of employability. Hence, any gap in skillset either soft or hard affects employability of individuals.

4.3.2 Vroom's expectancy theory

According to this theory, there is a tendency for individuals to showcase certain behaviour based on the results of a particular assignment, and a particular behaviour will culminate in the fulfilment of an expected goal (Vroom, 1964). Three terms will explain the Vroom's expectancy theory: instrumentality, expectancy, and valence. Instrumentality refers to what employees perceive about the rewards due to them because of their performance. Valence relates to the emotional affinity of

an individual towards a goal. Instrumentality is thus influenced by a clear distinction between performance and rewards, confidence level increases especially in the transparency of procedures and in leading characters of the job. Expectancy, on the other hand, deals with individual choices of employees and how far their efforts can reach the desired performance or goal.

According to Vroom, there exist a positive relationship between the behaviour of people and their objective thus efforts of individuals affect performance based on factors not limited to skills, experience, knowledge, resources, work conditions etc. (Dubey and Tiwari, 2020).

For this study, outcome is determined by employability whereas desirable skillsets exhibited by individuals are the desired level of efforts and performance towards the employability. Employability in this instance outcome includes one's ability to secure job, to be maintained in the job, to grow in the working environment and reemployment capability. Instrumentality for the desired outcome comes to play when new entrants exert an amount of effort yielding increased performance as perceive by practitioners. Notwithstanding, novice professionals or students exhibits a perceived level of expectancy with regards to the desirable skillset needed to enhance their performance for better employability. According to Dubey and Tiwari (2020), there exist a reduction to probability of staying long with regards to employability when a difference is shown in the perceived expectancy of prospective employees and practitioners. Figure 4.1 depicts the theoretical framework for the study.

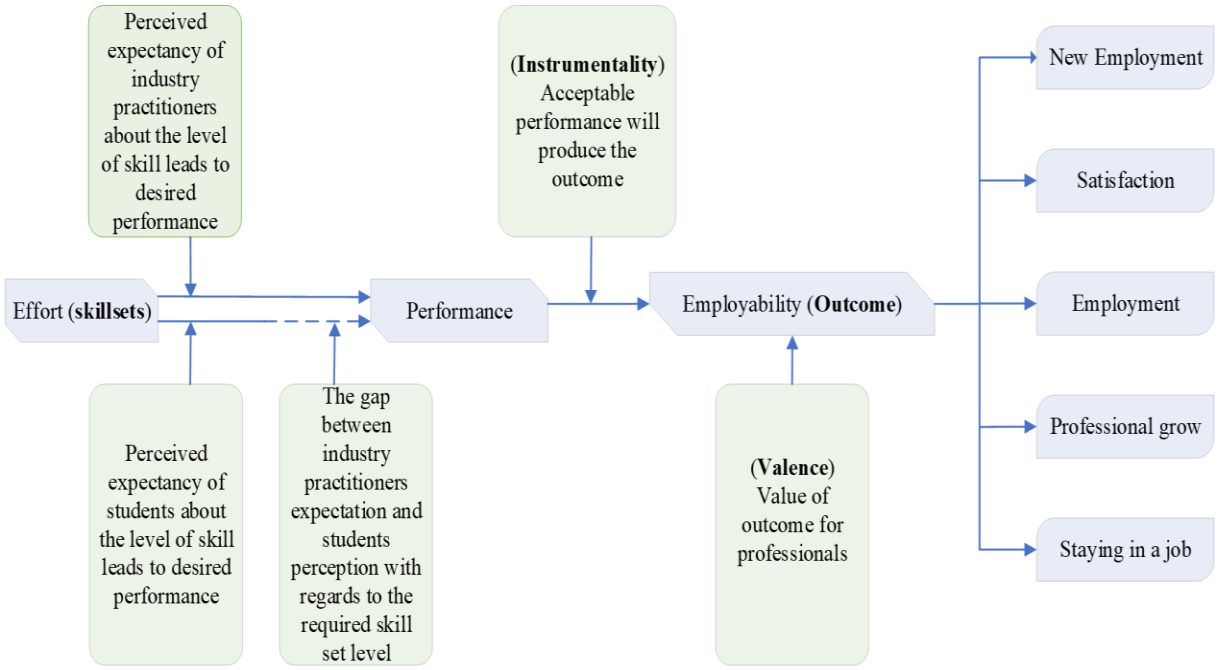

Figure 4.1. Perceived Expectancy of skillset leading to employability

Source: Vroom's expectancy theory (Vroom, 1964)

4.3.3 Hypotheses development

Prior studies (Abdelhamid, 2003; Manthe and Smallwood, 2007) have articulated the differences with regards to academics/students or industry/academia on perception towards skill sets in the construction domain. This study, however, fills a gap by examining discrepancies lying between prospective professionals (students) and practitioners regarding their perception of desirable skill sets.

Several skill attributes come together to form a major competence needed in the job market, and this is shown in several traits exhibited by employees. For instance, knowledge of construction drawings and their interpretation, and knowledge of construction materials and equipment, are some examples of skills that are technical in nature. Differences in perception of practitioners and

students on desirable skill sets in most cases may arise due to variations in prioritization of the skill sets or traits of the said groups. Therefore, this study proposes:

H1. There is a significant perceived expectancy gap between practitioners and students regarding various desirable skillset constructs.

Several skill attributes come together to form a major competence needed in the job market, and this is shown in a number of traits exhibited by the employee. For instance, knowledge of construction drawing, and its interpretation and knowledge of construction materials and equipment depict skills that are technical in nature. Differences in perception of practitioners and students on desirable skillset in most cases may arise due to variations in prioritization of the skillsets or traits of the said groups. Therefore, this study proposes:

H2. There exists a positive perceived expectancy gap between practitioners and students regarding the numerous desirable skillset variables.

Gender has posed conflicting stance when it comes to practitioners' views on perception of desirable skillset. Whiles some authors (McMurtrey et al., 2008) considers this for the difference on the desirable skills, others contradict this assertion (Gallivan, 2004). These opposing views led to the scrutiny of the effect of gender on the perception of practitioner on desirable skills. It is therefore hypothesized:

H3. There is a significant difference in perceived importance of skills required for novice professionals with regards to the practitioner's gender.

This hypothesis was developed to ascertain the effect of experience of practitioners on perception of desirable skillset as other studies have done similar (McMurtrey et al., 2008).

H4. There is a significant difference in perceived importance of skills desired in novice professionals based on practitioners' experience.

Several studies have indicated the effect of student's gender towards their perception of desirable skill sets. Whiles a few studies (Hopkins and Bilimoria, 2008) tend to reject the relationship, evidence from literature also supports this assertion (Jamali et al, 2008). Considering the above statement, the study puts forth the hypothesis:

H5. Perceived importance of skill factors does not vary statistically with gender amongst construction students.

4.4 RESEARCH METHODOLOGY

4.4.1 Sample selection

This study considered two categories of people thus construction industry practitioners and construction management students in their graduating year. As direct beneficiaries of employment, industry practitioners (category one) provide employment whereas graduating students (category two) are at the receiving end. This study therefore included students from construction management/building technology institutions in different parts of Ghana and professionals from D1K1 (high financial turnover) construction firms in Ghana. Through questionnaire distribution (either hard copy or email), 120 sample were solicited from construction practitioners. 96 usable responses were retained after 8 were rejected and 16 were not returned. Students in their graduating year targeted from Universities and Polytechnics offering construction management/building technology related programs were the respondents. Out of 182 responses, 124 valid responses were retrieved. It must be noted that participation in this study was voluntary, and confidentiality was assured of their responses.

4.4.2 Skillset variables

Through an extensive review of literature of 263 articles on skillsets and attributes in the Architectural, Engineering and Construction (AEC) industry, 41 manuscripts were deemed appropriate for the identification of the desirable skill attributes among construction professionals. 87 skillsets were identified from the 41 works of literature. After a pilot survey, 72 skill attributes were deemed viable for final questionnaire inclusion. This therefore formed the second section of the questionnaire survey. Presented in Table 4.2 is the list of all skill set attributes.

Table 4.2: Skillset attributes

S/N	Skillset and Attributes	S/N	Skillset and Attributes
1	Knowledge of construction materials	37	Knowledge of green and sustainable construction
2	Project management/ administration	38	Cost control
3	High regards to values/ Work ethics	39	Quality assurance/ Total Quality Management
4	Knowledge and information management	40	Productivity management
5	General computer proficiency	41	Value engineering/Constructability analysis/ Design Review
6	Desire to learn	42	Plans interpretation/ Understanding construction & shop drawings
7	Partnering	43	Understanding cultural issues
8	Construction trade knowledge	44	Knowledge of the permitting process
9	Awareness of industry trends	45	Knowledge of health and safety regulations
10	Problem solving/ Analytical skills	46	Planning and goal setting
11	Teamwork capabilities	47	Result orientation
12	Personnel/ Resource management	48	Risk taking
13	Knowledge of construction equipment	49	Knowledge of project delivery and contracting strategies
14	Leadership	50	Proficiency in construction information technology
15	Scheduling	51	Personal adaptability/Flexibility
16	Critical thinking	52	Understanding global construction Environment

17	Risk planning, assessment and control	53	Forecasting
18	Site planning and management	54	Financial management
19	Contract administration skills	55	Health and Safety management
20	Entrepreneurship	56	Estimating
21	Ability to follow up	57	Dependability
22	Long term commitment	58	Construction organization management/Business Management
23	Marketing with clients/ Developing client relations	59	Multi-tasking
24	Understanding complementary fields/disciplines	60	Change management
25	Dispute avoidance and resolution skills	61	Knowledge of construction data analytics
26	Proficiency in BIM technology software	62	Innovative mindset/ Creativity
27	Promptness in actions	63	Listening ability/ Giving attention to details
28	Understanding geographical issues	64	Knowledge of construction law and legal environment
29	Interpreting contract documents	65	Assertive attitude
30	Decision making skills	66	Knowledge of Augmented/Virtual reality software applications in construction
31	Knowledge of construction operations	67	Ability to understand
32	Economic and financial analysis	68	Ability to speak different languages / Multilingual
33	Knowledge of environment impact assessments	69	Knowledge of construction simulation and modelling tools such as Web cyclone
34	Knowledge of bidding procedures	70	Claims preparation and presentation Skills
35	Knowledge of big data applications in construction	71	Appreciation of construction industry supply chain
36	Time Management	72	Hands-on project experience prior to graduation/ Internship

4.4.3 Instrument

As an instrument for data collection, questionnaire survey was developed for both groups thus students and practitioners. The first section of the questionnaire tackled the demographic queries of both respondents whiles the second part was identical for both groups. Respondents in the

second section were asked to rate and evaluate the significance of skills sets according to their perception. A five-point Likert type scale rating was adopted.

4.4.4 Reliability and validity of the data

After the reduction of the initial variable to 72 following the pilot survey, a reliability test was performed. For $\alpha > 0.7$, reliability reported in terms of Cronbach α ranging between 0–1 signified the construct/variable being reliable. 20 respondents from each group of students and practitioners partook in the pilot survey. Cronbach α for students and practitioners were therefore 0.926 and 0.938 respectively. This outcome prompted data readiness for further analysis.

4.4.5 Demographic Characteristics

Samples comprised of 124 students and 96 practitioners. Male respondents constituted most of the respondents as seen in Fig 4.2. Both respondents were asked how long they have worked or been in the construction industry.

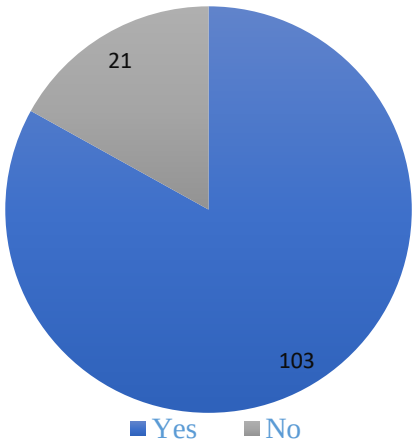

Figure 4.4: Student's Industrial Internship

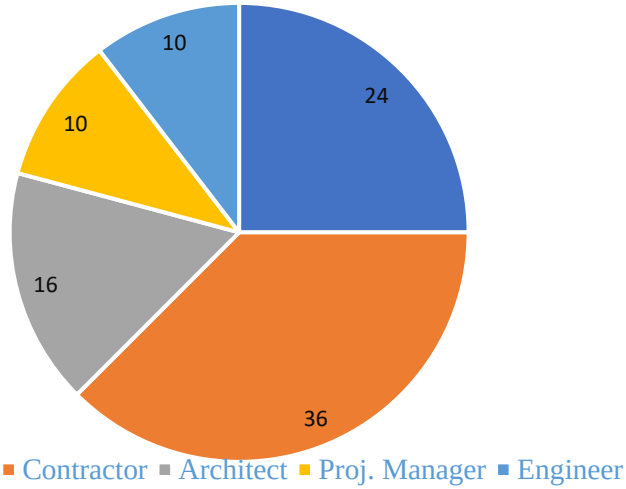

Figure 4.5: Professional's background

Presented in figure 4.3, majority of the students thus 75 had less than 6 years of experience followed by 30 students with no experience reflecting in the number of students with no industrial internship although some embarked-on internships in different fields other than construction related as seen in figure 4.4. Most practitioners possessed 6-10 years of experience, followed by professionals having less than 6 years of experience. A varying working experience of construction industry practitioners as a selection criterion was settled on to receive responses that will inform a balanced assessment of the desirable skillsets. Practitioners with experience level below 10 years were 66 in number and the majority. This category of respondents had graduated from universities and polytechnics not long ago and are therefore well abreast with current curricular of Institution of higher learning, hence their better assessment of desirable skillsets from that stance. 30 respondents however, had experience level of over 10 years depicting their industrial experience hence better informing skillsets of worth to the current industry.

On data stratification based on the professional background of practitioners, majority of them were contractors followed by quantity surveyors, architects, and engineers and project managers as shown in figure 4.5 above.

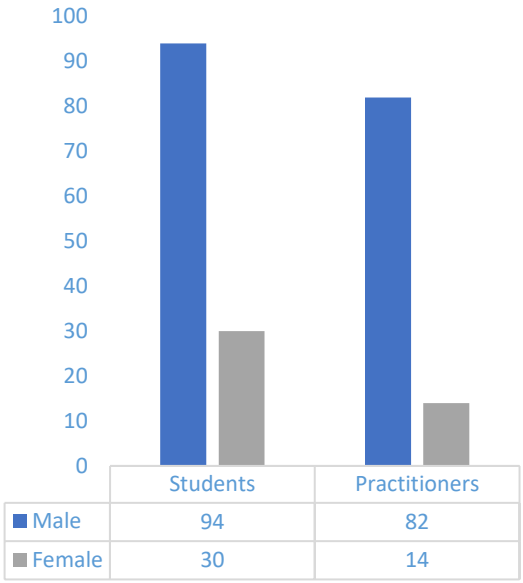

Figure 4.2: Gender of respondents

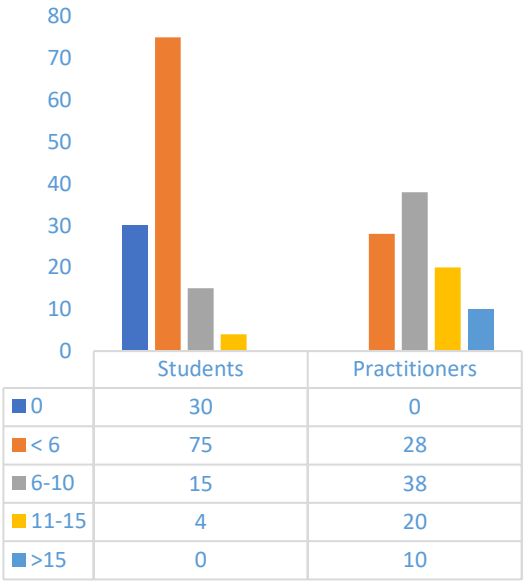

Figure 4.3: Years of experience of respondents

4.5 RESULTS

4.5.1 Operationalisation of factors

To fulfil the first objective, that is identifying significant factors in skillset development of construction management professionals, principal component analysis with varimax as orthogonal rotation was performed using practitioners' data. For data stability and onward analysis, two rules were elicited thus attributes with (1) loadings of more than 0.45 on 2 or more scale factors; and (2) loadings less than 0.45 were excluded. Based on repeated valuation and elimination, ten factors were excluded.

Personal attributes emerged as the first construct and thus seen to depict how individual personalities come to play when different situations are encountered. Among the variables under this construct include time management, desire to learn, and innovative mindset or creativity. The second factor–technical skill - is a specialty that an organisation wants from employees. Such professionals can executive the said task based on their specific knowledge. This factor is the chief predictor of the professional development of an individual along with the well-being of organisations. Management skill (the third factor) enables a person to perform effectively and efficiently. With better management skills, a person can prioritize things and accordingly accomplish various tasks. The fourth factor – digital literacy skill – is valued highly in professions especially now that the impact of Covid 19 has disrupted the face-to-face activities and meetings. Ability to understand and use digital technologies in accomplishing task cannot be overemphasized. The fifth factor – professional attributes - enable a person to think out of the box and generate innovative ideas. Legal and contractual skills came in sixth. These skills enable a person to dispense contractual dealings in an efficient manner. Skills here include but not limited to the following: interpreting contract documents, knowledge of bidding process and knowledge of dispute avoidance and resolution.

The last factor – industry and business skill - adds resourcefulness and knowledge of industry trends in professionals. It is also about gaining advantage through use of information. These seven factors explained 65.27 per cent of the variance in data. Seven factors, with their related attributes, factor loading and value of Cronbach's alpha, are displayed in Table 4.3. The Cronbach's alpha value of more than 0.7 for all the seven factors confirmed the reliability of the factors (Cronbach, 1951; George and Mallery, 2003). Further analysis was done with the sixty-three characteristics

and seven constructs. Results of factor analysis fulfil the first objective, i.e., identification of significant attributes and factors vital to the development of skills in Construction professionals.

Table 4.3 Factor analysis on Research variables

Factor Dimensions	Cronbach α	Factor Loadings
Technical Skills	**0.921**	
Plans interpretation/ Blueprint reading/Understanding construction & shop Drawings		0.724
Knowledge of construction operations		0.645
Knowledge of green and sustainable construction/ LEED		0.544
Scheduling		0.623
Estimating		0.544
Knowledge of construction materials		0.612
Knowledge of construction equipment		0.608
Value engineering/Constructability analysis/ Design Review		0.512
Professional Attributes	**0.812**	
Hands-on project experience prior to graduation/ Internship		0.658
Teamwork capabilities		0.604
High regards to values/ Work ethics		0.543
Planning and goal setting		0.523
Long term commitment		0.626
Problem solving/ Analytical skills		0.537
Result orientation		0.714
Critical thinking		0.732
Decision making skills		0.658
Forecasting		0.48
Ability to follow up		0.481
Risk taking		0.542
Multi-tasking		0.614
Managerial Skills	**0.84**	
Health and Safety management		0.525
Quality assurance/ Total Quality Management		0.622
Project management/ administration		0.522
Cost control		0.544
Leadership		0.714
Site planning and management		0.472
Personnel/ Resource management		0.488

Risk planning, assessment and control		0.532
Knowledge and information management		0.655
Industry and Business Skills	**0.781**	
Knowledge of health and safety regulations		0.544
Marketing with clients/ Developing client relations		0.523
Construction trade knowledge		0.498
Understanding cultural issues		0.463
Understanding complementary fields/disciplines		0.634
Awareness of industry trends		0.633
Understanding geographical issues		0.638
Entrepreneurship		0.654
Understanding global construction Environment		0.645
Personal Attributes	**0.935**	
Listening ability/ Giving attention to details		0.734
Time Management		0.698
Personal adaptability/Flexibility		0.654
Desire to learn		0.745
Promptness in actions		0.633
Comprehension ability		0.534
Innovative mindset/ Creativity		0.655
Ability to speak different languages / Multilingual		0.478
Legal and Contractual Skills	**0.789**	
Interpreting contract documents		0.711
Knowledge of construction law and legal environment		0.624
Contract administration skills		0.688
Knowledge of bidding procedures		0.64
Dispute avoidance and resolution skills		0.477
Claims preparation and presentation Skills		0.578
Digital Literacy skills	**0.821**	
General computer proficiency		0.745
Proficiency in construction information technology		0.634
Knowledge of construction data analytics		0.476
Proficiency in BIM technology software		0.644
Knowledge of construction simulation and modelling tools such as Web cyclone		0.547
Knowledge of big data applications in construction		0.48
Knowledge of Augmented/Virtual reality software applications in construction		0.572

4.5.2 Examining the perceived expectancy gap in soft skill attributes and factors

After performing exploratory factor analysis (EFA) on the 72 skill set variables, independent t-test was employed to identify the differences in perception of the expectancy of practitioners and students with regards to desirable skillsets in novice construction professionals. As presented in Table 4.4, practitioners' group (96 respondents) and students' group (124 respondents) were compared, and nine out of seventy-two variables were insignificant statistically. The remainder thus 63 skillsets were statistically significant, signifying that not all respondents had a similar perception towards desirable skillset variables. Hypothesis H1, had the support from the independent t-test thus confirming the perception of expectancy gap between practitioners and students for the varying skillsets.

Table 4.4 Independent t-test for skill attributes

Skill set	Levene's Test for Equality of Variances			t-test for Equality of Means	
	Equal variances	F	Sig.	df	*p*
Plans interpretation/ Blueprint reading/Understanding construction & shop Drawings	Not Assumed	6.37	0.00	594.47	0.00*
Knowledge of construction operations	Assumed	0.03	0.08	597.00	0.00*
Knowledge of green and sustainable construction	Assumed	0.35	0.47	595.43	0.00*
Scheduling	Not Assumed	14.91	0.00	594.23	0.00*
Estimating	Assumed	5.32	0.46	585.26	0.00*
Knowledge of construction materials	Assumed	2.56	0.89	594.35	0.00*
Knowledge of construction equipment	Not Assumed	13.24	0.02	596.47	0.00*
Value engineering/Constructability analysis/ Design Review	Assumed	0.72	0.29	594.43	0.00*
Hands-on project experience prior to graduation/ Internship	Not Assumed	30.44	0.01	598.46	0.00*
Teamwork capabilities	Not Assumed	15.89	0.00	594.47	0.00*
High regards to values/ Work ethics	Not Assumed	7.52	0.04	596.52	0.00*
Planning and goal setting	Assumed	0.57	0.21	593.68	0.00*
Long term commitment	Not Assumed	8.40	0.02	595.32	0.00*
Problem solving/ Analytical skills	Not Assumed	28.45	0.00	594.44	0.00*
Result orientation	Not Assumed	4.87	0.00	594.65	0.00*
Critical thinking	Not Assumed	32.00	0.00	594.46	0.00*
Decision making skills	Assumed	12.23	0.12	590.63	0.00*
Forecasting	Assumed	24.32	0.24	596.22	0.00*

Ability to follow up	Not Assume	16.51	0.03	591.31	0.00*
Risk taking	Assumed	14.00	0.06	594.41	0.00*
Multi-tasking	Assumed	2.46	0.08	596.51	0.00*
Health and Safety management	Not Assumed	34.00	0.02	593.52	0.00*
Project management/ administration	Assumed	3.67	0.32	594.46	0.00*
Leadership	Not Assumed	1.34	0.00	596.48	0.00*
Site planning and management	Not Assumed	3.40	0.01	594.44	0.00*
Risk planning, assessment and control	Not Assumed	12.76	0.02	594.48	0.00*
Knowledge and information management	Assumed	9.81	0.35	590.49	0.00*
Knowledge of health and safety regulations	Not Assumed	12.02	0.00	593.44	0.00*
Construction trade knowledge	Assumed	7.05	0.08	594.37	0.00*
Understanding cultural issues	Not Assumed	3.57	0.01	597.42	0.00*
Understanding complementary fields/disciplines	Not Assumed	3.55	0.03	594.57	0.00*
Awareness of industry trends	Assumed	19.32	0.06	596.43	0.00*
Entrepreneurship	Not Assumed	2.05	0.01	594.25	0.00*
Listening ability/ Giving attention to details	Not Assumed	2.67	0.05	594.42	0.00*
Time Management	Not Assumed	2.56	0.01	595.26	0.00*
Personal adaptability/Flexibility	Not Assumed	3.21	0.04	594.47	0.00*
Desire to learn	Assumed	2.97	0.78	594.40	0.00*
Promptness in actions	Not Assumed	5.72	0.01	594.57	0.00*
Ability to understand	Not Assumed	3.00	0.00	593.37	0.00*
Innovative mindset/ Creativity	Not Assumed	4.50	0.00	596.34	0.00*
Interpreting contract documents	Not Assumed	34.00	0.02	596.47	0.00*
Knowledge of bidding procedures	Not Assumed	5.00	0.01	592.75	0.00*
Claims preparation and presentation Skills	Not Assumed	2.34	0.02	594.57	0.10
General computer proficiency	Not Assumed	7.87	0.03	594.45	0.00*
Proficiency in construction information technology	Assumed	2.40	0.64	593.47	0.00*
Knowledge of construction data analytics	Not Assumed	23.40	0.04	595.93	0.00*
Estimating	Not Assumed	23.40	0.04	595.93	0.00*
Knowledge of design	Not Assumed	2.35	0.03	595.42	0.00*
Forecasting	Assumed	1.78	0.07	595.70	0.00*
Quality assurance/ Total Quality Management	Assumed	12.00	0.09	597.44	0.00*
Cost control	Not Assumed	23.64	0.02	594.54	0.00*
Personnel/ Resource management	Not Assumed	2.68	0.00	593.61	0.00*
Financial management	Not Assumed	3.45	0.01	594.87	0.00*
Knowledge of environment impact assessments	Not Assumed	1.04.	0.01	595.53	0.00*
Appreciation of construction industry supply chain	Assumed	0.17	0.09	595.90	0.00*
Understanding global construction Environment	Assumed	12.00	0.87	570.40	0.00*
Willingness to travel (when required)	Not Assumed	8.65	0.00	592.76	0.00*
Knowledge of construction law and legal environment	Not Assumed	2.00	0.01	590.43	0.00*
Contract administration skills	Not Assumed	4.56	0.00	594.47	0.00*
Dispute avoidance and resolution skills	Assumed	2.67	0.08	593.60	0.00*
Claims preparation and presentation Skills	Not Assumed	2.34	0.02	594.57	0.00*

Knowledge of construction data analytics	Assumed	0.24	0.63	595.49	0.00*
Knowledge of Augmented/Virtual reality software applications in construction	Not Assumed	3.57	0.02	596.20	0.00*

Note. * = Independent t-test was statistically significant ($p < 0.05$)
Not assumed (Sig. ≤ 0.5) Assumed (Sig. > 0.5)

Independent t-test only tells us the significance or in-significance of differences among groups and does not explain the magnitude of differences (Cohen, 1992). Thus, to investigate the magnitude of differences among various attributes, the standardised measure of effect (Cohen's d) was examined. The value of Cohen's d enables us to interpret the criticality of the variance of various attributes by effect size (Cohen, 1992). Value of Cohen's d was maximum for proactive, whereas it came out minimum for pleasing personality. Independent t-test results supported hypothesis H1, confirming the perceived expectancy gap between students and practitioners for various skills attributes. Cohen's d formula is as follows:

$$d = \frac{M_1 - M_2}{SD_{pooled}}$$

Where M_1 is mean of group 1, M_2 is mean of group 2; SD_{pooled} is pooled standard deviations for the two groups. The formula for $SD_{pooled\ is}$:

$$SD_{pooled} = \sqrt{\frac{SD_1^2 - SD_2^2}{2}}$$

The SD_1^2 and SD_2^2 are the standard deviations for group 1 and group 2 respectively.

The independent t-test for factors revealed that the differences were significant with all the factors - personal attribute, technical skills, management skills, digital literacy skills, professional attributes, legal and contractual skills and industry and business skill. Value of Cohen's d was

maximum for personal skill and least for industry and business skill. Table 4.5 depicts the results of the independent t-test and Cohen's d for constructs. Independent t-test results support H2, establishing the perceived expectancy gap for various skills factors.

Table 4.5 Cohen's d of Group Constructs

Factors	Group	M	SD	SEM	t	DF	P	Cohen's d
Technical Skill	Professionals	4.24	0.61	0.037	11.43		.000*	0.91
	Students	4.03	0.53	0.029			.000*	
Professional Skill	Professionals	4.08	0.65	0.033	10.23		.000*	0.79
	Students	3.65	0.57	0.03			.000*	
Managerial Skill	Professionals	3.34	0.54	0.037	8.48		.000*	0.87
	Students	3.68	0.62	0.039			.000*	
Personal Skill	Professionals	3.84	0.63	0.039	12.72		.000*	0.94
	Students	3.52	0.61	0.035			.000*	
Industry and Business Skill	Professionals	3.78	0.65	0.039	7.33		.000*	0.64
	Students	3.52	0.64	0.035			.000*	
Legal and Contractual Skill	Professionals	3.51	0.68	0.036	6.72		.000*	0.68
	Students	3.48	0.65	0.033			.000*	
Digital literacy Skill	Professionals	3.75	0.65	0.035	10.37		.000*	0.86
	Students	3.65	0.62	0.034			.000*	

Note. * = Independent t-test was statistically significant ($p < 0.05$)

4.5.3 Effect of backgrounds on the importance of skills factors

4.5.3.1 Effect of practitioner's level of experience, and gender on perceived importance of skill factor

To delve into the notion of uniformity of covariance among the two groups with criteria of $p < .001$, the Box's test of equality of covariance was used. If the assumption of covariance matrices between Practitioners and Students for level of experience and gender of practitioners tends to be equal, then Box M value becomes insignificant. The most robust Pillai's trace for suggesting MANOVA results was measured since unequal size of groupings of respondents based on level of experience

and gender indicated violation of the assumption of the equal cell. Therefore, results from one-way MANOVA displayed non-significant difference in perception of importance of skillsets for the tested categories, thus level of experience, and gender. Table 4.6 below presents the results of MANOVA.

Table 4.6 One-way MANOVA-Practitioner's view

Effect	Box's test of equality		MANOVA tests		
	Box's M	Sig.	F statistics	Pillai's Trace	Sig.
Gender	44.568	0.001	1.195	0.027	0.240
Experience	94.17	0.002	0.857	0.068	0.264
*P < 0.001					

4.5.3.2 Effect of gender on perceived importance of skill factors amongst graduates.

For P < 0.001 indicates that the Box M value is non-significant and thus meets the notion of equal covariance matrix between the groups. With regards to gender, there is a breach of the assumption of equal cell size of the MANOVA test and hence, the need to opt for robust Pillai's Trace for the inference of the MANOVA results. Table 4.7 shows the results of one-way MANOVA that indicates the difference in the perception of importance of skillset variables was non-significant due to gender.

Table 4.7 Results of one-way MANOVA for students

Effect	Box's test of equality		MANOVA tests		
	Box's M	Sig.	F statistics	Pillai's Trace	Sig.
Gender	27.431	0.181	2.512	0.037	0.05
*P < 0.001					

4.6 DISCUSSION

To carry out the first objective thus identifying the desirable skillset and factors required of novice construction management professionals, a list of the desirable skillsets was generated through a comprehensive literature review.

To serve the second purpose of the research, i.e., determine the skill gap, we carried out an independent t-test on the responses received from students and practitioners. Hitherto, literature has either mentioned existing differences between teachers and professionals, or in-experienced and experienced professionals. The main reason for including students as one group was the fact that their acquired competency would be carried forward when they become novice professionals. While determining the difference in perception between the two groups for 63 properties out of 72, the t-test showed that the difference existed between the two groups for all seven factors named above. As far as team skill and personal traits are concerned, the study confirms their importance in line with previous studies (Woodward et al, 2010). The value of Cohen's d revealed that the maximum visible difference was for technical skills followed by professional skills, managerial skills, personal skills, digital skills, industry and business skills and legal and contractual skills.

Our next objective was to explore the impact of various backgrounds of respondents on skills perception. We studied the effect of different backgrounds of both groups on 7 factors of skillsets. Through the MANOVA test, we tested the effect of gender, and level of experience on perception towards skills. The obtained results showed no effect of any of the above backgrounds on perception towards skills. Our results are in contrast with prior studies suggesting differences in skills due to gender and experience level (Jamali et al., 2008; McMurtrey et al., 2008). The study is in line with earlier studies which stated that experience and gender do not affect the importance of skills (Al-Gahtani et al, 2007; Hopkins and Bilimoria, 2008). For students' data also, we applied

the MANOVA test to find out the effect of their background on 7 factors of skillsets. Results indicated that there was no difference in students' perception of skills due to gender (Lethbridge, 2000; Roberts, 2000; de Grandbois, 2013; Cimatti, 2016).

4.7 THEORETICAL IMPLICATIONS

The study makes at least three contributions to extant body of knowledge. First, it establishes the significance of skills by conducting a comprehensive survey of literature that is consistent with previous studies that emphasized the importance of skills (Aasheim et al., 2011; Matturro, 2013; Merhout et al, 2009; Moreno et al, 2012; Pinkowska et al., 2011). The study explored seventy-two vital skill attributes clustered in seven constructs. Second, findings of the independent t-test indicated the gap between technical graduates and practitioners for both attributes and factors related to the rating of required skills in novice construction professionals. The study endorses previous works of authors that confirm perceived skill expectancy gap among technical graduates and professionals (Abas-Masturaet al., 2013; Blom and Saeki, 2011; Jackson and Chapman, 2012; Radermacher and Walia, 2013; Sweeney, 2005). The test reported a significantly higher score of practitioners as compared to students in nearly all skill attributes and factors. These discrepancies do not only lie in the scores, but both groups ranked these attributes differently (Lee et al., 2002). The independent t-test shows a significant skill gap for all seven constructs.

Results showed personal skill as the most important skill. Among some variables under Personal attributes included time management, flexibility, promptness in action, innovative mindset etc. Even though mostly acquired through on-site practicing, Institutions of higher learning has found a way of inculcating these skillsets into students through their trainings. For instance, assignments and examinations for assessments are time bound and therefore teaches the students time

management skill. Again, students are given challenging problems which requires thinking outside the box in coming out with workable solutions hence been creative thinkers". Unlike other studies, this investigation is done to also examine the effect of background of respondents on perception towards skill factors. Thirdly. one-way MANOVA demonstrated uniformity in the perception of practitioners irrespective of gender or level of experience. For students, the test reported consistency across gender on perception of students towards skill factors.

4.8 PRACTICAL IMPLICATIONS

Empirically, this study emphasized the significance of desirable skillsets that positively influence the employment of novice construction professionals. The described features reflect desired traits in new entrants. The study recommends that these attributes and factors to be taken care of by all stakeholders such as institution of higher learning, development and training firms, students and industry practitioners and utilise them in their respective context.

These skillsets should therefore be intentionally imparted as part of the undergraduate courses thus helping students in developing the required attributes at early stages and exhibiting improved performance right from the beginning of employment (McMurtreyet al., 2008). Participation of students in skill development programmes with careful monitoring and redesigning of programme objectives by faculty members to suit the particular time, will go a long way in enhancing student's employability. Exchange programmes of students on a short-term between institutions or industry will also broaden their experience and help them develop into a better professional (Funes et al, 2018).

As a measure of employability, the extracted attributes and factors can be taken by the industry and used to assess job applicants accordingly. Instruments can be developed given the findings from this study to select candidates during interviews. In the designing of training and development programs, the study's findings could be referred to.

By the better knowledge of requisite skillsets, industries can be in the state of conveying their need to academia about their requirements, thus developing a better industry-academia partnership. A plethora of scholarly works have discovered that institutions of higher learning identify crucial skillset through responses from industry practitioners during internships. Therefore, industry-institution partnership is one of the best approaches for desirable skillset development among students (Rainsbury et al, 2002; Nangia and Pramanik, 2011; Pour et al, 2000; Wickramasinghe and Perera, 2010).

4.9 STUDY LIMITIONS AND RECOMMENDATION FOR FUTURE DIRECTION

This study is presented by certain boundaries which needs acknowledging although the results are comprehensive. To begin with, practitioners' sample were drawn from the top two (2) classification of construction firms in Ghana (D1 and D2 construction firms - based on financial turnover and size). With regards to samples collected from students, only final year students of programs related to construction engineering and management were selected. This implies some equally important groups were not selected which could have improved the overall results of the study. Furthermore, the sample size between the survey participants were uneven which could also lower the findings worth. The study however was also perception based which could be different from the actual. Hence the need for future research to revisit these limitations. Further research on

this area could include practitioners from other construction firms in addition to D1 and D2 firms used in this study. Student participants could also include other years of students not necessarily final year students, and this could provide a holistic picture of student's skillset requirements.

4.10 CONCLUSION

Results of empirical analysis suggest that soft skills attributes and factors are noteworthy dexterity for gaining employment in the field of AEC, especially in construction management. The attributes mentioned in the study reflect the essential characteristics of new entrants that can be taken as reference by the stakeholders such as education, training and development organisations, students and industries and can use in their respective context. In addition, the study indicated a notable skills gap between students' preparation and industry requirement. A solution to this problem is absolutely necessary to increase the employability of students. Study advocates finding and practicing new dimensions of skill development in the institutions by making necessary changes in the curriculum and ways of imparting education. Finally, the authors of the manuscript believed in structured mapping of skill traits through this study. A strong partnership between academia and industry is the key to bridging the skill gap.

CHAPTER FIVE [5]

CRITICAL PERSPECTIVES ON TRADITIONAL INSTRUCTIONAL METHODS VULNERABILITIES AFFECTING CONSTRUCTION MANAGEMENT EDUCATION

5.1 INTRODUCTION

Instructional methods according to Akdemir and Koszalka (2008) can be referred to as activities that instructors adopt that engages learners in the process of learning. Learning styles on one hand has to deal with the integration of learners' motivation, perceptions, information processing and activity engagement (Aragon et al., 2002). On the other hand, various forms of instructional strategies should therefore be employed so as to engage different learners in different ways as individual learners have varying preference with regards to reception of information. For instance, Meyer (2003) posits that the traditional lecture format is characterized by direct and simple explanations whiles Akdemir and Koszalka (2008) postulates that group-discussion instructional method combines collaborative efforts of individual learners in arriving at a common understanding.

In construction management education for instance, the traditional instructional method has been criticized as inadequate in the provision of students with all the desirable skills and knowledge in an efficient manner (Vian et al. 2007; Park et al. 2003). This according to Felder and Silverman (1988) could be attributed to the differences between the teaching and learning styles of lecturers and most students respectively

5.2 LITERATURE REVIEW

Within the university setting, lecture is arguably the oldest instructional method as it has become indispensable part of teaching that has received considerable favor from universities

the world over (Omelicheva and Avdeyeva, 2008). Lectures are efficient in dealing with large chunks of materials in a faster manner which can be adapted to suit the needs of the audience (McKeachie 1969). Furthermore, lectures are less costly in the sense that one instructor can teach a large student group. The strength of Lecture thus "fast teaching and learning," also presents as one of its major weaknesses as this type of presentation leaves little room for fostering important intellectual virtues (Paul 1999). According to Nandi et al. (2000), the only learning outcome that has been ascribed to lecture is the transfer of basic knowledge or the memorization of information that is that lecture is an effective method to disseminate factual knowledge.

Recently, the presence of active instructional techniques has rendered the traditional instructional methods incapable of fostering higher order attitudinal and cognitive goals (Cashin 1985; Renner 1993; Frederick 1999). This can also be attributed to the efforts been made by active instructional techniques that provides students with an opportunity to interact, talk meaningfully, read, write as well as reflect on issues and ideas of an academic subject (Meyers and Jones 1993). Lectures also do not excel in fostering the skills of application, evaluation and analysis. Students are considered passive learners in a lecture class and are involved in extensive note taking. This format of instruction enhances students' ability to memorize and reproduce the presented information directly without examining and analyzing it. Table 5.1 below presents the issues with the traditional instructional strategies hence the need for active instructional methods.

Table 5.1: Issues with Traditional Teaching and Learning (Instructional) Method

Code	Issues with Traditional Teaching and Learning (Instructional) Method	Source
B1	Speed teaching and learning leaving little room for fostering important intellectual virtues	Paul 1999
B2	Ineffectiveness as a method for student learning	Mariya and Olga 2008
B3	Inability to foster higher order cognitive and attitudinal goals	Cashin 1985, Day, 1980, Frederick 1999, Renner 1993
B4	Short term memorization of content/information	Green and Dorn 1999, Nandi et al. 2000
B5	Maximum control overflow of information by lecturers	Mariya and Olga 2008
B6	Low student engagement (often seen taken notes)	Renner 1993, Ruyle 1995
B7	Inability to foster the skills of application, analysis and evaluation	Mariya and Olga 2008
B8	Lecture experiences are boring and sometimes irrelevant	Renner 1993, Nandi et al. 2000
B9	Influence of educational tradition	Bonwell and Eison 1991
B10	Lack of needed materials or resources	Bonwell and Eison 1991
B11	Poor interpersonal skills	Prince, 2004
B12	Increase course failure	Prince, 2004, Freeman et al. (2014)
B13	Low level of student achievement	Kuh, O'Donnell, and Schneider, 2017

5.3 RESEARCH DESIGN

Primary data via questionnaire survey was the instrument used to solicit opinion of respondents on the subject matter since the study focused solely on students' views. This type of data gives room for valid and reliable information given a relatively shorter period of data collection at a reasonable cost (Ameyaw et al. 2017). Another reason for using this survey approach was anonymity and confidentiality of data, as depicted in Lam et al. (2016) on effectiveness of instructional strategies for construction management graduates in Hong Kong and Zou et al. (2003) to measure construction management students' perception of e-learning in courses offered in Australia. Prior to the survey distribution, a comprehensive review was conducted to reveal the variables as encapsulated in the questionnaire. The questionnaire was left open ended to solicit any known variables not captured in the literature review. The respondents were asked the rate the identified barriers on a 5-point grading scale system from 1 (not severe) to 5 (very severe) (Landry et al. 2006).

5.3.1 Survey Participant

Final year undergraduate students enrolled in construction management (CM) related programs such as CM, Building Engineering and Management and Quantity Surveying were selected as the subjects of the research. A total of 157 valid responses were deemed suitable at the end of the survey pending data processing after checking and making good any discrepancies which will affect the data. Background information of the respondents are presented in Table 5.2. The 157 respondents came from Ghana and Hong Kong as depicted in the study's focus. As ongoing research, the focus is on the geoeconomics scopes of these two contexts thus representing the developing and the developed economies respectively. The number of received responses was suitable and adequate after conducting important pretests for further analysis.

Table 5.2: Background information of the respondents

	Overall		**Hong Kong**		**Ghana**	
Category	No. of respondents	Relative frequency	No. of respondents	Relative frequency	No. of respondents	Relative frequency
Male	117	74.1	22	66.7	95	76.0
Female	40	25.9	11	33.3	29	24.0
Total	157	100.0	33	100.0	124	100.0
Secondary	8	4.9	6	18.2	2	1.6
Diploma	35	22.2	14	42.4	21	17.1
HND	6	4.3	1	3.0	5	4.7
Associate degree	108	68.6	12	36.4	96	76.7
Total	157	100.0	33	100.0	124	100.0
Yes	135	85.2	30	90.9	105	83.7
No	22	14.8	3	9.1	19	16.3
Total	157	100.0	33	100.0	124	100.0
No experience	42	26.6	12	36.4	30	24.0
1-5 years	96	60.5	21	63.6	75	59.7
6-10 years	14	9.9	-	-	14	12.4
11-15 years	4	3.0	-	-	4	3.9
Total	157	100.0	33	100.0	124	100.0

5.4 DATA ANALYSIS AND RESULTS

5.4.1 Contextual Disparities Test

As a nonparametric technique, the Mann-Whitney U test is widely adopted in the assessment of significant difference between two distinct samples independent of each other (Osei-Kyei and Chan 2017). In classes of twos, significant differences have been determined on several topics of interest in construction management-related studies in diverse context using this statistical tool (Chan et al. 2017). Therefore, the Mann-Whitney U test was used to determine the statically significant disparities with respect to the critical traditional instructional methods vulnerabilities in the two regional contexts as in this study. This statistical technique's flexibility extends to cover uneven groups of respondents (Darko et al. 2017).

The null hypothesis is therefore presented as "there exist no statistically significant difference in the level of criticality of vulnerabilities between the two contexts". This implies that for the null hypothesis to be rejected, individual significance levels must exceed the critical alpha value of (0.05). Presented in Table 5.3 below is the test results for the identical comparisons of the variables.

Table 5.3: Identical comparisons of the variables

	Overall				Hong Kong				Ghana				Mann-Whitney U test statistics			
Code	Mean	SD	*p*-value	Rank	Mean	SD	Rank	*N*-value	Mean	SD	Rank	*N*-value	U stat	*W*	*Z*	*p-value*
B1	3.77	0.84	0.000	4	3.59	0.87	5	0.53	3.71	0.75	6	0.35	385.500	685.500	-0.931	0.352
B2	3.46	0.87	0.000	10	3.92	0.98	1	0.64	3.33	0.82	13	0.44	373.000	673.000	-1.113	0.266
B3	3.48	1.03	0.000	9	3.59	0.90	6	0.53	3.42	1.02	11	0.60	409.000	709.000	-0.543	0.587
B4	3.87	1.01	0.000	1	3.68	1.06	3	0.56	3.67	1.01	8	0.67	351.500	651.500	-1.438	0.15
B5	3.66	1.02	0.000	6	3.51	1.10	7	0.50	3.88	0.90	5	0.63	369.500	1072.500	-1.151	0.25
B6	3.77	1.04	0.000	5	3.51	1.12	8	0.50	4.04	1.00	3	0.76	333.500	1036.500	-1.727	0.084
B7	3.84	0.97	0.000	2	3.62	0.92	4	0.54	4.08	0.83	2	0.69	349.500	1052.500	-1.494	0.135
B8	3.79	0.88	0.000	3	3.7	1.05	2	0.57	3.67	0.76	7	0.33	368.000	668.000	-1.191	0.234
B9	3.64	0.88	0.000	7	3.22	0.89	11	0.41	3.96	0.81	4	0.48	314.000	1017.000	-2.052	0.04
B10*	3.62	1.16	0.000	8	3.22	1.16	12	0.56	4.17	0.87	1	0.58	257.000	960.000	-2.859	0.004
B11	3.26	1.14	0.000	11	3.24	1.14	9	0.56	3.63	1.13	9	0.54	315.000	1018.000	-1.977	0.048
B12	3.21	1.11	0.000	12	3.24	1.14	10	0.41	3.42	1.10	12	0.60	356.500	1059.500	-1.343	0.179
B13	3.2	1.24	0.000	13	3.19	1.20	13	0.55	3.46	1.25	10	0.61	360.500	1063.500	-1.266	0.206

Cronbach's alpha (Overall=0.886), (Developed=0.914), (Developing=0.918)

Subjected to statistical analyses such as exploratory factor analysis (EFA) and reliability analysis, the returned valid questionnaires were analyzed using the Statistical Package for the Social Sciences (SPSS) Statistics 26. With the aid of SPSS Amos 25 analytical software package, the relationship between the observed issues and student's perception of learning effectiveness was identified.

5.4.2 Reliability Analysis

The 13 variables after been rated by the students were checked for reliability testing. Attaining a scale of 0.954, the overall Cronbach's alpha indicated an acceptable internal consistency and reliability of the dataset. Acceptable values for alpha ranges from 0.70 to 0.95, with 1.00 as a perfect reliability as recommended by Tavakol and Dennick (2011).

5.4.3 Exploratory Factor Analysis (EFA)

To obtain a reasonable and smaller number of factors, the variables identified were consolidated using the EFA (Landry et al. 2006). Varimax rotation coupled with principal axis factoring was utilized as they provided a clear dimensionality of the variables and a better interpretation of factor loadings (Chinda and Mohamed 2008). According to Yang et al. (2009) the threshold of correlation values among the variables must be greater than 0.3 for the data to be considered as suitable for further analysis. All the variables exceeding the threshold limit hence suitable for EFA to be conducted (for the purpose of manuscript brevity, this was not shown).

To ascertain the appropriateness of EFA for factor extraction, the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were conducted. The value of the KMO statistic for this study is 0.670, which satisfies the condition for factor analysis as it was greater than the threshold of 0.5 (Chan 2012). For the Bartlett's test of sphericity to be significant the value of $p < 0.05$ is required (Williams et al. 2012). Weak variables needed to be screened out of the construct and as such a

cut-off of 0.5 factor loading was employed. Hair et al. (2010) postulates that loadings of 0.3-0.4 are minimally accepted. All the 13 variables were retained as the factor loadings were above 0.5. To extract a manageable number of factors, "eigenvalues greater than 1" was used, leading to extraction of four factors as shown in Table 5.4, accounting for 84.26% of the 13 variables (Yang et al. 2009).

The factor structure gave rise to four factors which was used as a baseline model for further analysis. The four factors were therefore labelled based on the variable with most influence as depicted by value as shown in Table 3 below. Hence interpreted as follows:

Factor 1 = Teacher-led approach

Factor 2 = Curricular barrier

Factor 3 = Poor lecturer-student relationship

Factor 4 = Resistance to change

Table 5.4: Factor Extractions

Code.	Observed variables	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1					
B4	Short term memorization of content/information	0.613	0.204	0.444	-0.523
B1	Speed teaching and learning leaving little room for fostering important intellectual virtues	0.835	0.150	0.124	0.364
B5	Maximum control overflow of information by lecturers	0.747	-0.472	0.206	0.180
Factor 2					
B3	Inability to foster higher order cognitive and attitudinal goals	0.060	0.688	0.094	0.601
B12	Increase course failure	0.038	0.842	-0.303	0.165
B13	Low level of student achievement	0.285	0.756	-0.504	0.068
B2	Ineffectiveness as a method for student learning	0.382	0.802	0.195	0.017

Factor 3					
B8	Lecture experiences are boring and sometimes irrelevant	0.326	-0.164	0.830	-0.156
B6	Low student engagement (often seen taken notes)	0.029	-0.314	0.789	0.267
B11	Poor interpersonal skills	-0.171	0.106	0.877	-0.240
B7	Inability to foster the skills of application, analysis and evaluation	-0.083	-0.844	0.425	0.051
Factor 4					
B9	Influence of educational tradition	0.509	0.058	0.280	0.575-
B10	Lack of needed materials or resources	-0.044	0.474	-0.214	0.758
Eigenvalue		5.806	2.308	1.729	1.111
Percentage of variance explained		44.660	17.755	13.298	8.548
Cumulative variance		44.660	62.415	75.713	84.261

5.4.4 Structural Equation Model (SEM)

As a combination of multiple regression and exploratory factor analysis, SEM determines the relationship among latent variables (Ullman 2001) and hence preferred to confirmatory factor analysis (CFA) (Schreiber et al, 2006). Unlike SEM, path analysis fails to directly observe most variables as is the case with most education research (Schreiber et al, 2006). For example, defining latent variable such as "learning Impact" is complex and as such requires the use of multiple indicators to reflect its meaning, an impractical step in path analysis. Hence the consideration of SEM as a suitable analysis to measure the extent of relationships between the latent variables. Presented below are the two components of the SEM, thus structural models and measurement.

5.4.4.1 Structural Model

To test the relationship between latent variables, the structural model is employed (Doloi et al. 2012). To test for the goodness of fit, the following were computed, the hypothesized baseline model, the first-order factors (F1 to F4) and second-order factors and the student's perception of

the impact on learning (ImpLearning) proposed in this study. Hence the structural model hinted on the relationship between the four first-order latent variables and the second-order latent variable. A look at the overall traditional instructional issues reveals factors 2 and 3 consisting of four observed variables with variables B2 and B11 having the strongest standardized path coefficients of 0.74 and 0.83 respectively. Similarly, factor 1 is made of three measured variables with B4 having the strongest standardized path coefficient of 0.84. likewise, factor 4 consist of two observed variables with variable B9 having the strongest standardized path coefficient of 0.91. The results depict contributions made by the various variables towards their respective issues and thus all four issues in the first-order factor level have significant relationship with impact on learning (ImpLearning). The standardized factor loadings between ImpLearning and factors 1, 2, 3 and 4 were 0.86, 0.56, 0.34 and 0.75 respectively, implying factor 1 having the highest significance with student's perceived impact on learning, followed by factors 4, 2 and 3 (figure 5.1).

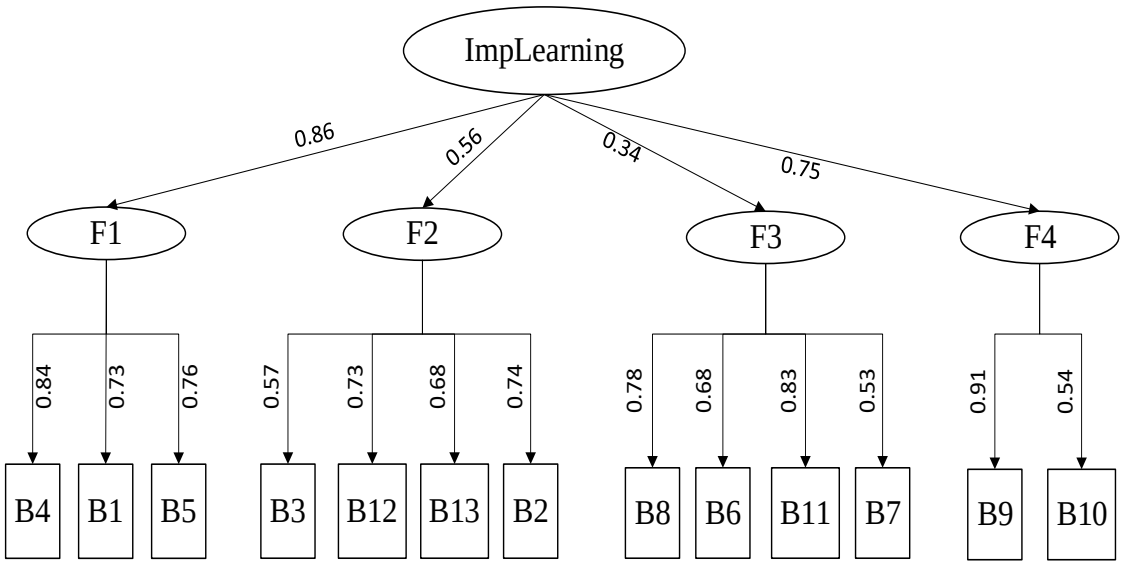

Figure 5.1. Traditional Instructional Methods Vulnerabilities model

5.4.4.2 Measurement Model

According to (Chinda and Mohamed, 2008; Doloi et al., 2012) measurement model relates observed (exogenous) variables to unobserved (latent) variables by testing their reliability and validity. Observed variables are labelled B1 to B13 which are grouped and labelled F1 to F4. Commonly referred to as confirmatory factor analysis (CFA), this is the measurement component of SEM. In this study, SEM was performed with the aid of Amos 23.0 statistical software. SEM has been used in a study by Landry et al. (2006) to measure student perceptions of Blackboard which is an e-learning platform. SEM was used to determine the inter-relationship among the variables and to avoid excessive multi-collinearity that could arise when other techniques such as multiple regressions are used (Chinda and Mohamed 2008).

To generate a relatively accurate model, certain goodness-of-fit (GOF) measures must be satisfied (Table 5.5). A value between 1 and 2 for the ratio, degree of freedom (x2=DF) and a value between 0 and 1 for the goodness-of-fit index (GFI) are indicators of an acceptable fit to the model. The root mean square error of approximation (RMSEA) value of 0.10 falls within the threshold of model acceptance. The comparative fit index (CFI), Tucker-Lewis index (TLI), normal fit index (NFI) and incremental fit index (IFI), as shown in Table 5.5, also indicate the acceptance of the fit between the measurement model and the data (Molenaar et al. 2000).

This means that the groupings F1—F4 are considered appropriate. Checking the significance levels of discrepancies between the proposed and estimated models, it was revealed that a large residual covariance existed between constructs F1 and F3 and measured variables B11 and B4 respectively. Therefore, B11 and B4 were subsequently omitted from further analyses due to a significant standardized residual covariance with an absolute value greater than 0.4 as suggested by Arbuckle (2009).

Table 5.5. Results of GOF Measures (Adapted from Lam et al. 2016)

GOF index	Recommended level of GOF measure	Baseline model	Final SEM
X^2/DF	1 to 2	1.76	1.62
GFI	0 (no fit)–1 (perfect fit)	0.68	0.77
RMSEA	<0.05 (very good)–0.1 (threshold)	0.12	0.10
CFI	0 (no fit)–1 (perfect fit)	0.74	0.86
TLI	0 (no fit)–1 (perfect fit)	0.71	0.82
NFI	0 (no fit)–1 (perfect fit)	0.62	0.69
IFI	0 (no fit)–1 (perfect fit)	0.77	0.89

Notes: CFI = comparative fit index; DF = degree of freedom; GFI = goodness-of-fit index; GOF = goodness of fit; IFI = incremental fit index; NFI = normal fit index; RMSEA = root-mean square error of approximation; SEM = structural equation model; TLI = Tucker–Lewis index

A summary of the model's coefficients of determination (R^2) are represented in Table 5.6. The results revealed positive coefficients of all paths, being statistically significant at $p < 0.05$, indicating that the convergent validity was achieved (Hon et al. 2013). A good convergent validity of the model was further confirmed by Hair et al. (2010) with a threshold value of 0.25 and the values of R^2 obtained in the analysis are up to 0.840. The strength of the measurement model can be established by carrying out Cronbach's reliability test (Jin et al. 2007). The results of Cronbach's alpha (Table 5.6) indicate a high degree of reliability of all the four constructs because all the values are above the recommended cutoff value of 0.70 (Tavakol and Dennick 2011)

Table 5.6. Results of Measurement Model

Regression Path	Factor	R^2	Cronbach's alpha (α)
B4	1	0.411	0.846
B1	1	0.828	
B5	1	0.576	
B3	2	0.660	0.792
B12	2	0.549	
B13	2	0.269	
B2	2	0.470	
B8	3	0.320	0.756
B6	3	0.534	

B11	3	0.422	
B7	3	0.840	
B9	4	0.263	0.781
B10	4	0.640	

5.5 DISCUSSION OF RESULTS

In addressing the objectives of this study, thirteen traditional instructional methods vulnerabilities were identified from literature and were combined into four major constructs. The relationship between the four constructs and students' perceptions of impact on learning was equally tested and discussed. The following section discusses further the Traditional Instructional Methods Vulnerabilities.

5.5.1 Factor 1 (Teacher-led approach)

Composed of three (3) variables, teacher-led approach had lecturers playing active role in the dissemination of course content to students who only served as passive listeners. This construct had the third highest overall mean score of 3.75. The three variables with their respective mean values are as follows: Speed teaching and learning with little room to foster important intellectual virtues (3.71), Short term memorization of content/information (3.67), and Maximum control overflow of information by lecturers (3.88).

In agreement with Blumenfeld (1991) studies, the students were of the view that better understanding of a course content may lead to effective learning instead of the chew, pour, pass and forget routine and hence lecturer may design tasks broken down to their level for easy participation and understanding.

5.5.2 Factor 2 (Curricular barrier)

In curricular barrier, the ability to be abreast with industrial offerings were lacking. Among the variables under this construct includes inability to foster higher order cognitive and attitudinal goals, increase course failure, low level of student achievement and ineffectiveness as a method for student learning. With an overall mean value of 3.41, this construct was ranked fourth. It should be noted that students learning abilities are greatly impaired if content in the curricular are not up to par with industrial demands.

This assertion is consistent with Vian et al. (2007)'s study on "A generic framework for the development of standardized learning objects within the discipline of construction management" where students' complain of the insufficiency of knowledge with only the usual traditional instructional methods of teaching and learning.

5.5.3 Factor 3 (Poor Lecturer-student relationship)

In this study, poor lecturer-student relationship refers to low engagement of students with lecturers where they are often seen only taken notes. Lecture experiences are boring and sometimes irrelevant, low student engagement (often seen taken notes), poor interpersonal skills and inability to foster the skills of application, analysis and evaluation were the four factors under this construct with mean values of 3.67, 4.04, 3.63 and 4.08 respectively. With an overall mean value of 3.86 poor lecturer-student relationship was the construct which was ranked second. This supports the assertion that once communication between a student and his/her teacher breaks down, the learning prowess of the student suffers and hence his/her poor performance at work as well.

5.5.4 Factor 4 (Resistance to change)

Influence of educational tradition and lack of needed materials or resources were the only variables under the resistance to change construct. With an overall mean of 4.06, resistance to change was

ranked 1st.Over reliance of the already inadequate resources first and foremost puts much pressure on these resources. The COVID-19 period exposed this phenomenon resulting in the breakdown of the already existing resources and hence leading to academic calendar displacement.

CHAPTER SIX

EFFECTIVENESS OF ACTIVE INSTRUCTIONAL STRATEGIES FOR NOVICE CONSTRUCTION PROFESSIONALS

6.1 INTRODUCTION

Not until recently, construction education has most of the times utilised traditional methods especially in teaching of relevant skills and industrial knowledge. This has however been criticized as not being sufficient in the provision of the requisite knowledge and skills to students in an effective manner (Vian et al., 2007; Park et al., 2003). As posited by Felder and Silverman (1988) and Katsioloudis and Fantz (2012), as a contribution towards this insufficiency is the incompatibility between teaching techniques of lecturers in this field and learning styles of most students. Content of various engineering-related curricula although many promoting integrated approach to teaching and learning, was however deemed insufficient in promoting the learning of students (Cotgrave and Alkhaddar, 2006).

According to Kim et al. (2002), not only is construction course content important but also the choice of proper learning and teaching styles drives home the inculcation of desired skillset in students. Current generation of students are more concerned with strategies that will aid in solving real-world challenges in their work environment (Frank, 2005). There is therefore the need to reach a balance between the approaches used by teachers as well as student-centred learning approaches so as to reach a state where there is active participation in both teaching and learning activities.

The focus here is to enhance students learning experience by way of assessing their perception of various learning strategies. Commonly used instructional methods in construction management

and engineering related programs were identified and their influence on student's learning highlighted. This will help boost lecturers' knowledge with regards to the effective instructional method to equipping students with the desirable skillset as the most suitable strategies to promote effective learning will be identified.

6.2 REVIEW OF RELEVANT LITERATURE

According to Akdemir and Koszalka (2008), instructional strategies refer to activities used in engaging students in the process of learning. Learning styles incorporates various processes such as activity engagement, learner's motivation, and processing of information and skills (Aragon et al. 2002). That is to say various forms of instructional strategies are employed to suit particular audience since every student has varying preference with regards to information reception so as to engage all learners. Traditional lecture system a form of expository strategy makes use of direct and simple explanation whereas group-discussion strategy has to do with individual learners collaborating in the process of analyzing, evaluating and synthesizing ideas to reach a common understanding (Akdemir and Koszalka, 2008).

Many scholarly works have asserted that students or learners are impacted differently when different learning styles are employed and hence the need for instructors or lecturers to use different strategies to accommodate the individual differences (Lovelace 2005; Favre 2007; SheaDoolan 2004). The findings from Nelson et al. (2015) sharing similar recommendation with Fine's (2003) study revealed that using only one indicator as course grades to quantify engineering students' engagement in class lessons proved difficult and thus recommended that lecturers deal with the so-called one-size-fits-all approach by making modifications to classroom settings and

their instructional approach. Thus, lecturers must make use of strategies that best matches with the learners' strength to increase their academic performance and attitude towards desirable skillset acquisition and development.

Students naturally and systematically after recognizing how best they learn, adjust and devise strategies that enhances their learning (Geiser, 1998). As posited by Rohrer and Pashler (2010), giving students the opportunity to review what they learnt improves learning as well as retention of what was learnt. With limited numbers of educators having trained in effective implementation of innovative teaching styles, the response to addressing individual learners' differences becomes difficult (Dunn et al. 2009). Good teaching should however have a blend of mixed instructional strategies for overall learning goals to be realized (Valiathan, 2002).

Many scholars have approved on novel pedagogies such as inverted/flipped classroom, problem-based learning (PBL), service learning, peer-reviewing, vertical integration etc. (Mason and Davis 2013; El-adaway, Pierrakos and Truax 2014), as the way to meet future desirable skill need. In an effort to place a quantity on students' preferred learning strategies, Lam et al. (2015) derived twenty-two diverse active instructional strategies having the potential to improve the learning performance of students. Table 6.1 below depicts the active instructional strategies as found from literature.

Table 6.1: Active Instructional Strategies (AIS)

No	Active Instructional Strategies (AIS)	Source
1	Using case study method teaching	Levin (1995)
2	Making use of in-class contests	Rohrer and Pashler (2010), Attle and Baker (2007)
3	Tutorial	Valiathan (2002), Dolmans et al. (2001)
4	Effective guest speaker's invitation	Mullins (2001)
5	Employing classroom demonstrations	Felder and Silverman (1988)

6	Group discussion	Felder and Silverman (1988), Akdemir and Koszalka (2008)
7	Lecture	Felder and Silverman (1988), Meyer (2003), Akdemir and Koszalka (2008)
8	Embarking on field trips (real, simulated or virtual)	Akdemir and Koszalka (2008), DeWitt and Storksdieck (2008)
9	Having short student presentations	Michlitscha and Sidleb (2002)
10	Integrating website use into course assignments	Hotchkiss (2002), Sims (2003)
11	Associating course content to current events	Meyer (2003)
12	Using Wiki	Valiathan (2002), Cole (2009)
13	Using popular video vignettes and films to stimulate critical thinking	Fine (2003), Krammer et al. (2006)
14	Using advanced online teaching tool (e.g., Blackboard)	Sims (2003), Landry et al. (2006)
15	Conducting experiments	Krammer et al. (2006)
16	Use of Laboratories and observations	Krammer et al. (2006)
17	Simulations	DeWitt and Storksdieck (2008)
18	Using cooperative learning strategies such as interleaving	Slavin (1996), Rohrer and Pashler (2010)
19	Using mobile live video learning system	Fine (2003), Ullrich et al. (2010)
20	Humor creation in class lectures	Valiathan (2002), Chabeli (2008)
21	Using blogs to support teaching and learning	Churchill (2009)
22	Employing in-class role plays by students	Aubusson et al. (1997)
23	Presenting brainstorming questions	Case (2005)
24	Creating classroom versions of television game shows	Rosas et al. (2003)
25	Assigning short in-class writings	Leki (1995)

6.3 RESEARCH METHODOLOGY

Through the distribution of questionnaire survey, data was gathered from final year undergraduate students enrolled in construction management and engineering related programs in University and Polytechnics in Ghana. This study focused mainly on students' opinion on active instructional

strategies to enhance their learning hence the suitability of the questionnaire survey. Time constraint prevented this study from inclusion of industry practitioners, employers and teachers and hence the focus on only CM students in their graduating year. Highlighted were 25 instructional strategies identified from extant literature review. Respondents were asked to rate each strategy on a five-point Likert scale in which 5 represents very high learning effectiveness and 1 signifying very low learning effectiveness. Out of 182 distributed questionnaires, 124 valid responses were retrieved. It must be noted that participation in this study was voluntary, and confidentiality was assured of their responses.

6.3.1 Reliability Analysis

According to Tavakol and Dennick (2011), the recommended acceptable values for Cronbach's alpha ranges from 0.70 to 0.95, with 1.00 indicating a perfectly consistent dataset. The collated data was finally subjected to reliability analysis to check for the consistency of the dataset. The overall Cronbach's alpha was 0.939, signifying an acceptable internal reliability.

6.3.2 Exploratory Factor Analysis (EFA)

To consolidate the number of variables into smaller and reasonable number of factors, the exploratory factor analysis was used (Landry et al. 2006). The varimax rotated and principal axis factoring were used to get a better interpretation of factor loadings. The data was checked for suitability of EFA thus correlation values be greater than 0.30 (Yang et al., 2009). The correlation of all the 25 variables were greater than the recommended threshold of 0.30 indicating data suitability for further EFA.

To ascertain the appropriateness for factor extraction, Kaiser-Meyer-Olkin (KMO) should not be below 0.5 (Chan, 2012). The statistical value of KMO was 0.766 as shown in Table 6.2 below satisfying the underlying condition for factor analysis. The Bartlett's test of sphericity was conducted and was deemed significant ($p < 0.05$) (Williams et al, 2012).

Table 6.2: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.766
Bartlett's Test of Sphericity	Approx. Chi-Square	1278.073
	df	300
	Sig.	.000

To strengthen the data to be used in the analysis, screening was done to eliminate any weak indicators of factors/constructs with a cut-off of 0.4 factor loading was used. According to Hair et al. (2010), 0.3–0.4 loadings are minimally accepted. All the variables were retained for further analysis as all their factor loadings were above 0.4. To extract a manageable number of factors, "eigenvalues greater than 1" (Yang et al. 2009) was used, leading to extraction of six factors, accounting for 70.417% of the 25 variables as shown in Table 6.3.

The six constructs therefore formed the factor structure/baseline model as presented in Table 6.3. The influential factors constituted to the constructs labelling as interpreted as follows:

Construct 1 = Activity-based instructional strategy
Construct 2 = Traditional instructional strategy (Passive)
Construct 3 = Relational Instructional strategy
Construct 4 = Technology-oriented instructional strategy
Construct 5 = Student-based instructional strategy (Active)
Construct 6 = Competitive based instructional strategy

Table 6.3: Result of Factor Analysis

Observed Variables		Construct 1	Construct 2	Construct 3	Construct 4	Construct 5	Construct 6
Construct 1							
8	Embarking on field trips (real, simulated or virtual)	0.740	0.060	0.182	0.159	0.182	0.066
11	Associating course content to current events	0.737	0.155	-0.004	0.271	0.269	-0.012
15	Conducting experiments	0.828	0.105	0.150	0.233	0.088	-0.030
16	Use of Laboratories and observations	0.799	0.086	0.253	-0.088	0.068	-0.060
17	Simulations	0.777	0.035	0.285	-0.037	-0.009	0.113
Construct 2							
3	Tutorial	0.212	0.735	-0.043	0.348	0.129	0.125
6	Group discussion	-0.002	0.556	0.219	0.316	0.377	-0.002
7	Using advanced online teaching tool (e.g., Blackboard)	0.011	0.693	0.204	0.252	0.102	0.097
12	Using Wiki	0.052	0.740	-0.050	0.076	0.227	0.137
22	Employing in-class role plays by students	0.314	0.539	0.489	-0.181	0.206	-0.029
23	Integrating website use into course assignments	0.173	0.587	0.567	0.267	0.080	0.037
Construct 3							
18	Using cooperative learning strategies such as interleaving	0.404	-0.120	0.643	0.155	0.144	0.088
20	Humor creation in class lectures	0.127	-0.053	0.646	0.164	0.151	0.043
21	Using blogs to support teaching and learning	0.130	0.416	0.585	0.460	0.057	0.031
24	Creating classroom versions of television game shows	0.252	0.240	0.745	0.063	0.023	0.133
25	Assigning short in-class writings	0.248	0.295	0.450	0.294	0.274	0.048
Construct 4							
1	Using case study method teaching	0.416	0.412	0.018	0.674	0.071	0.050
13	Using popular video vignettes and films to stimulate critical thinking	0.101	0.074	0.394	0.712	0.251	0.174
14	Lecture	0.088	0.331	0.160	0.819	0.137	0.085
19	Using mobile live video learning system	0.099	0.392	0.403	0.511	0.123	0.339

Construct 5							
4	Effective guest speaker's invitation	0.125	0.129	0.202	0.042	0.793	0.242
5	Employing classroom demonstrations	0.311	0.232	0.363	0.032	0.431	0.293
9	Having short student presentations	0.139	0.372	0.299	0.390	0.650	-0.316
10	Presenting brainstorming questions	0.251	0.287	0.000	0.205	0.627	-0.013
Construct 6							
2	Making use of in-class contests	0.009	0.345	0.253	0.322	0.173	0.787
Eigenvalue		10.326	3.049	1.926	1.534	1.382	1.007
Percentage of variance explained		40.164	11.030	6.396	5.095	4.403	3.330
Cumulative variance		40.164	51.194	57.590	62.684	67.088	70.417

Table 6.4: Ranking of Instructional Strategies

Learning Instructional Strategies		**Overall Rank**	**Mean**	**Std. Dev.**	**Construct Rank**
Activity-based strategy		1st	4.17		
8	Embarking on field trips (real, simulated or virtual)	1st	4.3115	0.8473	1st
11	Associating course content to current events	2nd	4.2459	0.7451	2nd
15	Conducting experiments	4th	4.1311	0.7632	3rd
16	Use of Laboratories and observations	6th	4.0328	0.9995	5th
17	Simulations	5th	4.1148	0.7094	4th
Traditional Strategy		**4th**	**3.724**		
3	Tutorial	11th	3.8525	0.9458	2nd
6	Group discussion	17th	3.7377	1.1240	4th
7	Lecture	12th	3.8525	1.0620	3rd
12	Using Wiki	25th	3.4262	1.0717	6th
22	Employing in-class role plays by students	20th	3.6066	1.11473	5th
10	Presenting brainstorming questions	10th	3.8689	0.88460	1st
Relational Strategy		**6th**	**3.64**		
18	Using cooperative learning strategies such as interleaving	13th	3.8197	0.80640	1st
20	Humor creation in class lectures	15th	3.7869	0.95070	2nd
21	Using blogs to support teaching and learning	24th	3.4590	0.97594	5th
24	Creating classroom versions of television game shows	19th	3.6230	0.91586	3rd
25	Assigning short in-class writings	22nd	3.5246	1.07404	4th

Technology-oriented strategy		**2nd**	**3.93**		
1	Using case study method teaching	3rd	4.2131	0.83894	1st
13	Using popular video vignettes and films to stimulate critical thinking	7th	4.0164	0.82647	2nd
14	Using advanced online teaching tool (e.g., Blackboard)	8th	3.9672	1.06407	3rd
19	Using mobile live video learning system	21st	3.5410	1.10414	4th
Student-centered strategy		**3rd**	**3.75**		
4	Effective guest speaker's invitation	15th	3.7869	0.95070	3rd
5	Employing classroom demonstrations	9th	3.9016	1.04411	1st
9	Having short student presentations	14th	3.8033	0.94551	2nd
23	Integrating website use into course assignments	23rd	3.5082	1.04280	4th
Competition based strategy		**5th**	**3.721**		
2	Making use of in-class contests	18th	3.7213	0.96835	1st

6.4 DISCUSSION

With the aid of principal component analysis, the twenty-five (25) identified learning instructional strategies from literature were clustered into six major constructs The mean and standard deviation of the constructs with their variables were computed aiding the ranking with regards to the highly effective strategies to promote learning and hence produce professionals for the industry. The following section discusses further the students' perception of effective learning strategies.

6.4.1 Construct 1 (Activity-based instructional strategy)

Composed of five (5) factors, activity-based instructional strategy has students being engaged in activities as a learning process instead of the passive talking mode in a typical lecture setting. This construct had the highest overall mean score of 4.17 and four (4) of its factors were among the overall top five factors for effective teaching and learning. The five factors with their respective mean values are as follows: embarking on field trips (real, simulated or virtual) (4.3115), associating course content to current events (4.2459), conducting experiments (4.1311),

simulations (4.1148) and the use of laboratories and observations (4.0328). In agreement with Blumenfeld (1991) studies, the students were of the view that better understanding of a course content may lead to effective learning and hence lecturer may design tasks broken down to their level for easy participation and understanding. For a factor like embarking on field trips, students had first hand information on certain abstract contents taught in school hence better appreciating and understanding the taught content.

6.4.2 Construct 2 (Traditional instructional strategy) (Passive)

In traditional instructional strategy, the use of face-to-face lecture and tutorials were prominent in the conveyance of knowledge. Among the factors under this construct includes tutorial, group discussion, lecture, using Wiki, employing in-class role plays by students, and presenting brainstorming questions. With an overall mean value of 3.724, this construct was ranked fourth. Even though this instructional seems to be the most popular, it is clear that it is not sufficient in its provision of all the requisite information and knowledge students need in an effective manner. This assertion is consistent with Vian et al. (2007)'s study on "A generic framework for the development of standardized learning objects within the discipline of construction management" where students' complain of the insufficiency of knowledge with only the usual traditional instructional methods of teaching and learning.

6.4.3 Construct 3 (Relational Instructional strategy)

In this study, relational strategy refers to strategies where construction management contents/topics to be taught are related to real world events. Using cooperative learning strategies such as interleaving, humour creation in class lectures, using blogs to support teaching and

learning, creating classroom versions of television game shows, and assigning short in-class writings were the four factors under this construct. Even though the overall mean value for relational instructional strategy was 3.64, this construct was ranked last. The students perceived this strategy to be the least to convey knowledge and hence its contribution to learning effectiveness not significant. Creating classroom versions of TV shows helped students to relate their classroom experience to real world happenings hence stimulating their learning experience. This is consistent with Meyer (2003) where this approach creates a real-world experience of a theory-based learning environment.

6.4.4 Construct 4 (Technology-oriented instructional strategy)

With technology-enhanced learning instructional strategy, online activities using computer aided processes are complimented with instructions from the lecture theatres (Schmidt, 2002). Web-based learning environment, an aspect of technology-oriented strategy according to Strother (2002) provides a fast communication between lecturers and students and via a corresponding instructional conception which facilitates the interactivity of the participants. As a result of the COVID-19 pandemic, this strategy has received a major boost in its usage. Several studies (Walker and Johnson 2008; lam et al. 2016) emphasize that there exist a significant correlation or positive influence of technology-aided/web-enhanced instructional strategy on perceived students' learning effectiveness. Online lectures can be passive or active depending on its intended use at the time. In an active case, there is more visible interaction witnessed as students tend to ask questions showing their interest in the lecture. The reverse is true as students tend to not show their faces and concentration levels below average. The study's results revealed that technology oriented instructional strategies proved to be an effective means of enhancing students learning outcome

with an overall construct rank of 2nd among the 6 identified constructs. Of the four variables (S1, S13, S14 and S19) attributed to this construct, using popular video vignettes and films to stimulate critical thinking had the highest graded mean integration representation of 2.93 implying usage of this technology-oriented learning technique inspires students' effectiveness although cost and time sometimes renders this method used less in most class settings.

6.4.5 Construct 5 (Student-based instructional strategy) (Active)

With an overall third place ranking, student-based instructional strategy was considered to be very effective by the students. For students to better learn in an effective manner, strategies such presentations and classroom demonstrations needs to be in place. The four factors under this construct with their respective mean values include effective guest speaker's invitation (3.7869), employing classroom demonstrations (3.9016), having short student presentations (3.8033) and integrating website use into course assignments (3.5082). Both group discussion and having brief student presentations introduce more engagement of students in the classroom settings, and improve students' learning (Fine 2003; Rohrer and Pashler 2010). According to Felder and Brent (2006), it is noted that the benefit of employing student-based instructional strategy outweighs other known methods like the traditional face-to-face lecture.

6.4.6 Construct 6 (Competitive based instructional strategy)

Making use of in-class contests was the only factor under the competitive-based instructional strategy. This approach stimulates students' ability to reason hence producing in them the desire to want to know more. Nelson et al. (2015) opined out that engagement of engineering students in

a particular course via only one motivator is not effective and hence employing in-class contests offers another way for students to show their talents which is consistent with this study as well.

6.5 IMPLICATIONS OF EFFECTIVE TEACHING AND LEARNING STRATEGIES AND CONCLUSION

Among the six developed constructs, activity-based instructional strategy was deemed the most effective teaching and learning strategy by students. The factors in this construct include embarking on field trips (real, simulated or virtual) (4.3115), associating course content to current events (4.2459), conducting experiments (4.1311), simulations (4.1148) and the use of laboratories and observations (4.0328). With the practicability of the construction industry, course content in construction management programs can benefit immensely if classroom teachings are synchronised to real world activities. This the activity-based instructional strategy does very well. In resonance with Kim et al. (2002), the choice of the ideal teaching and learning strategy is very paramount to students grasp of knowledge. Hence appreciation of real world in classroom teaching through activity-based instructional method is very much in the right direction.

As a measure of how effective students gain knowledge from teaching and learning, effectiveness of teaching and learning is somewhat environment controlled. According to lau (2003), the attention of students is impacted by their environment been conducive or not and hence very important to factor that in any instructional manual. This study's outcome put forward that a number of factors have impact of student's learning effectiveness. That is to say learning effectiveness cannot be only achieved with a single instructional strategy. A number of approaches such as activity-based instructional strategy, traditional instructional strategy (Passive), relational

instructional strategy, technology-oriented instructional strategy, student-based instructional strategy (Active) and competitive based instructional strategy should be adopted to help students learn better.

More research efforts should therefore be made on collecting more samples to alleviate possible sample bias counter to some widely accepted student-centred teaching strategies. Therefore, this study can also be replicated in other schools or different countries other than Ghana to enhance students' learning effectiveness.

CHAPTER SEVEN

EFFECTIVE FRAMEWORK FOR PREPARING CONSTRUCTION MANAGEMENT STUDENTS TOWARDS A KNOWLEDGE-BASED ECONOMY

7.1 INTRODUCTION

This chapter presented the framework for preparing construction management students towards a knowledge-based economy. Via the conduct of in-depth review of literature, questionnaire survey, and interviews, the framework for this study was developed. Serving as a guide, this framework will serve as a reference for stakeholders such as academic staff, industry practitioners, decision-makers and students in improving certain practices and performance not only in emerging economies but also established economies as well. Moreso, the developed framework will be validated through survey questionnaires by experienced experts in academia and industry

7.2 SUMMARY OF RESEARCH FINDINGS

Table 7.1 depicts the summary of how five research objectives of the study were attained. Triangulating the appropriate research methods through different data collection methods, each objective was achieved. For example, semi-structure interviews coupled with questionnaire survey provided answers that later formed the basis for the framework development. After all the findings of the various objectives (1-4) were consolidated, the framework was developed for novice construction graduates.

Table 7.1 Achieving each research objective

	Research Aim and Objectives	**How each objective was achieved**	**Findings**
Aim: Develop a comprehensive and best guideline framework for better preparing Construction management graduates for the job market			
1	To explore past and current trends on existing literature on the numerous concepts and themes of knowledge management and construction management education	After the extensive review of relevant literature, thematic analysis was conducted revealing five (5) themes	Five (5) themes including skill development, teaching and learning strategies, information and communication technologies in CM education, curricula development and sustainability in CM Education were found
2	To identify and model the desirable skillsets and competencies of construction management students needed to prepare them for the knowledge-based economy	Eighty-seven (87) initial skillsets variables were consolidated through literature review. With the aid of mean scale and factor analysis, the skillsets were reduced as they were ranked and categorized	Seventy-two (72) variables were categorised into seven (7) groups of desirable skillsets based on the underlying common theme
3	Identify and model the barriers inhibiting active instructional methods by Institutions of Higher Learning	Thirteen (13) variables from extant literature were identified, subsequently ranked, factor analysed and SEM-PLS applied	Overall, thirteen (13) factors were categorized into four (4) groups
4	To investigate the effective teaching and learning strategies by Institutions of Higher Learning in preparing students for the knowledge-based economy	Twenty-five (25) active instructional strategies were initially collated from literature. Through a questionnaire survey the factors were ranked and factor analysed	Six (6) constructs were obtained from the twenty-five (25) variables consolidated via literature review
5	To develop and propose a comprehensive framework needed to prepare construction management students for the knowledge-based economy	The findings from the surveys and interviews (results from the first four objectives) were triangulated into the framework	The framework was presented and later validated by experts to be appropriate and suitable for practice

7.3 RESEARCH FRAMEWORK

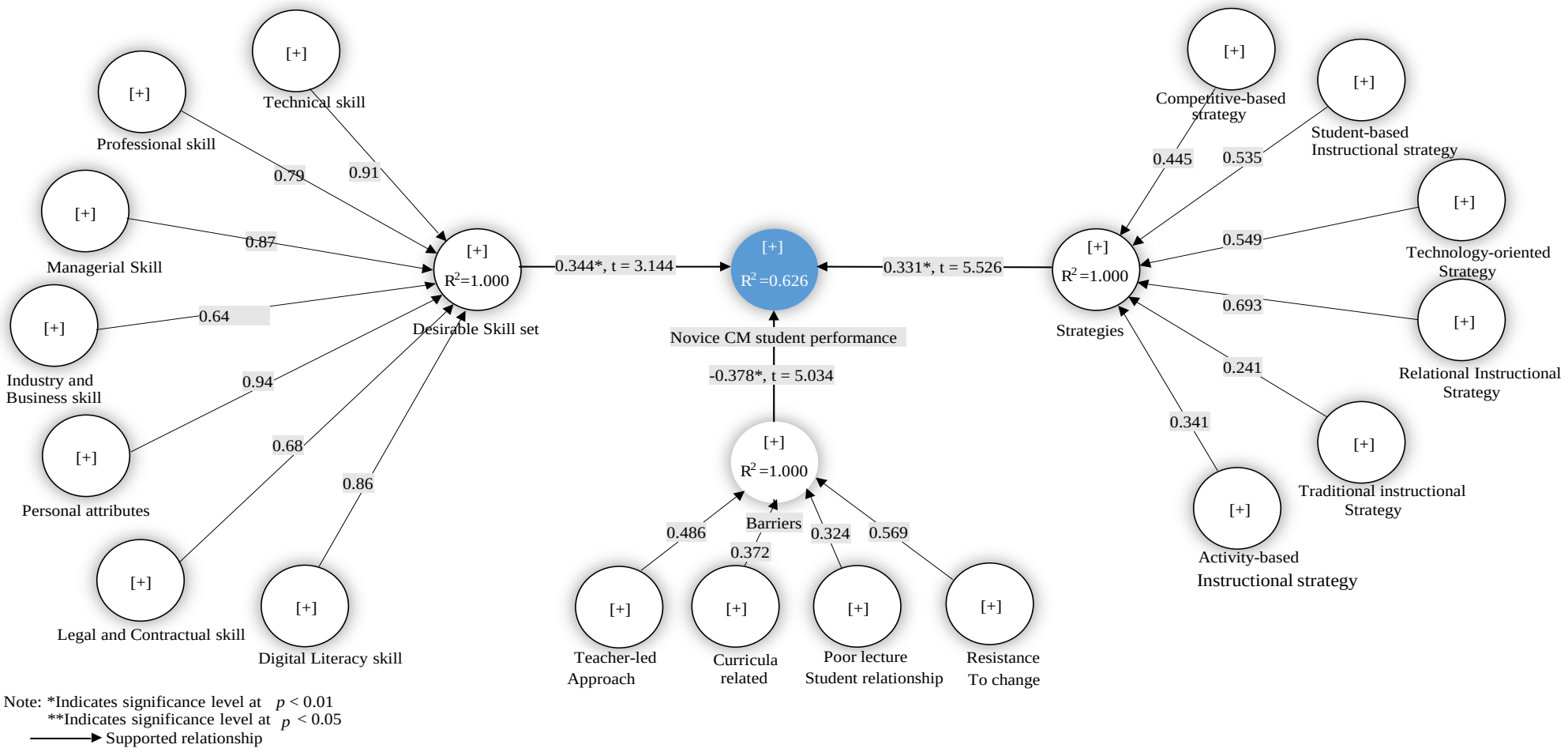

Figure 7.1 Framework for preparing novice construction management students

7.3.1 Discussion of Results

The results from the PLS-SEM revealed that all hypotheses held true. The broad hypotheses that desirable skillsets help improve the performance CM students which, is, in turn, hampered by several barriers to active instructional methods was empirically proven. In addition to this sequential effect, putting in place structures by means of effective strategies to enhancing active instructional methods also demonstrated to improve the performance of CM students whiles adversely mitigating the negative relationship between the barriers and the performance. Figure 7.2 depicts the comprehensive framework for preparing novice construction management students.

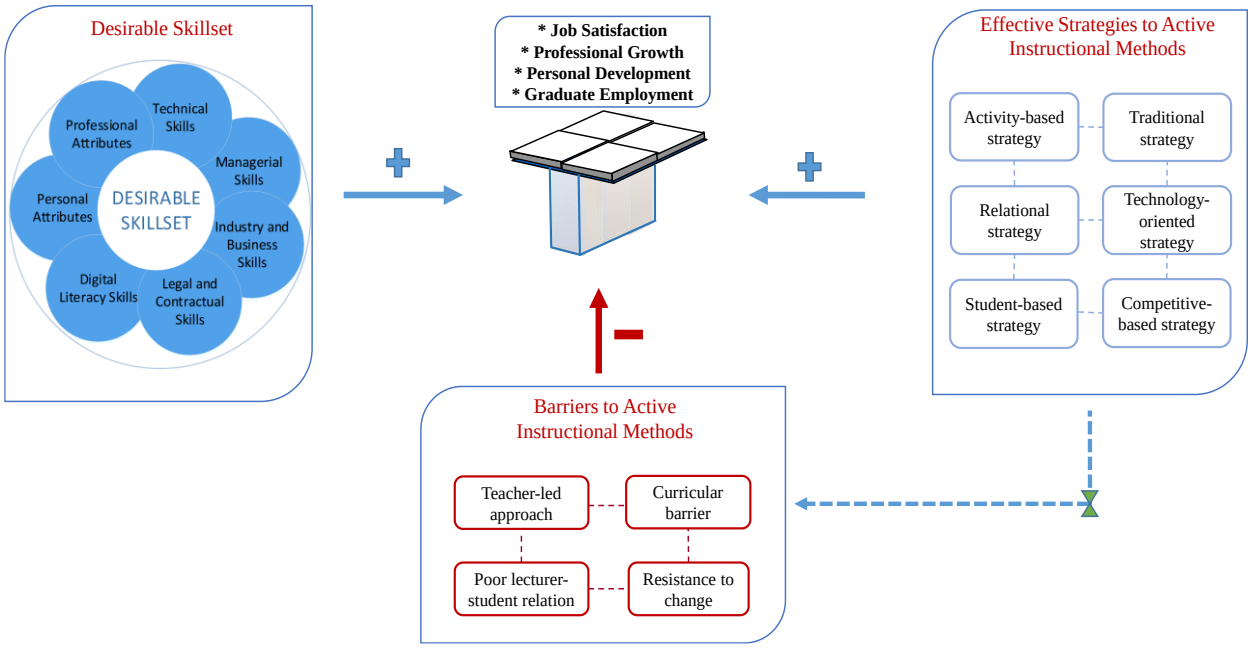

Figure 7.2 Comprehensive framework for preparing novice construction management students

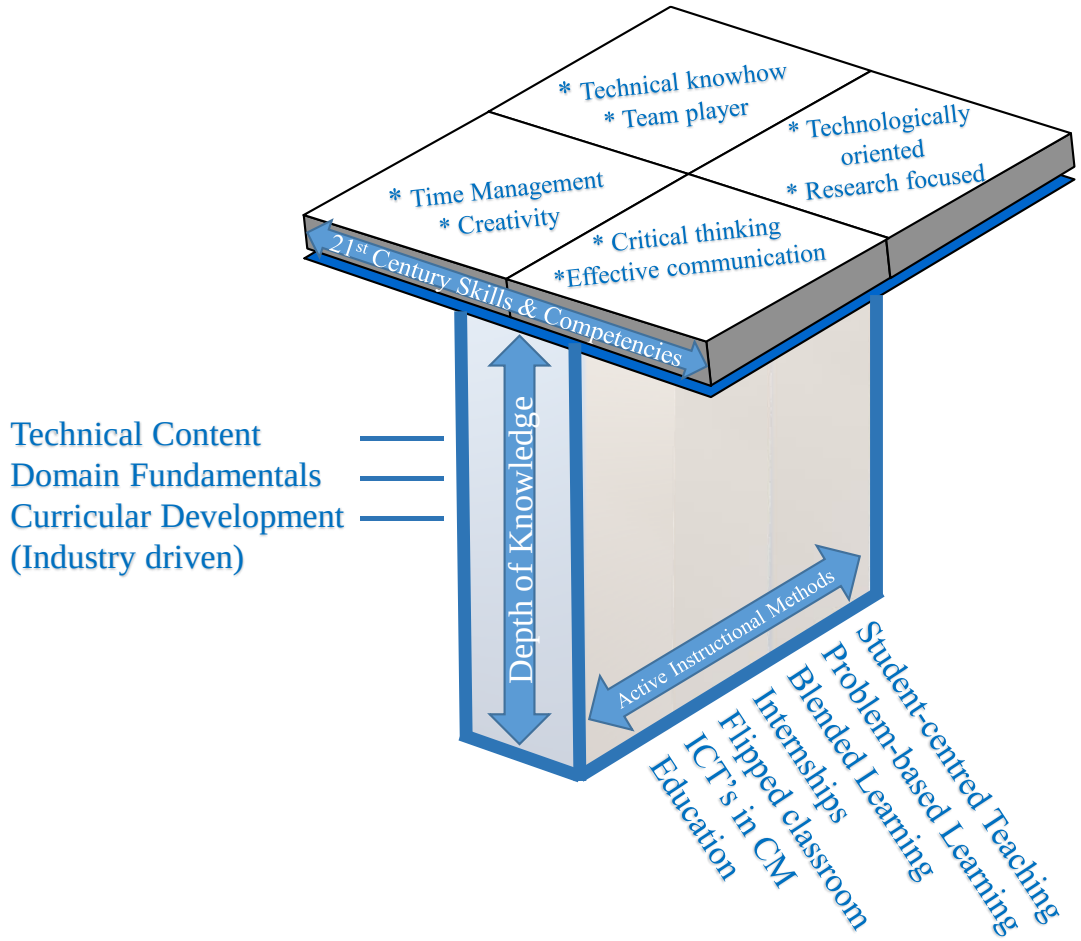

Figure 7.3 T-Shape Construction Professional model

Figure 7.3 above highlights the T-Shape construction professional model where CM professionals exhibits 21st century skills and competencies such as time management, creativity, team player, critical thinking, effective communication etc. through proper technical content, and industry driven curricular development where academics are experts in their delivery aided by active instructional methods (blended learning, flipped classroom etc.).

7.4 VALIDATION OF FRAMEWORK FOR PREPARING CONSTRUCTION MANAGEMENT STUDENTS TOWARDS KNOWLEDGE-BASED ECONOMY.

As a final process in the cycle of this study, validation was undertaken to assess the usefulness of the developed framework or model (Hu et al., 2016). According to Law (2007), choosing a particular technique for validation is reliant on the study's research purpose since no formal or systematic procedure is known for its identification. To assess how usable, adequate, and accurate a developed model is, validation is used (Yeung et al, 2007). As posited by Carson (2002), improving or to a large extent confirming how reliable a developed model will be is the work of the validation process that is to say validation seeks to "do the right things" as opposed to verification which covers "doing things right".

Two main approaches thus quantitative and qualitative exist for validation seek in research. Whiles the quantitative method makes use of objective and statistical data in the testing of relationships hypothesised in the study, qualitative approach on the other hand adopts perception-based data via words and ideas. The qualitative validation approach was adopted for this study as a result of some constructs in the framework been abstract such as "ensuring the right stakeholder participation in student up-bringing", which is very challenging to quantify. Therefore, it was appropriate to undergo perception-based approach as against formulated assessments. As adapted from Osei-Kyei (2008), to assess the credibility of the framework, seven validation questions were put forward to cover internal, external, content and construct validity areas of the study.

To internally validate a study according to Lucko and Rojas (2010) refers to deriving relationships within dataset. That is in relation to how user-friendly and understandable the developed framework is (Osei-Kyei, 2018). External validity explains how the study's framework is generalised and, in this study, assesses how the developed framework is generalised in the

Ghanaian construction education sector (Hu et al., 2016). Additionally, content validity has to do with assessing the relationship between the study's content and reality (Lucko and Rojas, 2010). This study performed content validity by evaluating whether the known practices and performance could be improved in reality in the construction education sector. As posited by (Hu et al., 2016; Lucko and Rojas, 2010), construct validity concerns with how operational the constructs of the study are and how measurable the research process is. This therefore assesses the comprehensiveness and appropriateness the developed framework is for practice.

7.4.1 Validation Survey Questionnaire Design

To validate the reliability and quality of the developed framework, questionnaire survey was employed and conducted on industry practitioners and lecturers. As shown in appendix C, the questionnaire consisted of four (4) sections. Section I sought to solicit expert's background information; Section II put forward the final framework developed to guide CM students' preparation towards the industry; Section III required the experts to input their agreement level with each validation question using the 5-point Likert scale of 1= "strongly disagree", 2= "disagree", 3= "neutral", 4= "agree", and 5= "strongly agree"; and Section IV presented the experts with an opportunity to provide useful comments for improvement and finalization of the framework. The participants for the validation were purposively selected upon meeting the following criteria: (1) "knowledge and in-depth understanding of the construction education and skillset concept", (2) "recent practical experience with construction management students/graduates", and (3) "ten (10) years or more construction industry/academia experience" (Hu et al., 2016).

In all, eight experts (three from academia and five industry practitioners) out of twenty-two (2) partook in the validation questionnaire as shown in Table 7.2 below. The sample size of eight relates positively with seven, six, and five respondents for the validation questionnaire survey by Osei-Kyei (2018), Ameyaw (2014), and Darko (2019) respectively. Hence, the sample size is reasonable making the validated framework more reliable, credible, and generalizable. The survey participants were seen to occupy top management and senior positions in their various firms. Both the industry practitioners and lecturers had an experience well above 10 years in their respective affiliations making their responses reliable, credible, and generalisable.

Table 7.2: Biographic information of experts for validation

Expert	Professional Affiliation	Position in Organization	Organization	Nature of project
1	Academia	Professor	University	Handled consultancy services
2	Academia	Associate Professor	University	Practiced in a construction firm
3	Academia	Associate Professor	Polytechnic University	Has a consultancy firm
4	Industry	Senior Project Manager	Contractor	Building and Civil
5	Industry	Principal Architect	Consultant	Building
6	Industry	Senior Quantity Surveyor	Consultant	Building and Civil
7	Industry	Assistant Quantity Surveyor	Contractor	Building
8	Industry	Chief Engineer	Consultant	Civil

7.4.2 Validation Survey Outcome

Presented in Table 7.3 is the results of the validation survey of the experts in academia and industry. All observable validation statements were well above the mean value of 4.00. This confirmed that all the participants agreed on the four validation aspects of the framework, hence a very good framework. Statements one and six assessed the external validity of the framework. With a rating of 4.63 for the first statement signified an agreement to a large extent that the

developed framework is made up of all the essential concepts and elements needed in the preparation of CM students towards the industry. Again, the statement 6 with a mean value of 4.38 signifies the experts' opinion of the overall framework being suitable for the successful management and performance of CM novice. In assessing the internal validity, the 3rd and 5th statements with mean values of 4.50 and 4.50 respectively were looked at. The participants strongly agree (Statement 3) that the structure and relationships among all the constructs in the framework are organized appropriately. Conversely, the experts are also of the agreement (Statement 5) that appropriate use of the framework would help to improve the performance of novice in the construction industry therefore the developed framework can be easily followed and understood.

Table 7.3: Outcome of the validation survey

No	**Validation Questions**	**Responses of Experts**								
		L1	L2	L3	P1	P2	P3	P4	P5	Mean
1	The framework captures all the relevant concepts for the preparation of CM student towards the industry	4	5	5	4	5	4	5	5	4.63
2	The framework is easily understandable and could be useful for both academia and industry's use	4	5	4	4	3	5	4	4	4.13
3	The structure and relationships among all the constructs in the framework are organized appropriately	5	4	4	5	4	4	5	5	4.50
4	The framework is objective, inclusive and reasonable	5	4	4	3	5	5	4	4	4.25
5	The appropriate use of the Construction Professional framework would help to improve the performance of novice in the construction industry	5	5	5	4	5	4	3	5	4.50
6	The overall framework is suitable for the successful management and performance of CM novice	4	5	4	4	5	4	5	4	4.38
7	The practice framework will serve as a systematic reference for future work	5	4	5	4	5	5	4	4	4.50

Note: The eight respondents are represented with L1 – L3 (Lecturers) and P1 – P5 (Practitioners).

The construct validity was assessed using statement 4 with a mean value of 4.24 where the experts agree that the framework is objective, inclusive and reasonable for practice. Finally, in assessing the content validity, statement 7 with mean value of 4.50 was used. The respondents agreed that the developed framework can be adopted as a systematic reference for future sake thus confirming its intention to achieve success once followed through properly.

The Construction Professional model is therefore credible, reliable, and suitable for equipping novice construction practitioners in the Ghanaian construction industry.

7.4.3 Additional Feedback from the Participants

Additional feedbacks were given by the experts aside from the perception-based scale responses for improving the overall findings to include:

1. Academia-industry collaboration seems inevitable should this framework achieve massive success. Industry practitioners need to liaise with academia on their requisite skillsets leading to the adoption of appropriate teaching methods for the impartation of the said industrial skills to novice construction graduates.
2. A stagewise progression checker should be incorporated having the desirable skillsets in mind so as to include key skillsets, active instructional methods and effective means of measuring performance to reflect that needed at the industry level.
3. As most countries tend to tailor their educational needs to suit them, it is necessary to categorise context specific skillsets to serve as a benchmark for future reference.

7.5 CHAPTER SUMMARY

Presented in Chapter seven (7) is the developed framework for the preparation of construction management students towards a knowledge-based economy. The findings from the extant review of literature, interviews, and survey were all incorporated into the framework. Validation of the framework follow where all its four aspects thus internal, external, content and construct validity tests with eight respondents (experienced industry practitioners and academic staffs) were conducted. The results of the validation proved the framework to be generally reasonable, suitable, and practical for novice construction students' preparation towards the industry. This therefore calls for all stakeholders of construction education to carefully embrace and follow the framework for reshape in the desirable skillsets needed in the industry. Chapter eight (8) draws the conclusion and subsequently outlines the needed recommendations.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

8.1 INTRODUCTION

The previous chapter produced the developed framework which findings were presented and later validated. This chapter therefore put forward the research conclusion. Both academia and industry stand a great chance of benefitting from the value and significance of the study. Presented finally are the study's limitation and clear recommendations for improvement.

8.2 REVIEW OF RESEARCH OBJECTIVES AND CONCLUSION

The research aim was *"to develop a comprehensive and best guideline framework for better preparing Construction management graduates for the job market"*. Five objectives were formulated to aid in the realization of the study's main aim. In accomplishing the objectives, extant review of literature, interviews, questionnaire survey, and validation survey were employed. The major conclusions of the various objectives have been highlighted in the following section:

8.2.1 Objective 1

Explore past and current trends on existing literature on the numerous concepts and themes of knowledge management and construction management education

In achieving the first objective, comprehensive review of literature was conducted on Knowledge management (concept, practice, theory) and construction management education. With the paucity

of knowledge on KM and its influence on CM education, a thorough analysis of relevant literature was appropriate to understand the study area and reveal the likely future trends.

In achieving this, firstly, trends of annual publications of KM in CM education were carried out to the year 2018. With an increasing trend of one (1) publication in 1990 to eleven (11) and seven (7) in 2016 and 2017 respectively, the total number of published papers from these selected journals constituted seventy-six (76). There was a rapid increase in 2006 and then saw a gradual increase with 5 publications from the year 2011 onwards. The peak was witnessed in 2016 with 11 publications, indicating the gradual rising of interest in exploring what KM has to offer in Construction Management Education. The first decade (1990-2000) depicted the infant stage of the concept of KM with regards to construction management education. Few countries such as the US, UK, and Japan had begun with a scratch at the surface of this concept. The next 2 decades between 2001 and 2018 looked at the dynamisms of KM in the sense of skills and competencies, pedagogies, learning strategies, and ICTs in construction education (BIM, Virtual and Augmented reality, and simulations).

Secondly, contributions from countries of authors, institutions, and research institutes as well as author to this research area were carried out. From the past 28 years as depicted in Table 2.3 above, the USA and the UK with scores of 32.61 and 10.08 respectively had the highest number of researchers devoted to exploring the concept of KM and Construction Management Education. Countries such as China, Australia, Hong Kong# and Israel also had a contribution score of 3.68, 3.44, 3.00 and 3.00 respectively. This proved how developed and widespread the concept of KM and CM education has been for the past 28 years as more researchers from different parts of the world have shown interests. However, not much was witnessed by developing countries as they had a low contribution to this growing phenomenon. Pioneering the course of KM in CM education

research is the USA where most of their institutions/universities have published the most papers. Almost all the research institutions/universities contributing most to this research were from developed countries hence the need for developing countries to take a cue from these developed nations in coming to speed with this phenomenon.

Finally, key research areas and sub-focus captured in KM and CM Education were identified to include skill development, teaching and learning strategies, information and communication technologies in CM education, curricula development and sustainability in CM Education.

8.2.2 Objective 2

Identify and model the desirable skillsets and competencies of construction management students needed to prepare them for the knowledge-based economy

The two main responsibilities of construction education programs include imparting the desirable skillset and competencies for successful construction professionals and re-modification of academic curricula to reflect future construction industrial needs. The second objective sought to identify and model the desirable skillset needed to prepare CM student to be industry ready. Seven (7) major category of desirable skill sets were identified. These included technical skills, digital literacy skills, industry and business skills, managerial skills, legal and contractual skills, professional attributes, and personal attributes. From these seven categorizations of desirable skillsets, significant factors in skillset development of construction management professionals were identified.

Independent t-test was employed to identify the differences in perception of the expectancy of practitioners and students with regards to desirable skillsets in novice construction professionals, hence there existed no differences in the respondent's perception.

8.2.3 Objective 3

Identify and model the barriers inhibiting active instructional methods by Institutions of Higher Learning

In achieving this objective, thorough review of literature and questionnaire survey were employed. In chapter 2, a total of thirteen (13) factors were identified through literature as barriers inhibiting active instructional methods. Chapter 5 saw the survey respondents been empirically instructed to score the degree to which they considered the 13 obstacles to be critical. All the factors had a mean score above the benchmark of 3.00. Among the top ranked obstacles based on mean scores include (mean $\geq$ 3.50): short term memorization of content/information (3.87), inability to foster the skills of application, analysis, and evaluation (3.84), lecture experiences are boring and sometimes irrelevant (3.79) and Speed teaching and learning leaving little room for fostering important intellectual virtues (3.77).

Using Exploratory Factor Analysis, the 13 critical obstacles identified were further grouped into four principal factors as: (1) information mismanagement, (2) curricula barrier, (3) Poor lecturer-student relationship, (4) resistance to change. In-depth knowledge about these critical barriers will ensure the development of proactive measures to counteract the barriers.

8.2.4 Objective 4

Investigate the effective teaching and learning strategies by Institutions of Higher Learning in preparing students for the knowledge-based economy

With the aid of thorough literature review, content and thematic analysis, questionnaire survey and semi-structured interviews, the fourth objective was realized. Chapter two (2) presented twenty-five (25) effective teaching and learning strategies through comprehensive literature review.

In Chapter six (6), the 25 established strategies were all considered as important warranting further analysis using a benchmark of mean 3.50. Among the top ranked strategies included: embarking on field trips (real, simulated or virtual) (4.31), associating course content to current events (4.25), conducting experiments (4.13), use of Laboratories and observations (4.03), simulations (4.11) and using case study method teaching (4.21).

The principal component factor analysis on the 25 effective instructional strategies resulted in a six (6) factor solution and subjectively named as: (1) Activity-based instructional strategy, (2) Traditional instructional strategy (Passive), (3) Relational Instructional strategy, (4) Technology-oriented instructional strategy, (5) Student-based instructional strategy (Active), and (6) Competitive based instructional strategy. Carefully implementing these strategies will ensure that the desired skillset and competencies needed in the industry are being effectively taught to CM students.

8.2.5 Objective 5

Develop and propose a comprehensive framework needed to prepare construction management students for the knowledge-based economy

The research findings through comprehensive literature review, content and thematic analysis, structured questionnaire survey and semi-structured interviews, a framework was developed to enhance the preparation of CM students towards a knowledge-based economy.

The framework was further validated with eight participants (experts) (3 lecturers and 5 experienced industry practitioners) in CM education. The outcome of the validation process witnessed the framework's generalizability, comprehensiveness, reliability and realistic for practice.

8.3 CONTRIBUTIONS OF THE RESEARCH

8.3.1 Theoretical Implication

Theoretically, the study establishes the significance of skills by conducting a comprehensive survey of literature that is consistent with previous studies that emphasized the importance of skills. The study explored seventy-two (72) vital skill attributes clustered in seven factors. Second, findings of the independent t-test indicated the gap between technical graduates and practitioners for both attributes and factors related to the rating of required skills in novice construction professionals. The study endorses previous works of authors that confirm perceived skill expectancy gap among technical graduates and professionals whiles still putting forward some novel findings. One-way MANOVA demonstrated uniformity in the perception of practitioners

irrespective of gender or level of experience. For students, the test reported consistency across gender on perception of students towards skill factors.

Furthermore, holistic evaluation of influential issues for novice construction practitioners in Ghana, one of the few studies in developing countries were articulated by the study. The integration of human capital theory with the triple helix theory helped situated the study hence a novel approach to tackling the skill gap as witnessed in CM education.

Although this study is limited to the developing country of Ghana, many Institutions of Higher learning, especially established in any developing countries, share generic characteristics in spite of the different levels of variations in political, cultures, environmental, and socioeconomic conditions. Thus, countries/jurisdictions that share similar conditions with Ghana can adopt and implement this proposed comprehensive framework. Moreover, the approach used in this study could be adopted to investigate the impacts of the desirable skillset inculcation into curricular, issues with traditional instructional methods, and active instructional strategies on the performance of novice CM students in other countries/jurisdictions and the findings could be based upon to propose localized implementation framework.

Finally, this study advances knowledge on how to effectively prepare students for any knowledge-based economy especially developing economies by uncovering the quantitative effects of various desirable skillsets and attributes, barriers to action teaching and learning and effective strategies on the performance of novice construction management students. Arguably, the first to combine and empirically test such interactions in Construction Management education research. The understanding of the interdependences of the constructs not only contributes to devising suitable strategies to improve the performance of students but also useful for the successful application and advancement of desirable skillsets as demand for these skillsets keep changing with time.

8.3.2 Implications to Practice

With regards to practical implications, the study emphasized the significance of desirable skill sets that positively influence the employment of novice construction professionals and recommends that all stakeholders utilize them in their respective contexts. The described features reflect desired traits in new entrants.

Furthermore, by intentionally incorporating the desirable skillsets into undergraduate courses, thus students can be helped in the development of the required attributes in the early stages of their academic endeavor.

Again, with careful monitoring and redesigning of program objectives by faculty members to suit desirable industrial skillsets, students can participate in these skill development programs which will in turn enhance their employability.

Finally, the extracted attributes and factors can be taken by the industry and used to assess job applicants accordingly as a measure of employability. By the better knowledge of requisite skillsets, industries can be in the state of conveying their need to academia about their requirements, thus developing a better industry-academia partnership.

8.4 VALUE AND SIGNIFICANCE OF THE RESEARCH OUTUT

The study's significance and valuability to CM education research and industry practice cannot be overemphasized. In Ghana and any other developing economy, the findings of the study will proof valuable for practice and advance research as well.

First, five thematic groupings of KM's application in CM Education were put forward providing useful insight into areas of interest with regards to this subject area. This has opened the conversation for further research to advance the individual themes of the subject area revealing peculiar gaps worth paying attention to. One of such themes this study looked at was skillset development which was broad enough. Understudying the skillset unlocked the industry-academia collaboration, issue of employability based on desirable skills, curricula re-development etc.

Second, significant barriers identified provided an overview of the reasons behind the non-performance of active instructional methods. Consequently, knowledge of this paves way strategic measures to be taken and enforced to reduce the adverse effect of the barrier while amplifying the active instructional method to reach its full potential. A barrier such as boring and irrelevant lectures can be turned around active teaching and maximum participation of students once it is known, and efforts are being made to correct such hinderance.

Third, noteworthy strategies modelled for optimizing the use of active instructional methods were revealed giving rise to proper practices or steps in training CM graduates to be ready for the job market. Gone were the days where every

Finally, the comprehensive framework for preparing construction management students towards a knowledge-based economy provides an opportunity for student skill development and improvement. Stakeholders of education such as industry practitioners, decision makers, academic staff etc., are enlightened on how well a honed and developed skill will prove vital to an organizations success and vice versa. However, this can only be possible if there exist a collaboration between industry and academia with regards to desirable skillsets knowledge. At the industry level, professional firms can use this framework as a guide in training their employees to improve their skillset level via the knowledge gained.

8.5 LIMITATIONS OF THE RESEARCH STUDY

As with any studies, this research was also presented with a few limitations worth mentioning. To begin with, the relatively small sample size of students (124), industry practitioners (96) and lecturers (5) were involved in the questionnaire survey, and interview. The relatively smaller sample size can be attributed to the difficulty in reaching especially practitioners and lecturers. However, the responses were consistent which ensured reliable research outcome.

Again, contextually the study was limited to Ghana. As a result of differences in the characteristics of local education programs such as influence of culture, external stakeholders and geographical location, the developed framework might be limited in its applicability worldwide. That notwithstanding, countries who find themselves in the developing economy such as Nigeria, and South Africa could benefit from the generalization of the findings from this study upon validation.

Moreso, the impact of major variables on each of their respective construct were not determined on the combined model. Only variables with high impact were chosen to form part of the overall model neglecting variables with smaller impact. This could alter the results/findings should the smaller variables all combine to form a construct.

Finally, this study relies heavily on surveys driven data. The entire framework could have benefitted from real-time performance measurement of novice construction students on the job. Cost and time constraint also limited the need for real time data collection. However, the validation results indicate the reliability, comprehensiveness and practicable the survey was with confident results.

8.6 RECOMMENDATIONS FOR FUTURE STUDIES

This study could still benefit from other avenues presented in the form of future studies despite the potential of the present results been useful for practitioners and researchers.

Firstly, other developing / emerging economies and subsequently established economies can adopt the framework after consolidation of the findings which could aid in future comparison. Caution should be sound here for prior validation in these jurisdictions with experts for proper generalization and applicability of findings. In cases of different jurisdictions, this research's framework can be adapted to suit such environment for practice. A clearer and deeper understanding will therefore be forged with regards to the concepts, interrelationships among constructs and variables, critical barriers and effective strategies for performance improvement globally.

Secondly, the sample size could be enlarged to consolidate findings. The scope of the study could be enlarged to accommodate more participants in the persons of industry practitioner, decision makers, academic staff, students. The sampling size will therefore be greatly improved ensuring that the findings will be more generalizable.

Thirdly, another exciting area of construction management education worth paying attention is emerging technologies in education. A thorough literature review of the concept of KM and CM education revealed emerging technologies as a hot topic in CM education. As a recommendation for future research, emerging technologies such as BIM, virtual and augmented reality, gaming etc could be research into providing insightful discoveries.

Fourthly, the model could have been validated based on a real data from project handled by novice construction workers. This will provide a truer to live experience as compared to the perception-based survey that was conducted even though was validated by experts.

Last but not the least, a knowledge-based economy index could be developed to measure, assess and benchmark the performance of CM professionals so as to inform periods of reskilling and or training.

8.7 CHAPTER SUMMARY

This chapter presented the summary of the major contributions to practice and research. Furthermore, the significance, values, and contribution of the study to research and practice were highlighted. Also discussed were the major limitations of the study. Finally, recommendations for future studies in construction management education have been put forward.

APPENDIX A

MAIN SURVEY QUESTIONNAIRE, GHANA (FOR GENERAL SURVEY-ACADEMIA)

To whom it may concern

Dear Sir/Madam

Invitation to participate in a Doctor of Philosophy (Ph.D.) research on Skill gap as it pertains to the Construction Management Education and Construction Industry in Ghana

As stakeholders in Construction Management Education, you are cordially invited to complete the attached questionnaire for a Ph.D. research entitled "**Preparing Construction Management Students towards a Knowledge-based Economy: A Comparative Study of Emerging and Established Economies**." This research is sponsored by The Hong Kong Polytechnic University's Postgraduate Studentship Scholarship. This research is supervised by Associate Professor Patrick S.W. Fong.

This research aims to explore Knowledge Management in Construction Management Education and to develop a comprehensive and best guideline framework for better preparing Construction management graduates for the job market. In realizing the above-stipulated aim, this questionnaire is developed to solicit your views on the desirable skillset of construction management students, effective teaching and learning forms/strategies of construction management program, barriers to the traditional method of teaching and lastly the effective means of incorporating holistically sustainability principles into curricula of construction management programs. All the most influencing variables within the constructs are to be selected based on their level of importance. It is envisaged that this study will potentially contribute to reducing the widened skill gap plaguing the construction industry and a move towards a sustainability friendly construction environment.

The questionnaire is simple and takes approximately 20 minutes to complete. **Please, there are no correct or wrong answers, only your much-needed opinions.** All your responses will be treated with strict confidentiality and used only for academic purpose.

For any inquiries, please contact Daniel Yamoah Agyemang (Tel.: +23354659 ; and email: daniel.yamoahagyemang@ or Dr Patrick Fong (email: patrick.fong.bre@).

Your views are valuable to the success of this research. After the research, we are willing to share a summary of the outcomes with anyone who shows interest.

We would be grateful if you could complete and return the questionnaire to the researchers within two weeks. Thank you again for your kind consideration.

Yours sincerely,

……

Daniel Yamoah Agyemang, Ph.D. Student

Dr Patrick S.W Fong, Associate Professor, Department of Building and Real Estate

The Hong Kong Polytechnic University, Hong Kong.

Preparing Construction Management Students towards a Knowledge-based Economy: A Comparative Study of Emerging and Established Economies

Questionnaire Survey

Important instructions:

1. Please, consider your experience in academia or construction industry to complete this survey.
2. Use any suitable symbol (such as "√") to indicate your opinions.
3. Please, you have TWO WEEKS to complete the questionnaire.
4. Your mobile number: _____and email address: _____
5. For any queries, please contact me via e-mail at: daniel.yamoahagyemang@_____.

Section A1: Information of Participants (Students)

1. Your gender
   ☐ Male ☐ Female
2. What is your Highest academic qualification?
   ☐ Secondary ☐ Diploma ☐ HND
   ☐ Associate Degree ☐ Other please specify_____
3. Have you embarked on an industrial internship before?
   ☐ Yes ☐ No
4. Years of working experience in the construction industry?
   ☐ No experience; ☐ < 6 years; ☐ 6-10 years; ☐ 11-15 years
   ☐ 16-20 years; ☐ >20 years

Section A2: Information of Participants (Lecturers)

1. Current position in University
   ☐ Lecturer ☐ Senior Lecturer ☐ Associate Professor
   ☐ Associate Professor ☐ Other, please specify_____
2. Years of working experience in academia
   ☐ <6 years ☐ 6-10 years ☐ 11-15 years ☐ 16-20 years ☐ > 20 years
3. Years of working experience in the construction industry
   ☐ <6 years ☐ 6-10 years ☐ 11-15 years ☐ 16-20 years ☐ > 20 years
4. How prevalent is the skill gap in Ghana's construction industry?
   ☐ Not Prevalent; ☐ Less Prevalent; ☐ Neutral; ☐ Prevalent; ☐ Highly Prevalent

SECTION B

Q1. Desirable Skillset, and attributes of Construction Management (CM) students.

How important are the following skillset of CM student to the growth of construction industry?
1= Not important; 2= Less important; 3=Neutral; 4 Important; 5=Extremely important.
Please, also indicate how satisfied you are with these identified skillsets contribution to the CI growth.
1= Not satisfied; 2= Less satisfied; 3= Neutral; 4= Satisfied and 5= Very Satisfied

No	Skillset, Attributes and Competence		Level of Importance	Level of Satisfaction
1	**Technical Skills**	Plans interpretation/ Blueprint reading/Understanding construction & shop Drawings	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
2		Knowledge of construction operations	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
3		Knowledge of green and sustainable construction/ LEED	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
4		Scheduling	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
5		Knowledge of project closeout and handover procedures	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
6		Estimating	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
7		Cost accounting	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
8		Knowledge of construction materials	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
9		Knowledge of construction equipment	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
10		Economic and financial analysis	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
11		Knowledge of design	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
12		Value engineering/Constructability analysis/ Design Review	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
13		Scope review	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
14	**Professional Attributes**	Hands-on project experience prior to graduation/ Internship	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
15		Teamwork capabilities	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
16		High regards to values/ Work ethics	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
17		Planning and goal setting	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
18		Problem solving/ Analytical skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
19		Result orientation	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
20		Critical thinking	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
21		Decision making skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
22		Forecasting	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
23		Ability to follow up	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
24		Risk taking	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
25		Multi-tasking	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
26		Long term commitment	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
27	**Managerial Skills**	Quality assurance/ Total Quality Management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
28		Health and Safety management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
29		Project management/ administration	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
30		Cost control	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
31		Leadership	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
32		Site planning and management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
33		Personnel/ Resource management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5

34		Risk planning, assessment and control	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
35		Productivity management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
36		Knowledge and information management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
37	**Industry and Business Skill**	Knowledge of health and safety regulations	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
38		Knowledge of building codes and regulations	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
39		Knowledge of environment impact assessments	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
40		Marketing with clients/ Developing client relations	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
41		Knowledge of the permitting process	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
42		Awareness of industry trends	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
43		Entrepreneurship	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
44		Understanding lean culture	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
45		Understanding complementary fields/disciplines	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
46		Understanding global construction Environment	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
47	**Personal Attributes**	Listening ability/ Giving attention to details	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
48		Time Management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
49		Dependability	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
50		Personal adaptability/Flexibility	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
51		Desire to learn	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
52		Assertive attitude	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
53		Promptness in actions	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
54		Comprehension ability	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
55		Ability to learn	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
56		Innovative mindset/ Creativity	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
57	**Legal and Contractual Skills**	Interpreting contract documents	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
58		Knowledge of construction law and legal environment	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
59		Contract administration skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
60		Knowledge of bidding procedures	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
61		Dispute avoidance and resolution skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
62		Knowledge of project delivery and contracting strategies	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
63		Change management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
64		Understanding labor laws	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
65		Claims preparation and presentation Skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
66		Claims defense skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
67	**Digital Literacy Skills**	Knowledge of Artificial Intelligence Application in Construction Management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
68		Proficiency in construction information technology	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
69		Knowledge of construction data analytics	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
70		Proficiency in BIM technology software	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
71		Knowledge of construction simulation and modelling tools such as Web cyclone	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
72		Knowledge of big data applications in construction	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
73		Knowledge of Augmented/Virtual reality software applications in construction	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5

Q2. Barriers to Traditional Teaching and Learning (Instructional) Method.

How likely are the following barriers affecting the traditional instructional method to happen and should they occur how severe are their impact to teaching and learning? Use

1=Not Probable; 2=Less Probable; 3= Neutral; 4= Probable; 5=Highly Probable; at the probability section and

1=Not Severe; 2= Less Severe; 3= Neutral; 4= Severe; 5= Very Severe at the Severity Section

No.	**Barriers to Traditional Teaching and Learning (Instructional) Method**	**Level of Probability**	**Level of Severity**
1	Inability to foster higher order cognitive and attitudinal goals	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
2	Ineffectiveness as a method for student learning	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
3	Speed teaching and learning leaving little room for fostering important intellectual virtues	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
4	Short term memorization of content/information	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
5	Maximum control over flow of information by lecturers	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
6	Low student engagement (often seen taken notes)	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
7	Inability to foster the skills of application, analysis and evaluation	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
8	Lecture experiences are boring and sometimes irrelevant	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
9	Influence of educational tradition	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
10	Lack of needed materials or resources	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
11	Poor interpersonal skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
12	Increase course failure	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
13	Low level of student achievement	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
	***Others**, please specify*		
		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5

Q3. Familiarity and Effectiveness of Active Instructional (Teaching and Learning) methods in Construction Management Education.

How familiar are you with the following Active Instructional methods? Use
1= Not Familiar; 2= Less Familiar; 3= Neutral; 4= Familiar; 2= Very Familiar.
Secondly, how effective are the following Active Instructional methods to better preparing students for the job market as compared to the traditional (passive) instructional method?
1= Not Effective; 2=Less Effective; 3=Neutral; 4= Effective; 5=Very Effective

No	**Active Instructional (Teaching and Learning) methods**	**Level of Familiarity**	**Level of Effectiveness**
1	Problem-based Learning (PBL)	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
2	Peer-reviewing	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
3	Vertical integration	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
4	Inverted/flipped classroom	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
5	Service learning	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
6	Cooperative learning	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
7	Educational Debate	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
8	Collaborative virtual classroom	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
9	Game-based learning (Gamification)	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
10	The Jigsaw Technique	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
11	Learning by teaching	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
12	Role Playing	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
13	Mind Mapping/Brainstorming	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5

Q4. Active Teaching and Learning Strategies of Construction Management (CM) students.

How would you rate the following active teaching and learning strategies as having influence on students' performance?
Please indicate how effective the active teaching and learning strategies are, using the following scale:
1= Very Low; 2= Low; 3=Neutral; 4 High; 5=Very High

No	**Active Teaching and Learning Strategies (ATLS)**	**Level of Effectiveness**
		Very Low ⟺ Very High
1	Using case study method teaching	☐1; ☐2; ☐3; ☐4; ☐5
2	Employing in-class contests	☐1; ☐2; ☐3; ☐4; ☐5
3	Tutorial	☐1; ☐2; ☐3; ☐4; ☐5
4	Inviting effective guest speakers	☐1; ☐2; ☐3; ☐4; ☐5
5	Employing classroom demonstrations	☐1; ☐2; ☐3; ☐4; ☐5
6	Group discussion	☐1; ☐2; ☐3; ☐4; ☐5
7	Using advanced teaching tool (e.g., Blackboard)	☐1; ☐2; ☐3; ☐4; ☐5
8	Embarking on field trips (real, simulated or virtual)	☐1; ☐2; ☐3; ☐4; ☐5
9	Having short student presentations	☐1; ☐2; ☐3; ☐4; ☐5

10	Introducing brainstorming questions	☐1; ☐2; ☐3; ☐4; ☐5
11	Connecting course content to current events	☐1; ☐2; ☐3; ☐4; ☐5
12	Using Wiki	☐1; ☐2; ☐3; ☐4; ☐5
13	Using popular films and video vignettes to stimulate critical/creative thinking	☐1; ☐2; ☐3; ☐4; ☐5
14	Lecture	☐1; ☐2; ☐3; ☐4; ☐5
15	Conducting experiments	☐1; ☐2; ☐3; ☐4; ☐5
16	Use of Laboratories and observations	☐1; ☐2; ☐3; ☐4; ☐5
17	Simulations	☐1; ☐2; ☐3; ☐4; ☐5
18	Using cooperative learning strategies such as interleaving	☐1; ☐2; ☐3; ☐4; ☐5
19	Using mobile live video learning system	☐1; ☐2; ☐3; ☐4; ☐5
20	Humor creation in class lectures	☐1; ☐2; ☐3; ☐4; ☐5
21	Using blogs to support teaching and learning	☐1; ☐2; ☐3; ☐4; ☐5
22	Employing in-class role plays by students	☐1; ☐2; ☐3; ☐4; ☐5
23	Integrating website use into course assignments	☐1; ☐2; ☐3; ☐4; ☐5
24	Creating classroom versions of television game shows	☐1; ☐2; ☐3; ☐4; ☐5
25	Assigning short in-class writings	☐1; ☐2; ☐3; ☐4; ☐5
	Others, please specify	
		☐1; ☐2; ☐3; ☐4; ☐5
		☐1; ☐2; ☐3; ☐4; ☐5
		☐1; ☐2; ☐3; ☐4; ☐5
		☐1; ☐2; ☐3; ☐4; ☐5

Please, if you would like to receive a summary of the research findings, kindly provide your email address.

***Please, enter your email address*_____**

-End of Questionnaire-

Many thanks for your valuable time

DEFINITION OF KEY TERMS

(Please, if necessary, refer to the following definitions when answering Q3 in section B)

No	Active Instructional Methods	Description
1	Problem-based Learning (PBL)	Instructional strategy in which students confront contextualized, ill-structured problems and strive to find meaningful solutions thereby enhancing their complex problem-solving ability with exposure to real-world problems.
2	Peer-reviewing	A process in which students constructively evaluate the work of other students thus students submit their work (e.g., written papers, homework) to peers, who review it and give feedback but who do not assign grades
3	Vertical integration	Actively connecting and engaging groups of students at different levels within education for retention and learning in each group to be encouraged
4	Inverted/flipped classroom	Lessons are 'flipped' means that most of the work like reading and research are all done outside of class
5	Service learning	Pedagogical technique by which a student completes the objectives of a course while fulfilling a community need in a coordinated effort between the school and client
6	Cooperative learning	Instructional use of small groups through which students work together to maximize their own and each other's learning thus an approach in which high-ability and low-ability students work together to solve a problem.
7	Educational Debate	An active learning strategy designed to engage students in the practice of important cognitive skills, such as critical thinking and deliberation and shaping learners' attitudes toward divisive topics
8	Collaborative virtual classroom	Aside from the usual audio-video conferencing and chat features, virtual classrooms also provide synchronous and asynchronous annotation, communication, and resource sharing for facilitators and participants
9	Game-based learning (Gamification)	Turning a certain aspect of learning into a game
10	The Jigsaw Technique	learners are given a "piece of the puzzle" that they need to solve on their own. After this, they need to collaborate with other learners to finally complete the puzzle
11	Learning by teaching	Learners are allowed to prepare and teach the lessons (or part of them) to their fellow students through media such as webinar and online discussion boards
12	Role Playing	Simulates real-life situation that requires problem-solving skills.
13	Mind Mapping/Brainstorming	Here, learners come up with ideas and post them on a board. As a group, the students then select the best ones and use those to come up with a solution.

APPENDIX B

MAIN SURVEY QUESTIONNAIRE, GHANA (FOR GENERAL SURVEY-INDUSTRY PRACTITIONERS)

To whom it may concern

Dear Sir/Madam

Invitation to participate in a Doctor of Philosophy (Ph.D.) research on Skill gap as it pertains to the Construction Management Education and Construction Industry in Ghana

As a practitioner with knowledge of desirable skill sets and competencies of the Construction industry in Ghana, you are cordially invited to complete the attached questionnaire for a Ph.D. research entitled "**Preparing Construction Management Students towards a Knowledge-based Economy: A Comparative Study of Emerging and Established Economies**." This research is sponsored by The Hong Kong Polytechnic University's Postgraduate Studentship Scholarship. This research is supervised by Associate Professor Patrick S.W. Fong.

This research aims to explore Knowledge Management in Construction Management Education and to develop a comprehensive and best guideline framework for better preparing Construction management graduates for the job market. In realizing the above-stipulated aim, this questionnaire is developed to solicit your views on the desirable skillset of construction management students, and effective teaching and learning forms/strategies of construction management students. All the most influencing variables within the constructs are to be selected based on their level of importance. It is envisaged that this study will potentially contribute to reducing the widened skill gap plaguing the construction industry and a move towards a sustainability friendly construction environment.

The questionnaire is simple and takes approximately 15 minutes to complete. **Please, there are no correct or wrong answers, only your much-needed opinions.** All your responses will be treated with strict confidentiality and used only for academic purpose.

For any inquiries, please contact Daniel Yamoah Agyemang (Tel.: +23354659 ; and email: daniel.yamoahagyemang@ or Dr Patrick Fong (email: patrick.fong.bre@).

Your views are valuable to the success of this research. After the research, we are willing to share a summary of the outcomes with anyone who shows interest.

We would be grateful if you could complete and return the questionnaire to the researchers within two weeks. Thank you again for your kind consideration.

Yours sincerely,

……

Daniel Yamoah Agyemang, Ph.D. Student

Dr Patrick S.W Fong, Associate Professor, Department of Building and Real Estate

The Hong Kong Polytechnic University, Hong Kong.

Preparing Construction Management Students towards a Knowledge-based Economy: A Comparative Study of Emerging and Established Economies

Questionnaire Survey

Important instructions:

1. Please, consider your experience in academia or construction industry to complete this survey.
2. Use any suitable symbol (such as "√") to indicate your opinions.
3. Please, you have TWO WEEKS to complete the questionnaire.
4. Your mobile number: _____and email address: _____
5. For any queries, please contact me via e-mail at: daniel.yamoahagyemang@_____.

SECTION A:

Information of Participants (Construction Industry Practitioner)

1. Your current professional affiliation
   ☐ Private sector ☐ Public sector……..☐ Both
2. What is your Highest academic qualification?
   ☐ HND/Diploma ☐ Undergraduate degree ☐ Masters/MPhil degree
   ☐ PhD Degree ☐ Other, please specify_____
3. What is your professional background?
   ☐ Quantity Surveyor ☐ Contractor ☐ Architect ☐ Project Manager
   ☐ Engineer ☐ Human Resource Manager ☐ Other, please specify_____
4. Years of working experience in the construction industry?
   ☐ 1-5 years; ☐ 6-10 years; ☐ 11-20 years ☐ Above 20 years
5. What are the key positions occupied by construction management students either as new hires or interns?
   ☐ Assistant Quantity Surveyors ☐ Supervisor ☐ Drafts man
   ☐ Technical Officers ☐ Other, please specify_____
6. What are the key duties of construction management students serving as interns or new hire?
   ☐ Preparing BOQs ☐ Drawing and interpreting building plans ☐ Site Supervision
   ☐ Contract Administration ☐ Project Management
   ☐ Others, please specify_____
   _____
   _____
   _____
   _____

SECTION B

Q1. Desirable Skillset, attributes & competence of Construction Mgt (CM) interns/new hires.

How important are the following skillset of CM students/new hires to the firm's growth?

1= Not important; 2= Less important; 3=Neutral; 4 Important; 5=Extremely important.

Please, indicate how satisfied employers are with these identified skillsets of new hires/interns.

1= Not satisfied; 2= Less satisfied; 3= Neutral; 4= Satisfied and 5= Very Satisfied

No	Skillset, Attributes and Competence		Level of Importance	Level of Satisfaction
1	**Technical Skills**	Plans interpretation/ Blueprint reading/Understanding construction & shop Drawings	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
2		Knowledge of construction operations	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
3		Knowledge of green and sustainable construction/ LEED	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
4		Scheduling	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
5		Knowledge of project closeout and handover procedures	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
6		Estimating	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
7		Cost accounting	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
8		Knowledge of construction materials	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
9		Knowledge of construction equipment	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
10		Economic and financial analysis	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
11		Knowledge of design	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
12		Value engineering/Constructability analysis/ Design Review	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
13		Scope review	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
14	**Professional Attributes**	Hands-on project experience prior to graduation/ Internship	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
15		Teamwork capabilities	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
16		High regards to values/ Work ethics	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
17		Planning and goal setting	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
18		Problem solving/ Analytical skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
19		Result orientation	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
20		Critical thinking	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
21		Decision making skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
22		Forecasting	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
23		Ability to follow up	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
24		Risk taking	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
25		Multi-tasking	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
26		Long term commitment	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
27	**Managerial Skills**	Quality assurance/ Total Quality Management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
28		Health and Safety management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
29		Project management/ administration	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
30		Cost control	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
31		Leadership	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
32		Site planning and management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
33		Personnel/ Resource management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
34		Risk planning, assessment and control	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5

35		Productivity management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
36		Knowledge and information management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
37	**Industry and Business Skill**	Knowledge of health and safety regulations	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
38		Knowledge of building codes and regulations	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
39		Knowledge of environment impact assessments	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
40		Marketing with clients/ Developing client relations	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
41		Knowledge of the permitting process	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
42		Awareness of industry trends	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
43		Entrepreneurship	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
44		Understanding lean culture	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
45		Understanding complementary fields/disciplines	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
46		Understanding global construction Environment	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
47	**Personal Attributes**	Listening ability/ Giving attention to details	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
48		Time Management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
49		Dependability	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
50		Personal adaptability/Flexibility	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
51		Desire to learn	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
52		Assertive attitude	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
53		Promptness in actions	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
54		Comprehension ability	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
55		Ability to learn	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
56		Innovative mindset/ Creativity	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
57	**Legal and Contractual Skills**	Interpreting contract documents	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
58		Knowledge of construction law and legal environment	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
59		Contract administration skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
60		Knowledge of bidding procedures	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
61		Dispute avoidance and resolution skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
62		Knowledge of project delivery and contracting strategies	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
63		Change management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
64		Understanding labor laws	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
65		Claims preparation and presentation Skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
66		Claims defense skills	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
67	**Digital Literacy Skills**	Knowledge of Artificial Intelligence Application in Construction Management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
68		Proficiency in construction information technology	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
69		Knowledge of construction data analytics	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
70		Proficiency in BIM technology software	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
71		Knowledge of construction simulation and modelling tools such as Web cyclone	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
72		Knowledge of big data applications in construction	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
73		Knowledge of Augmented/Virtual reality software applications in construction	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5

Please, if you would like to receive a summary of the research findings, kindly provide your email address.

Please, enter your email address_____

APPENDIX C

SURVEY QUESTIONNAIRE: VALIDATION OF STUDY

Validation Questionnaire: Doctor of Philosophy (PhD) Research into Preparing Construction Management Students Towards a Knowledge-based Economy: A developing economy's perspective

Purpose of Survey

This survey's purpose is to validate how applicable, practical and comprehensive the developed framework for construction management students' preparation is in the Ghanaian Construction Education (GCE) sector.

Selection Criteria of Expert (Respondent)

This study requires your experiential knowledge of construction education and skillsets required in GCE. Upon meeting the following criteria, you are deemed qualified to validate the framework: (1) "knowledge and in-depth understanding of the construction education and skillset concept", (2) "current/recent practical experience construction management students/graduates", and (3) "ten [10] years or more construction industry/academia experience".

Background of the Framework

The study's aim is "*to develop a framework that will serve as a guide for preparing construction management students towards a knowledge-based economy*". In accomplishing the study's aim, comprehensive review of literature, questionnaire surveys and interviews in Ghana were conducted. The findings have been consolidated from the various objectives into the developed framework.

Important Instructions

1) Please review the framework at the **Section II** and details in the **Table** before rating your agreement level using the five-point Likert scale with each of the seven validation questions.
2) Please do also provide feedback comments in the spaces provided under the framework.
3) Kindly complete the questionnaire within 2 weeks from today and return to researcher through email

Outline of Questionnaire

Section I: Requires the input of your profile information. Section II: Presents the final framework developed. Section III: Requires the input of your agreement level with each validation question using the 5-point Likert scale. Section IV: Requires you to add comments to help improve and finalize the framework.
Many thanks for your kind assistance.

Daniel Yamoah Agyemang, PhD Research Student.
Dr. Patrick S.W. Fong, Chief Supervisor, The Hong Kong Polytechnic University.

Emails: Daniel.yamoahagyemang@ .

SECTION I: Participants Background Information

1. Your current professional affiliation
   ☐ Academia ☐ Industry… ……..☐ Both
2. What is your Highest academic qualification?
   ☐ HND/Diploma ☐ Undergraduate degree ☐ Masters/MPhil degree
   ☐ PhD Degree ☐ Other, please specify_____
3. What is your professional background (Industry practitioner)?
   ☐ Quantity Surveyor ☐ Contractor ☐ Architect ☐ Project Manager
   ☐ Engineer ☐ Human Resource Manager ☐ Other, please specify_____
4. What is the nature of projects handled by your organization (industry practitioner)
   ☐ Building and Civil ☐ Building ☐ Civil ☐ Other, please specify_____
5. Years of working experience in the construction education/industry?
   ☐ 11-20 years; ☐ 21-25 years; ☐ 25-30 years ☐ Above 30 years
6. What are the key duties of construction management students serving as interns or new hire?
   ☐ Preparing BOQs ☐ Drawing and interpreting building plans ☐ Site Supervision
   ☐ Contract Administration ☐ Project Management ☐ Others, please

SECTION II: Developed Framework for preparing CM students for the industry

PLEASE INSERT THE ATTACHED FIGURE (FRAMEWORK) ABOUT HERE

SECTION III: Validation Questions

INSTRUCTION: Please rate the following validation questions relating to the developed framework for the Ghana Construction education sector based on the five-point Likert scale: 1= "strongly disagree", 2= "disagree", 3= "neutral", 4= "agree", and 5= "strongly agree"

S/N	Validation Question	1	2	3	4	5
1	The framework captures all the relevant concepts for the preparation of CM student towards the industry	☐	☐	☐	☐	☐
2	The framework is easily understandable and could be useful for both academia and industry's use	☐	☐	☐	☐	☐
3	The structure and relationships among all the constructs in the framework are organized appropriately	☐	☐	☐	☐	☐
4	The framework is objective, inclusive and reasonable	☐	☐	☐	☐	☐
5	The appropriate use of the Construction Professional framework would help to improve the performance of novice in the construction industry	☐	☐	☐	☐	☐
6	The overall framework is suitable for the successful management and performance of CM novice	☐	☐	☐	☐	☐
7	The practice framework will serve as a systematic reference for future work	☐	☐	☐	☐	☐

SECTION IV – Follow-up Reservations and Comments

Please indicate your reservations and comments in the space provided below to help improve the framework.

……
……
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