THE EFFECTS OF PEER INSTRUCTION THROUGH SOCIAL LEARNING ENVIRONMENT TOWARDS STUDENTS' COGNITIVE LOAD AND LEARNING PERFORMANCE

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DEDICATION

To GOD,
the custodian of supreme knowledge and wisdom,
who gives liberally to them that ask of Him

and

to the most important people in my life

My parents, Mr. Sunday Adeniyi Faniran and Mrs Esther Ajoke Faniran

My husband, Olanrewaju Steve Edwards

and

My children, Josephine Opeyemi, IniOluwa Stephen and Priscilla Boluwatife

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LIST OF ACRONYMS

BCI	-	Brain-Computer Interface
BDM	-	Backwards Design Model
CAQDAS	-	Computer Assisted Qualitative Data Analysis Software
CL	-	Cognitive Load
CLT	-	Cognitive Load Theory
CRG	-	Conditional Relationship Guide
CTs	-	ConcepTests
FB	-	Facebook without Peer Instruction
FB-DiS	-	Facebook Distraction Survey
FBPI	-	Facebook with Peer Instruction
HCA	-	Human Cognitive Architecture
HOTS	-	Higher Order Thinking Skills
ICT	-	Information Communications Technology
ID	-	Instructional Design
IPT	-	Information Processing Theory
ISD	-	Instructional Systems Design
LAWIX	-	Learning Activity Workload Index
LE	-	Learning Environment
LMS	-	Learning Management System
LOTS	-	Lower Order Thinking Skills
LP	-	Learning Performance
LTM	-	Long Term Memory

MCQ	-	Multiple Choice Questions
MKO	-	More Knowledgeable Other
NASA	-	National Aeronautics and Space Administration
NVivo	-	Nudist Vivo
OBE	-	Outcome Based Education
PI	-	Peer Instruction
Q-Q	-	Quartile-Quartile
SM	-	Sensory Memory
SRS	-	Student Response System
StD	-	Standard Deviation
SWAT	-	Subjective Workload Assessment Technique
T&L	-	Teaching and Learning
TLX	-	Task Load Index
TSQ	-	Text Search Query
WFQ	-	Word Frequency Query
WM	-	Working Memory
WP	-	Workload Profile
ZPD	-	Zone of Proximal Development

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Technology in education holds the potential to enhance the productivity of both students and teachers by cutting down the required effort, time and cost for tasks. Research has emphasized the positive impact of Information Communications Technology (ICT) in education (Amali et al., 2012; Rashmi, 2011; Marshall, 2012) and reports abound of studies in diverse fields and across disciplines of the great ways old and new ICTs have enabled improved teaching and learning (T&L) directly or indirectly.

With the arrival of Web 2.0 tools however, systems not originally designed for educational purposes are being leveraged upon for learning. Facebook, for example has fostered interconnectedness of users in ways not previously known (Datko, 2015; Grant & Osanloo, 2010) and as such, have shown great educational benefits (Forgie, Duff, & Ross, 2013; Tess, 2013). Their advantages, including the ability to support multimedia learning has been well reported (Claros & Cobos, 2013; Lee & Sing, 2013) in addition to being able to serve as a platform for academic communication and cooperative learning (Irwin, Ball, Desbrow, & Leveritt, 2012).

The advent of Facebook groups for example proved to be a new dimension in classroom communication (Meishar-Tal, Kurtz, & Pieterse, 2012; Melor Md Yunus & Salehi, 2012). Rheingold (2010) in his submission on what constitutes 21st-century social media literacies highlighted factors including network awareness and critical

consumption. He noted that the required fluency in the current education landscape is the ability to put those new forms of literacies together into what he described as the "way of being" in a digital culture. He noted particularly, the irreversible changes that emerging media and tools are effecting on current education. These realizations have led to the use of tools like Facebook in classrooms across the globe.

Employing these novel technologies in education is however not without challenges. There are reports on the adverse effects associated with their use; including academic-related ones like distraction and addiction (Dhaha, 2013; Jafarkarimi, Sim, Saadatdoost, & Hee, 2016; Richtel, 2010; Rosen, Mark Carrier, & Cheever, 2013). When these challenges are evaluated in terms of learning, the nature of the human memory system becomes a key issue that must be addressed.

The human memory system is composed of a Sensory Memory (SM) that receives information as various forms of stimuli; a short-term or Working Memory (WM) where information is believed to undergo processing, and a Long Term Memory (LTM) (Paas et al., 2008; Paas et al, 2004a, b) where processed information are stored permanently (Baddeley, 2010; Baddeley, 1992). The entire system layout is referred to as the Human Cognitive Architecture (HCA) (Byrne, 2003).

In cognitive activities including learning, the processing responsibility is measured as mental demand or Cognitive Load (CL) (Benassi, Overson, & Hakala, 2014; Paas, Renkl, & Sweller, 2003; Paas, van Gog, & Sweller, 2010). CL is thus related to mental tasks in the same way physical energy is related to physical tasks.

During social media-based learning, learners become susceptible to challenges from the activities inherent in the platform. Because these media are originally designed for social interactions, they do not take into account, conditions required for effective learning and these can represent sources of challenges to learners during learning. Studies have reported inability to focus and task switching (Judd, 2014; Rosen et al., 2013) as some of the ways in which learners may be affected. The consequence of this may include clogging of the WM, poor processing, ineffective transfer and poor storage (Liefooghe, Barrouillet, Vandierendonck, & Camos, 2008). In addition, schema formation may hindered and retrieval of stored

information at a later time may become ineffective, that is, learning may fail or become inefficient (Cavanagh & Alvarez, 2005).

Addressing these challenges to minimize demands on the working memory is therefore a key issue that instructors and instructional designers must give attention to (Sweller, van Merrienboer, & Paas, 1998). Strategies that improve processing and transfer and those that encourage schema formation are required in addressing these challenges. Pedagogical techniques that promote social and blended learning as well as metacognition and conceptual learning have been found to be very effective in this respect. Such techniques include peer instruction and other forms of collaborative and peer learning strategies that promote deeper processing. This is in line with Weimer's (2009). In addition, Mao (2014) in her study on the affordances of social media for learning, concluded that for social media to be effectively engaged as useful learning tools 'complicated efforts in designing, scaffolding, and interacting during the process are necessary'. Toland (2013) referred to the same concept as 'best practices' in the use of social media in education, though she offered no specific suggestions on what these might be.

The aim of this study is to address the challenges of distractions as cognitive load during learning on social media to bring about improved learning performance. The study is focused on the development of a formal pedagogical framework supported by the peer instruction model. The model takes into consideration factors that support effective instructional delivery through conceptual, collaborative and social learning and promotion of learning readiness, transfer of learning and reduction of cognitive load within the social media environment. The framework will constitute a foundation for best practices in the use of current social media for teaching and learning in addition to providing a blueprint for addressing similar challenges in future media.

1.2 Background of the Study

Social media have become inevitable tools in the twenty-first century classroom due to the great advantages that could be derived from their use in T&L. However, the challenge these tools pose to effective instruction remains a major issue with their use. These challenges are directly linked to information processing in the WM in terms of the limited capacity assumption. This is the ability of the WM to handle only a limited amount of information in parallel processing per time (Cowan et al., 2005; Yamamoto, Ito, & Watanabe, 1998). This amount of information represents the total cognitive capacity of the WM (Halford, Cowan, & Andrews, 2007). The information to be processed exerts a mental demand or total cognitive load (CL_t) which is a sum of its sub-components (Sweller, Ayres, & Kalyuga, 2011; Sweller, 2010).

In learning with social media, the need for qualitative means of addressing these challenges are critical issues that instructors and instructional designers have to face (Rheingold, 2010). This calls for proactive strategies in the design of instruction, the use of appropriate pedagogies and a rethink of classroom collaboration (Mao, 2014) to achieve greater effectiveness in teaching and learning.

1.2.1 Information Processing and Learning

The working memory is directly responsible for the processing of the information received by the sensory memory which is seated in the sense organs. However, the processing capacity of the working memory is non-extendable and it becomes ineffective when the maximum point is exceeded (Mayer & Moreno, 2003; Kirsch, 2000). This overloading of the working memory (Paas et al., 2008) can result in inefficient processing with consequent failure of transfer during learning (Paas, Renkl, & Sweller, 2004). This condition is captured in Cognitive Load Theory (CLT) as described by Paas et al. (2004; 2010) and van Merriënboer and Sweller (2005).

Instructional efforts should as such prioritize the reduction of cognitive demands on the brain's processing capacity.

Materials processed in the working memory and successfully transferred into the long term memory become permanent there, stored as chunks of information on whole processes referred to as schemas (Recker, 1996; McLeod, 2009). Pankin (2013) describes schema as 'an organized unit of knowledge for a subject or event'. It is made up of the entire known information associated with an item, entity or event. Schemas are based on past experiences. They are dynamic and change by accommodating new information gained on an 'object' or 'subject' represented.

Ghosh and Gilboa (2014) confirming these, describe schemas in terms of four features including its lack of unit detail, its adaptability or dynamism, its associative network structure and its basis on multiple episodes. Information stored as schema is said to have become automated, requiring no further or continuous processing but retrievable for use whenever needed (Wallis, 2010; Paas et al., 2003). This represents the ultimate goal of instruction which is to bring about a rich store of prior knowledge from completely processed learnt information or schema which are stored as huge chunks of information that requires no future processing. Figure 1.1 shows the conceptual model of information processing in the HCA.

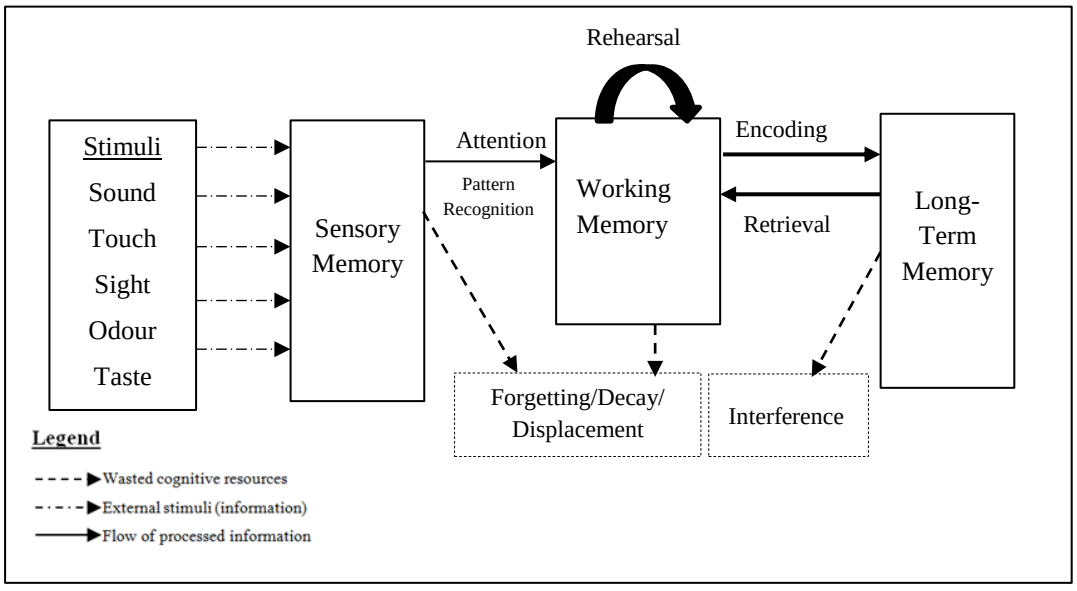

Figure 1.1: Information Processing Model

1.2.2 Cognitive Load Theory (CLT)

Cognitive Load Theory describes the components of total cognitive load (CL_t) or total demand on the memory for the learning of a material. Initial descriptions (Mayer, 2004, Mayer & Moreno, 2003; Paas et al, 2003) conceptualized total CL as made up of three components, intrinsic load (CL_{int}), extraneous load (CL_{ext}) and germane load (CL_{ger}), which are summative in nature. For instruction to be effective, this total amount, must not be greater than the working memory capacity (de Jong, 2010). Good instruction minimizes overall CL and especially, CL_{ext} (Paas et al., 2010)

The actual learning material or intrinsic load, as well as the unnecessary materials associated with the learning material and/or the learning process (extraneous load) together compete for available cognitive resources (WM capacity). These total 'load' is the sum of all cognitive activities occurring during learning and it describes the link between information processing and CLT. Figure 1.2 shows the relationship of CLT to HCA and information processing in the WM. It shows allocation of cognitive resources, flow of information from reception to schema formation and how cognitive resources are wasted in extraneous processing.

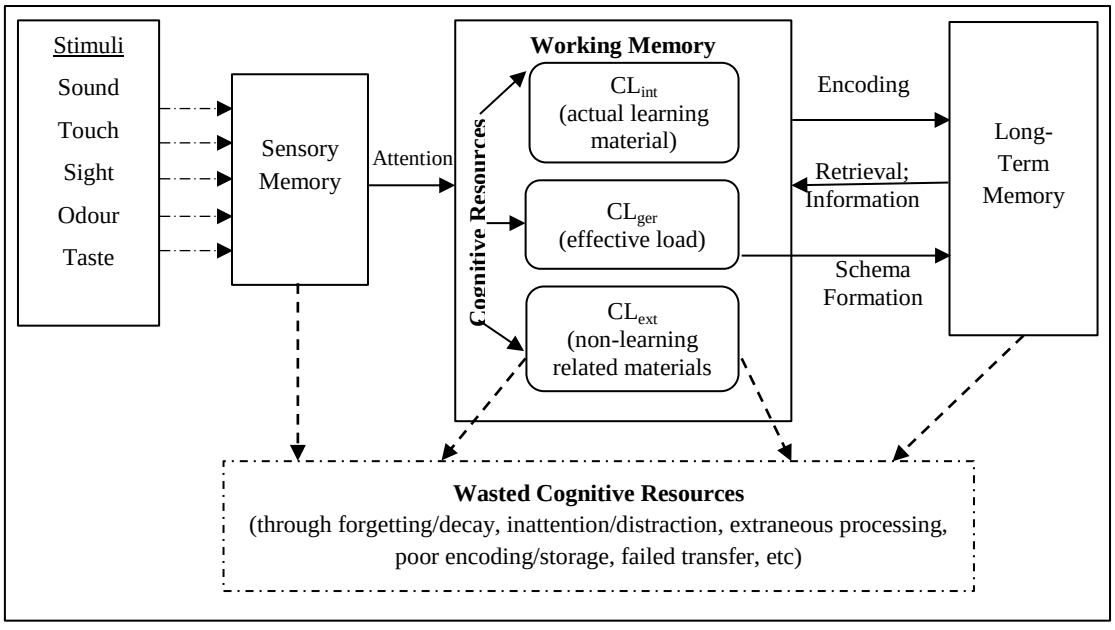

Figure 1.2: How Information Processing is related to Cognitive Load Theory

Information from Figures 1.1 and 1.2 show that cognitive resources are wasted in the instructional process through forgetting and decay which can be occasioned by extraneous processing, inattention, displacement and interference.

1.2.3 Implications of Social Media for Education

The implication of the status of information processing in the WM and the limited capacity for CL handling as discussed with respect to learning within the social media environment thus concerns the level of extraneous processing. This level can become very high as a result of the activities enabled on the platform, thereby compromising the learning process. For example, in one of their models of CL in relation to eLearning environments, Hollender, Hofmann, Deneke and Schmitz (2010) identified load due to software usage in addition to load induced by instructional design as contributing to extraneous load. Research also attests to the detrimental effect of distraction on the brain (Wallis, 2010) and the fact that 'distractions make learning hard' (Stevenson, 2006). These further strengthened the issues raised regarding the impact of social media-based education.

The implications of distractions on social media for education can also be evaluated from CL viewpoint. Studies by Edwards, Aris and Shukor (2015) and Lavie (2010) support the possibility that on social media, extraneous processing may override the actual learning material in the demand for cognitive resources and the significance of distractions during learning in terms of cognitive load. Lavie (2010) further observed that in conditions of high cognitive load on the working memory, attention deteriorates These observations have implications for education, implying the need for social media in education to employ the principles of Cognitive Load Theory. In particular, principles that promote essential and effective processing and those that reduce extraneous processing should be adopted.

Learning should be guided by the way the brain works (Project Flexner, 2012; McNeil, 2009; OECD, 2008; Schmidt et al., 2007; Kirschner et al., 2006) and

as such, should exclude processes that clogs the memory or impose unnecessary demands on its processing capacity. It should employ strategies that free the memory capacity for effective processing which support efficient transfer and storage. These include processes that support collaborative and active learning, two-way communication, rapid feedback and diverse ways of learning (Project Flexner, 2012) which have also been found to have capacity for reducing cognitive load during learning (Gerjets, Scheiter, & Catrambone, 2004; Mayer & Moreno, 2003a) but they are unachievable through regular lectures and most other traditional pedagogies (Mazur, 2013).

1.2.4 Reduction of Cognitive Load (CL) during Learning on Social Media

Recent studies (Chong, Wan, & Toh, 2012; Guastello, Shircel, Malon, & Timm, 2014; Leppink & van den Heuvel, 2015; John Sweller, Ayres, & Kalyuga, 2011b) in cognitive psychology and learning has focused on CL management. Collaborative learning techniques have been identified as ways by which learners' cognitive load can be managed for effective learning (Kolfschoten, 2011; Kolfschoten & Brazier, 2013). This is achievable through cognitive load sharing (Kirschner, Paas, & Kirschner, 2009), teacher-student interactions and peer learning (Roehl, Reddy, & Shannon, 2013). Collaborative learning techniques that employ blended and flipped learning modes support active learning (Karlsson & Janson, 2016), promote engagement, improved classroom interaction and multiple learning styles in addition to supporting efficient use of class time, instructional scaffolding through conceptual learning, learning readiness and segmentation of instruction (Arnold-Garza, 2014). A combination of these factors are identified as highly effective for achieving reduced cognitive load (Kalyuga, 2014; J. Liu, 2011; Mayer & Moreno, 2003b). These findings were further strengthened through a systematic review of literatures in collaborative learning techniques to evaluate their comparative effectiveness in promoting reduction of CL. A summary is provided in Appendix B. Figure 1.3 shows the systematic review process flow with the findings.

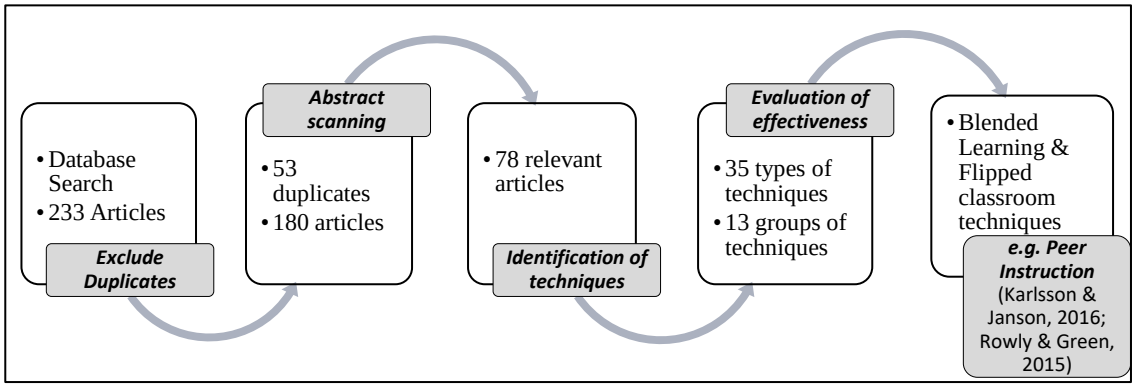

Figure 1.3: Systematic Literature Review Process Flow and Findings

These techniques are able to utilize a combination of several other techniques including Web 2.0 affordances, simulations, collaboration and ICT-supported learning modes. Others include peer- and discussion-based, role-play, mapping, problem-based and eLearning techniques. This is in line with Gilboy, Heinerichs, & Pazzaglia (2015). The study further discussed the usefulness of peer instruction (Mazur, 1997a, 1997b) as a technique that combines the advantages of blended and collaborative learning within the flipped classroom (Karlsson & Janson, 2016; Rowley & Green, 2015).

1.2.5 Peer Instruction

Peer Instruction is an active learning strategy that focuses on social and collaborative learning in addition to conceptual understanding. Peer instruction operates using four elements. These include the use of pre-class assignments aimed at giving learners early contacts with the to-be-learnt material. Conceptual questions known as ConcepTests (CTs) are posed to students to activate learning and provide feedback on students' understanding and previous knowledge. Classroom voting for students' choice of answers to the CTs shows students' reasoning, conceptions and misconceptions and helps the teacher to focus instruction on areas that requires more attention. Peer discussion is done after the voting session in small groups to foster

social and collaborative learning. This process in addition promotes self-reflection and metacognition. Kester, Lehnen, Van Gerven, & Kirschner (2006) reported on the reduction of cognitive load through Peer Instruction and just-in-time presentation of learning support.

PI has been used in many subjects by many instructors and researchers (Zingaro, 2010, 2012; Turpen & Finkelstein, 2010; Arnesen et al., 2013; Vaughan et al; 2011; Roth, 2012). Its effectiveness in promoting conceptual learning (Simon, Kohanfars, Lee, Tamayo, & Cutts, 2010) and meaningful learning (Cortright, Collins, & DiCarlo, 2005; Crouch & Mazur, 2001) has been validated. PI engages learners in the classroom (Fagen, 2002) in addition to increasing learners' motivation (Dogru, 2013) and promoting active classroom atmosphere (Conderman, Bresnahan, & Hedin, 2011). PI also provides the instructor with information for instructional adjustment. Overall, discussions regarding the advantages of PI had been significant in recent academic discourse.

The advantages of PI are also reflected as discussed in its ability to promote students' learning performance through its elements which contribute to the promotion of active and deeper learning, retention and transfer of learning.

1.2.6 Improving Learning Performance with Peer Instruction

The challenges a learner faces on social media may not just be that of inability to focus but also that of having to switch between tasks or perform more than a single task while learning. Rogers and Monsell (2014) discussed the switching costs of dual-task performance. They showed that the processing demands and difficulty in control in such situations account for reduced speed and inaccuracy. Junco (2012) also noted that social media use among student is negatively related to learning engagement, indicating positive relation to disengagement, distraction or inattention and poor outcomes (learning performance).

Teaching proceeds with the objectives learners should achieve at the end of the learning process (Shepard, 2000). Measuring learning outcomes or performance is thus a significant concept in teaching and learning. It provides the teacher with feedback on students' learning, helping the teacher evaluate own teaching in order to engage strategies required to assist learners (Brookhart, 2009). Measures of performance can also serve as an additional indication of students' cognitive load in the sense that cognitive overload burdens the working memory and hinders processing, transfer and storage and consequently, performance. In this manner, learning performance can be viewed as directly linked to cognitive load.

Peer Instruction was designed to address the challenges of frustration and lack of motivation during traditional instruction (Mazur, 2013). Through its various elements, PI has been reported to contribute to increased motivation and students' success (Dogru, 2013). ConcepTests improves students' motivation and conceptual learning (Donovan, 2008; Mcconnell et al., 2006) and contribute to active learning (Piepmeier, 1998). Peer discussion promotes social and meaningful learning as well as problem-solving abilities (Cortright et al., 2005). PI has also been noted to improve learners' self-efficacy and learning outcomes (Antimirova, Kulesza, Noack, & Stewart, 2015; Fagen, 2003; Zingaro, 2014).

1.2.7 Research Gap

The foregoing discussion addressed the use of social media in learning (Roblyer, McDaniel, Webb, Herman, & Witty, 2010) and the usefulness of the platform as a tool whose advantages can be employed for academic communication. The relationship between social media use in education, student disengagement and cognitive load were also noted. It has been shown that engagement, motivation and reduced CL can be promoted through active learning pedagogies; especially those that leverage on blended and flipped learning. PI has been shown to have the ability to foster engagement, promote attention, reduce CL and create an active classroom based on flipped and blended learning modes (McCallum, Schultz, Sellke, & Spartz,

2014; Rowley & Green, 2015). Based on these characteristics, this study proposes the employment of PI as a measure of addressing the problems of students' CL during learning on social media.

Despite the significant advantages that PI offers, some challenges with implementation have been reported. ConcepTests (CTs) and clickers or Student Response Systems (SRSs) are central to PI implementation; however, the cost implication of providing clickers at whole-institution levels or in large classes does not seem practical (Crouch et al., 2004). Other issues highlighted in a global survey of instructors implementing PI include the time and effort demand for developing ConcepTests (CTs). The inadequacy of the available time for conducting the PI classroom procedure in a regular class session based on school time-table was also noted. The limitations of multiple choice question items in providing the teacher with adequate information on the concepts that underlie students' thinking is also a key issue. The ability to engage all students in the PI classroom process and students' resistance to active participation in discussions are other issues noted in addition to the traditional requirement for syllabus content coverage by institutions' mangers.

Attempts at improving current PI model have not been too rigorous. A recent review by Antimirova, Kulesza, Noack and Stewart (2015) on reported the use of student-generated multiple-choice format questions instead of instructor-developed CTs. Carrington and Green (2007) also suggested that new technologies may be leveraged for integrating regular formative e-assessment into learning objects to provide instructors with feedback on students' needs and knowledge gap for achieving more effective teaching. However, they did not go further to discuss how this may be done.

The implementation challenges identified with current PI model therefore inform the need for an integrated model of PI. Such a model will be such that addresses the implementation challenges of insufficient time, CT type and development, SRSs issues, student engagement and participation among other things, without compromising syllabus coverage.

The challenges with CTs are currently being addressed through the development of databases of CTs across disciplines made freely available online. An example is the Force Concept Inventory by Mazur group which has been used by many instructors and in many research studies (Antimirova et al., 2015; Coletta & Phillips, 2005; Fagen, 2002). However, CTs databases are mostly focused on the mathematical and natural sciences. Attempts at CTs in the social and behavioural sciences and Arts are yet to receive serious attention. Review of literatures with regards to the focus of this study identified gaps in addressing the disadvantages of social media in learning especially in terms of cognitive load. Other gaps noted include the need for a revision/modification of current implementation model of Peer Instruction and the implications for instruction within various learning environments. Detailed information on the review of literatures is provided in Chapter 2.

1.3 Statement of the Problem

The emergence of social media as learning tools has transformed communication in all sectors including education. Social media however also constitute challenges to effective learning due to their ability to promote distraction, waste cognitive resources and induce cognitive load (Jackson, Kleitman, & Aidman, 2014; Lavie, 2010). These can frustrate the learning process as well as the long term instructional goals of transfer, storage and retrieval. However, due to the several advantages that social media provide, instructors appear carried away with the lure of these tools without much attention to the critical challenges they pose. There remains a gap in in the literatures on research in social media for education, especially as it concerns the specific implications of the features of the tools in relation to the mental demand or cognitive load associated with their use in education. The literatures have yet to address the problem despite the fact that many institutions of higher learning currently employ social media in instruction.

Peer instruction is able to integrate collaborative, blended and flipped learning approaches, for addressing improved learning performance (Antimirova et

al., 2015; D. A. Mcconnell et al., 2006; Zingaro & Porter, 2014) and reduced CL (Kolfschoten, 2011; Quiroga, Crosby, & Iding, 2004; Yu, Chen, Kong, Sun, & Zheng, 2014). Though the benefits of the current model of Peer Instruction have been reported, a few challenges have also been identified with its implementation. Hence, this study will in addition propose a review of the current Peer Instruction implementation process for addressing CL during learning on Social Media.

1.4 Research Objectives

The study was carried out in two phases. Findings from phase 1 guided the main study (phase 2) which addressed the following objectives:

i. To design learning process in social media learning environment based on Peer Instruction for reducing students' cognitive load.
ii. To assess the effect of Peer Instruction in learning through social media for:
    a. Enhancing students' performance
    b. Reducing students' cognitive load
iii. To identify sources of students' cognitive load during learning on social media
iv. To investigate student preferences on the factors of peer instruction that reduce students' cognitive load during learning on social media.
v. To develop a modified framework of peer instruction implementation for reducing cognitive load during learning on social media.

1.5 Research Questions

Based on the above objectives, the following research questions are generated:

i. What is the effect of Peer Instruction in learning through social media for:
    a. Enhancing students' performance?

b. Reducing students' cognitive load?

ii. What are the sources of students' cognitive load during learning on social media?

iii. What are student preferences on the factors of peer instruction that reduce students' cognitive load during learning on social media?

iv. What is the modified framework of peer instruction implementation for reducing cognitive load during learning on social media?

1.6 Theoretical Framework

This study is designed with a focus to address a learning problem (cognitive load) within a particular learning environment (social media) through the application of an instructional approach (peer instruction) that possesses an inherent capacity to address the problems identified. The noted problems stems from the limitation of the human working memory in handling huge amounts of information at any given time (information processing theory). For instruction to be effective, the cognitive capacity of the WM, that is, the maximum amount of information (CL or mental demand it can handle per time) must be more than the total CL of the learning material. The component of this maximum CL is described by the cognitive load theory.

This study is therefore guided by the information processing and cognitive load theories as well as the peer instruction model. Figure 1.4 shows the interplay of these factors and principles in the theoretical framework of the study. The concepts are discussed briefly in the following sub-sections while more detailed discussions are provided in relevant sections in Chapter 2.

Learning on social media, such as Facebook entails a complex play of scenarios that promote social, personalized, multimedia and collaborative learning, in addition to serving as an informal learning management system (Hew, 2011; Judele, Tsovaltzi, Puhl, & Weinberger, 2014; Wang, Woo, Quek, Yang, & Liu, 2012)

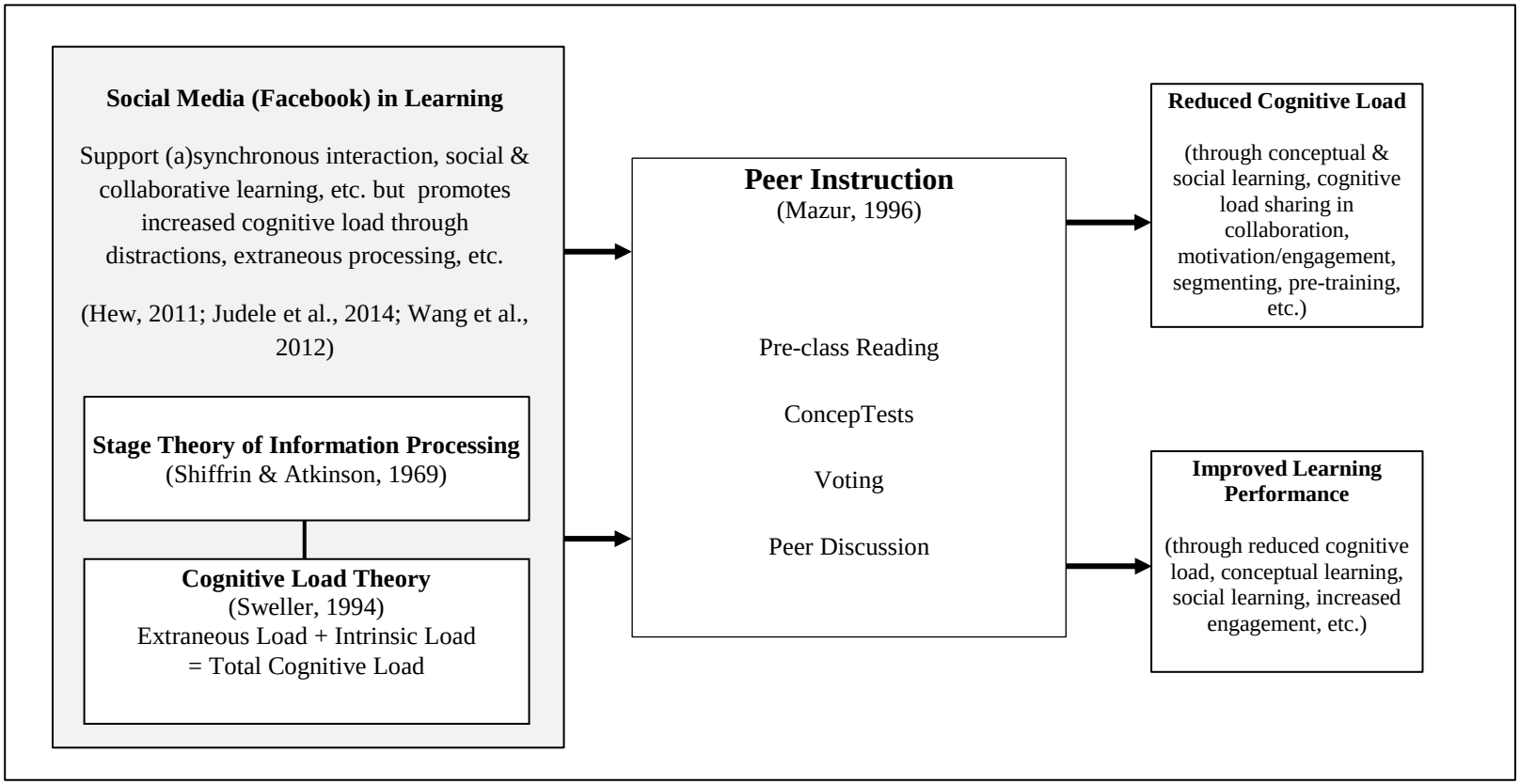

Figure 1.4: Theoretical Framework

However, because of the limitation of the human working memory in handling huge amounts of information per time (Baddeley, 2010; Kalyuga, 2007), the scenario also incorporates factors that are detrimental to learning. These include distractions, waste of cognitive resources in extraneous processing and increased cognitive load which are capable of compromising effective instruction (Edwards et al., 2015; Gupta & Irwin, 2014; Lavie, 2010b). These issues are captured in information processing and cognitive load theories.

Cognitive Load Theory (CLT) was developed by John Sweller in the early 1980s (Sweller, 1994). Cognitive load refers to the demand placed on the memory system for the achievement of a particular task and it is composed of the intrinsic, extraneous and germane cognitive loads which sum up to the total cognitive load induced by a learning material. While intrinsic load is native to the learning material and cannot be manipulated, extraneous load wastes cognitive resources and hence, undesirable. CLT is therefore concerned with the design of instruction with a focus on the efficient use of the limited cognitive capacity of the human working memory to ensure effective transfer and storage (Paas, Tuovinen, Tabbers, & Van Gerven, 2003). This will aid consequent automation or formation of schemas.

The peer instruction process involves conceptual learning, collaboration, self-evaluation, cognitive load sharing, increased motivation/interest, higher engagement and other factors that bring about improved attention and focus. The effect is that cognitive capacity is freed for allocation to deeper learning which results in effective transfer, storage and schema formation. Hence, employing peer instruction for instruction within the social media learning environment holds the promise of reduce total cognitive load.

Reduced cognitive load has however been noted to have a direct relationship with improved performance, hence, when cognitive load reduces through engaging peer instruction, learning performance also improves. In addition, the elements of peer instruction, including conceptual tests and peer discussion as well as voting have been noted to promote social, conceptual and peer learning and to increase students' self-efficacy, motivation and engagement. Each these factors also influences learning outcomes positively.

1.7 Conceptual Framework

The conceptual framework presented in Figure 1.5 features the advantages derivable from and the challenges inherent in employing Facebook in education and how Peer Instruction contributes to addressing the challenges and promote effective learning. The research approach (mixed method) and how the different steps are leveraged in the two phases are indicated in addition to relevant information with respect to the research methodology.

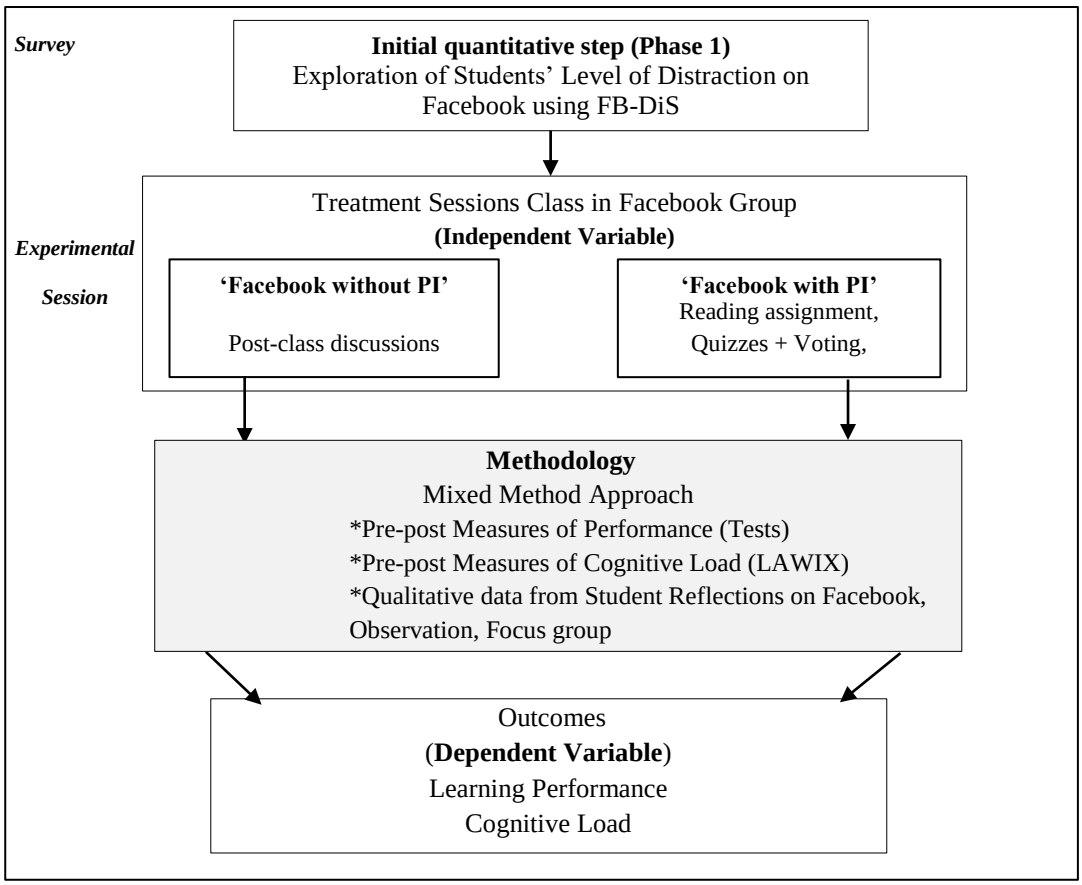

Figure 1.5: Conceptual Framework

Two treatment procedures constituting the independent variables in the study were conducted as learning sessions on social media (Facebook). The main study objective is reducing cognitive load during learning on social media. The outcomes or dependent variables are measures on the independent variables. Quantitative as well as qualitative data were collected during the sessions. Information from the data are indicated in the outcomes which represent the dependent variables.

1.8 Research Significance

The 21st century classroom is becoming more tech-focused everyday with the emergence of new media and tools. The future of the classroom is undoubtedly greatly dependent on current and future gadgets and media. Instructors, instructional designers as well as learners cannot overlook the possible negative effects of these tools while continuing to take advantage of the positive opportunities they offer for enhancing learning.

Findings from the study have implications for theory, practice and methodology. On-going debates regarding Cognitive Load Theory and the components of total cognitive load (Debue and van de Leemput, 2014; Kalyuga, 2011; Leppink and van den Heuvel, 2015;) are among issues that are addressed by findings from the study. The theories of information processing, attention and other issues theory-related issues are also addressed. In addition, important concepts in teaching and learning, and particularly online and distance learning are other relevant issues addressed in the study. The study also has significance for mixed methods research and cognitive load measurement. The instruments developed for use in the study as well as the findings present directions for future studies.

The challenges posed by social media tools in education, especially in terms of increased mental demand or cognitive load and the negative effects on the key instructional goals of transfer, storage and retrieval has yet to receive considerable attention in educational studies. This study will suggest a solution for addressing the issue of increased students' cognitive load and the resulting problems it poses to learning in social media-based education. Findings will provide guidelines for the employment of social media for learning by proposing a model for its implementation through the peer instruction pedagogy. The study will in addition inform the proper understanding of the nature and use of the social network interface as a multimedia learning platform. It will contribute to the body of literature available in the areas of effective learning strategies, active learning, cognitive load theory, student-centered learning, mediated instruction and innovative assessment among many other concepts that are becoming critical to 21st century education.

Results from the study will advise the proper use of social network and other web-based tools of the future for educational purposes. The model will represent best practices in social media-based education specifically and online/web-based learning in general. Findings from the study will shed light on the importance and benefits of Peer Instruction as an effective pedagogy in addition to validating its usefulness for reducing student cognitive load and enhancing effective learning. It will contribute to on-going global studies in PI implementation. Furthermore, PI on a social platform will simplify the PI implementation process. It will address key challenges with the use of ConcepTests, response systems and insufficient class time noted in previous studies (Carrington & Green, 2007; Crouch & Mazur, 2001; Fagen, 2003).

1.9 Operational Definition

This section provides a definition of the key terms used in this study. It provides general definitions as well as specific definitions as it applies to this study.

1.9.1 Social Media

Social media refers to online platforms where social interactions take place among people who share some things in common. These individuals may or may not have real-life connections but are connected in ways whereby they can share information of different kinds including text as well as multimedia materials (Boyd & Ellison, 2007). It is also described as a web-based platform that provides several means of connections to individuals who are subscribed to them (Awake, 2012). In this study, social media refers to the Facebook platform/interface. Learning through social media is organizing instruction to take advantage of online social platforms like Facebook, Twitter, Google, YouTube, Wiki, etc. (Liu, 2010; Ravenscroft, Warburton, Hatzipanagos, & Conole, 2012). In this study, it refers to the use of Facebook group for learning purposes.

1.9.2 Cognitive Load

Cognitive load refers to mental effort or the extent of demand placed on the mental system of a learner for a particular learning task (Windell &Wiebe, 2007; Paas et al, 2003). The total cognitive load is the sum of the intrinsic, that is, the load inherent difficulty of material, also referred to as element interactivity (Sweller, Ayres, & Kalyuga, 2011) and extraneous load, referring to all other demands external to the learning material including those generated by the learning environment, distractions and other unnecessary materials (Fong, 2013; John Sweller et al., 2011b). In this study, Cognitive Load refers to the mental demand on the learner required to cope with the requirements of learning within the social media environment on Facebook. It refers specifically to the distractions experienced by learners on Facebook due to multi-tasks and inattention, affective demands, as well as the mental demands placed by the difficulty of the actual learning tasks.

1.9.3 Reducing Cognitive Load

Reducing cognitive load refers to efforts at reducing the demand placed on a learner for a particular learning task (Bertolo, Vivian, & Dinet, 2014; Quiroga et al., 2004). This includes efforts at reducing both total cognitive load as well as either of intrinsic or extraneous load (Chong et al., 2012; Kalyuga, 2014). This can employ several measures including instructional design as well as the use of appropriate pedagogies (van Merrienboer, Kirschner, & Kester, 2003). In this study, reducing cognitive load refers to efforts at lowering the demand placed on the learner for learning on social media.

1.9.4 Peer Instruction

Peer Instruction is defined as an ‘effective method of instruction that exploits classroom interaction among learners and focuses on the teaching of the underlying

concepts of a particular subject as a means of fostering better understanding and performance among learners (Mazur, 1996). It is also defined as an instructional method that engages learners in knowledge sharing as a means of encouraging understanding and improving learning through teaching others (Fagen et al, 2002) and one that transforms a standard, passive lecture into an opportunity for students to answer questions individually and in groups (Zingaro, 2012). In this study, the term is used to refer to instructor-guided instruction, focused on students' engagement and motivation through individual contributions from all participants.

1.9.5 Learning Performance

Learning performance refers to measures of learning outcomes which are usually taken during or immediately after instruction (Soderstrom & Bjork, 2015). It serves as a measure of the effectiveness of teaching and learning as well as of schools (Johnson, 2012) and a measure of the actual achievement at the end of a learning programme (Harden, Crosby, & Davis, 1999). In this study, learning performance refer to measures of students' learning as evaluated through various outcomes measures including quantitative measures through graded and ungraded tests, and qualitative measures through student reflections, votes, peer discussions and focus group

1.10 Summary

This chapter introduces the study; it provides a background on how the study is situated within past and current studies within the field. The aims of the study were presented in addition to the related frameworks. The benefits of ICTs in education and how this has influenced current classroom practices regarding the employment of new and emerging technologies were discussed. Cognitive load induced by social media when engaged in teaching and learning was highlighted as constituting a key challenge in education due to its negative effect on information processing that is

capable of jeopardizing effective learning. The implication of this for the human memory system with respect to learning and transfer was highlighted.

This study aims to address this issue by suggesting a pedagogical framework for that will represent best practices in the use of social media for education. It aims to achieve this by employing peer instruction for education on social media. The capabilities of peer instruction in reducing cognitive load being a function of its ability to combine multiple learning opportunities in blended and cooperative learning mode within the flipped classroom. Key issues including the background of the problem, the problem statement, research focus and significance and definitions of key terms as employed in the study were discussed. The chapter closes with a conclusion that provides a summary of the chapter.

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