

**UNIVERSITY OF EDUCATION, WINNEBA**

**COMPUTER-ASSISTED INSTRUCTION (CAI) USAGE IN  
TEACHING GRAPHIC DESIGN IN SENIOR HIGH SCHOOLS IN  
THE EASTERN REGION**



**2025**

**UNIVERSITY OF EDUCATION, WINNEBA**

**COMPUTER-ASSISTED INSTRUCTION (CAI) USAGE IN TEACHING  
GRAPHIC DESIGN IN SENIOR HIGH SCHOOLS IN THE EASTERN  
REGION**



**A thesis in the Department of Art Education,  
School of Creative Arts, submitted to the school of  
Graduate Studies in Partial Fulfilment  
of the requirements for the award of the degree of  
Master of Philosophy  
(Art Education)  
in the University of Education, Winneba**

**JULY, 2025**

## DECLARATION

### Student's Declaration

I, Jacob Kwesi Fofu, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

**Signature**.....

**Date**.....

### Supervisors Declaration

We hereby declare that the preparation and presentation of this thesis was supervised in accordance with the guidelines set for thesis laid down by the University of Education, Winneba.

**Name of:** Dr. Agbeyewornu Kofi Kemevor (Principal Supervisor)

**Signature**.....

**Date:**.....

**Name of Supervisor:** Dr. Cyril Kpodo (Co-Supervisor)

**Signature**.....

**Date:**.....

## **DEDICATION**

This work is dedicated to God Almighty, for his protection and care upon my life. I also dedicate this work to my wife Lydia Wemegah and my son Edudzi Fofu, not forgetting Dr. Albert Boamah for his assistance.



## ACKNOWLEDGEMENTS

I give Glory to God, the one in whom I live and have my being, for His strength and guidance during this study. I acknowledge the immense care, support and directions I received from Dr. Agbeyewornu Kofi Kemevor who guided, mentored and indeed taught me the basic tenets in research and report writing. I wish God's guidance and blessing for him in all his endeavours. Dr. Cyril Kpodo, the Co-Supervisor, who also helped me through this study, I will forever remain grateful to him. My sincere appreciations go to my family members for their support. When all seems to fade out, they were there to save me with their rich counselling.



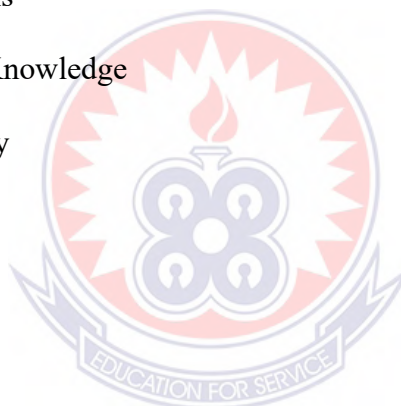
## TABLE OF CONTENTS

<b>Content</b>	<b>Page</b>
<b>DECLARATION</b>	<b>iii</b>
<b>DEDICATION</b>	<b>iv</b>
<b>ACKNOWLEDGEMENTS</b>	<b>v</b>
<b>TABLE OF CONTENTS</b>	<b>vi</b>
<b>LIST OF TABLES</b>	<b>x</b>
<b>GLOSSARY</b>	<b>xi</b>
<b>ABSTRACT</b>	<b>xii</b>
<b>CHAPTER ONE: INTRODUCTION</b>	<b>1</b>
1.1 Overview	1
1.2 Background to the Study	1
1.3 Statement of the Problem	3
1.4 Purpose of the Study	4
1.5 Objectives of the Study	5
1.6 Research Questions	5
1.7 Significance of the Study	5
1.8 Delimitations of the Study	6
1.9 Definition of Terms	6
1.10 Organization of the Rest of the Text	7
<b>CHAPTER TWO: LITERATURE REVIEW</b>	<b>8</b>
2.1 Overview	8
2.2 Purpose of the Literature Review	8
2.3 Mapping of the Review of Literature	9

2.4 Theoretical Framework	10
2.4.1 Constructivism	10
2.4.2 Behaviourism.	14
2.4.3 Integrating Theories in CAI	18
2.5 Teaching	20
2.6 Teaching Methods in CAI and Graphic Design	23
2.7 Learning and CAI Integration	25
2.8 Learning Styles	27
2.9 Computer-Assisted Instruction (CAI)	29
2.10 Computer-Assisted Instruction in Graphic Design Education	32
2.11 The Efficacy of Computer-Assisted Instruction in Graphic Design Education	35
2.12 Impact of CAI on Learning and Students' Achievement	39
2.13 Challenges of Computer-Assisted Instruction (CAI) in Education	43
2.14 ICT Policy in Ghana	45
2.15 Empirical Review	48
2.16 Digital Pedagogy in Visual Arts Education	51
2.17 Teacher Professional Development for CAI Integration	54
2.18 Equity and Access in Technology-Based Art Education	56
2.19 Emerging Trends in Digital Literacy and 21st Century Skills in Art Education	59
2.20 Evaluation and Assessment in CAI-Based Art Education	61
2.21 Curriculum Alignment and Policy Support for CAI in Visual Arts	64
2.22 Integration of Local Culture and Indigenous Knowledge in Digital Art Curricula	66
2.23 Role of Educational Leadership in Promoting CAI in Visual Arts	68

2.24 Summary of Literature	71
<b>CHAPTER THREE: METHODOLOGY</b>	<b>73</b>
3.1 Overview	73
3.2 Philosophical Underpinning of the Study	73
3.3 Research Approach	75
3.4 Research Design	77
3.5 Population	78
3.6 Sample size	79
3.7 Sampling Technique	80
3.8 Data Collection Instrument	81
3.8.1 Semi-structured Interview	81
3.8.2 Participant Observation	82
3.8.3 Document Analysis	83
3.9 Data Collection Procedure	84
3.10 Data Analysis Plan	85
3.11 Trustworthiness of the Study	88
3.12 Ethical Consideration	89
3.13 Chapter Summary	90
<b>CHAPTER FOUR: DATA PRESENTATION ANALYSIS AND</b>	
<b>DISCUSSION</b>	<b>91</b>
4.1 Overview	91
4.2 Demographic Characteristics of Respondents	91
4.3.1 Overview of the Analytical Approach	93
4.3.2 Researcher Role and Reflexivity	93

4.4 Thematic Presentation of Findings	94
4.3.2 Discussion of Findings on Available Instructional Technologies	99
4.3.3 Discussion of Findings on Barriers to CAI Adoption	112
<b>CHAPTER FIVE: SUMMARY, CONCLUSION, AND</b>	
<b>RECOMMENDATIONS</b>	<b>117</b>
5.1 Overview	117
5.2 Summary of the Study	117
5.3 Key Findings	118
5.4 Conclusion	121
5.5 Recommendations	123
5.5 Contribution to Knowledge	126
5.7 Chapter Summary	126
<b>REFERENCES</b>	<b>127</b>
<b>APPENDIX A</b>	<b>140</b>
<b>APPENDIX B</b>	<b>142</b>
<b>APPENDIX C</b>	<b>143</b>
<b>APPENDIX D</b>	<b>146</b>
<b>APPENDIX E</b>	<b>148</b>
<b>APPENDIX F</b>	<b>152</b>



## LIST OF TABLES

<b>Table</b>	<b>Page</b>
1: Thematic Map of Literature Review	9
2: Distribution of Population Based Teachers	79
3: Distribution of Samples Based on Teachers	80
4: Professional Background of Teacher Participants (N = 6)	92



## GLOSSARY

CAI	Computer-Assisted Instruction
CRDD	Curriculum Research and Development Division
ECAIQ	Computer-Assisted Instruction Questionnaire
GES	Ghana Education Service
ICT	Information Communication and Technology
SHS	Senior High School



## ABSTRACT

In Ghana, integrating Computer-Assisted Instruction (CAI) is essential for aligning Graphic Design education with contemporary digital practice. However, a significant gap persists between national ICT policy aspirations and classroom reality in Ghana. This study explored the integration of CAI in the teaching of Graphic Design within selected Senior High Schools in the Abuakwa North Municipality. Guided by an integrated theoretical framework of Constructivism and Behaviorism, the study pursued three objectives: to investigate available instructional technologies, explore current CAI practices, and assess systemic barriers to adoption. A qualitative research design was employed, using semi-structured interviews with six Graphic Design teachers and non-participant observations. Data were analysed through thematic analysis. The findings revealed a fragile technological foundation characterised by scarce and outdated hardware, unreliable utilities, and negotiated access. CAI practices were predominantly teacher-centred, relying on demonstrations and constrained group work due to resource limitations, though student engagement was notably high. The most profound barriers were systemic, with the high-stakes examination (WASSCE) favouring manual skills acting as the primary disincentive. This was compounded by a critical lack of subject-specific teacher training, attitudinal resistance to digital art, and inflexible school timetables. The study concludes that meaningful CAI integration is hindered not merely by a lack of resources, but by a complex ecosystem of conflicting assessment priorities, inadequate professional support, and institutional culture. It recommends strategic reforms, including revising national assessment to include digital portfolios, mandating specialised digital pedagogy training for teachers, and ensuring stable foundational infrastructure in schools to bridge the gap between policy and practice in Graphic Design education.

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Overview**

This chapter introduces the study's framework, including background, problem statement, objectives, purpose, delimitation, and significance. Key terms are defined to clarify the scope, and the chapter concludes with an overview of the thesis structure.

#### **1.2 Background to the Study**

Art serves as a foundational element in the development of societies, contributing significantly to cultural identity. The contribution of art in Ghana is recognized not only for its cultural values but also for its role in equipping learners with employable skills and supporting national development. The Visual Arts program was introduced at the Senior Secondary School level in 1991 because art was recognized to have enormous contributions to life. The program sought to preserve cultural heritage while preparing students for vocational careers (Curriculum Research and Development Division [CRDD], 2007). The CRDD (2007) emphasized its dual role in fostering creativity and addressing industrial demands, though implementation gaps persist.

Within the Visual Arts program, Graphic Design stands out as a critical subject. It uniquely blends artistic creativity with technological application, preparing students for careers in the fast-growing media and design industries. The Graphic Design syllabus is inherently practical, demanding consistent hands-on activity to ensure students master the necessary competencies before they graduate (CRDD, 2007). In today's world, these competencies are increasingly digital.

Acknowledging this shift, the Ghanaian government launched the ICT for Accelerated Development policy (ICT4AD) in 2003. This national framework promotes the integration of digital tools into all sectors, including education, to foster a more skilled and competitive workforce (Ministry of Communications, 2003). In line with this, many schools have received computer laboratories and other technological resources.

A key method for using these resources is Computer Assisted Instruction (CAI). This involves using computers to deliver lessons, provide interactive tutorials, and offer simulations, making learning more dynamic and often allowing students to progress at their own pace (Roblyer & Doering, 2013). For a subject like Graphic Design, which requires both technical skill and creative problem solving, CAI offers powerful tools. It can help students learn precise software techniques while also providing a digital space for experimentation and original design.

However, there appears to be a significant gap between national policy and what happens in many Visual Arts classrooms. Despite the push for digital integration, teaching methods in Graphic Design often remain heavily reliant on traditional, teacher centred approaches (Kushiator, Adashie, Ayim, & Klodzi, 2023). This creates a contradiction. Students are learning a digitally driven trade using largely manual methods, which may leave them underprepared for the actual tools and processes used in the professional design world.

While a lack of computers or internet is often cited as a barrier, the problem is more complex. There is a lack of deep, contextual understanding of how teachers and students are actually navigating this digital transition. Little is known about the specific experiences of Graphic Design teachers in Ghana: what software they use,

how they incorporate it into their lessons, and what they perceive as the biggest hurdles beyond just equipment. Understanding these human perspectives is crucial.

### **1.3 Statement of the Problem**

The Government of Ghana has long recognized Information and Communication Technology (ICT) as a vital tool for educational modernization, as outlined in the Ghana ICT for Accelerated Development (ICT4AD) policy (Government of Ghana, 2003). Subsequent initiatives have aimed to provide computer laboratories and relevant software to Senior High Schools (SHSs), creating a national infrastructure intended to support technology-enhanced learning across all subjects, including practical disciplines like Graphic Design within the Visual Arts programme (Ministry of Education, 2019). In the Abuakwa North Municipality, this policy context creates significant potential for Graphic Design instruction to adopt interactive, digital approaches that mirror contemporary creative industries.

Despite this substantial investment and supportive policy environment, a significant disconnect persists between resource availability and classroom practice. Instructional methods in many Graphic Design classrooms remain predominantly traditional and teacher-centred, with limited adoption of innovative pedagogies like Computer-Assisted Instruction (CAI) (Gyemfi & Boateng, 2021). This indicates that the mere presence of technology does not guarantee its effective pedagogical integration. Consequently, the potential of existing ICT resources to create engaging, personalized, and industry-relevant learning experiences for Graphic Design students remains largely unrealized.

This gap between policy intent and teaching practice has critical implications. It hinders the development of essential digital literacies and practical software competencies that students need to thrive in the 21st-century creative economy

(Kushiator et al., 2023). As a result, students may complete their SHS education inadequately prepared for further studies or vocations in graphic design, thereby undermining the core objectives of the Visual Arts curriculum and the national digital education strategy.

While existing research explores broad ICT integration in Ghanaian education (e.g., Agyemang & Dadzie, 2023; Buabeng-Andoh & Essel, 2023), there is a little of in-depth, research that specifically investigates the use of CAI in teaching Graphic Design, particularly within the context of the Abuakwa North Municipality. A focused exploration is needed to understand not just if technology is available, but how teachers are using it, the specific barriers they face beyond infrastructure, and their lived experiences in navigating this digital transition. This study is designed to address this precise gap by exploring the current practices and systemic barriers to CAI integration in Graphic Design classrooms in selected SHSs in the Abuakwa North Municipality.

#### **1.4 Purpose of the Study**

The purpose of this study is to gain an in-depth understanding of Computer-Assisted Instruction (CAI) integration in the teaching of Graphic Design. Focusing on selected Senior High Schools in the Abuakwa North Municipality, it extends to investigate the available instructional technologies, explore the current CAI practices of Graphic Design teachers, and identify the systemic and pedagogical barriers that impede its effective adoption.

### **1.5 Objectives of the Study**

This study aims to:

1. To investigate the available instructional technologies for teaching and learning Graphic Design in the Senior High Schools in the Abuakwa North Municipality.
2. To explore the current practices of Computer-Assisted Instruction (CAI) in Graphic Design classrooms in senior high schools in the Abuakwa North Municipality.
3. To assess systematic and pedagogical barriers to CAI adoption in the Graphic Design classroom in the Senior High Schools in the Abuakwa North Municipality.

### **1.6 Research Questions**

The following research questions guided the investigation of the study:

1. Which instructional technologies (e.g., Software, hardware, and digital resources) are available for teaching Graphic Design in Senior High Schools in the Abuakwa North Municipality?
2. How are CAI experiences being taught by Graphic Design teachers in Senior High Schools in the Abuakwa North Municipality?
3. What do teachers perceive as the barriers/challenges to effective use of CAI in Graphic Design classroom in the Senior High Schools in the Abuakwa North Municipality?

### **1.7 Significance of the Study**

This study has several potential benefits for different stakeholders in art education. This study aligns with Ghana's ICT4AD policy goals (Ministry of Education, 2018) by providing empirical data on CAI barriers. Findings could inform teacher training

programs, as similar interventions improved technology integration in Nigeria (Adeoye et al., 2020). The results are also a helpful document for the Ghana Education Service in curriculum development aimed at improving the quality of teaching and learning art.

The results also stimulate further research into the theory of Computer-Assisted Instruction and its application in either art education or other fields of study. The results may also serve as reference material for teachers, guidance and counselling officers, and art teachers. The results will assist education program coordinators in enhancing the quality of in-service training, thereby improving the chances that technological tools and material resources contribute meaningfully to academic outcomes.

### **1.8 Delimitations of the Study**

The following are the delimitations of the study:

1. This study is confined to public and private Senior High Schools within the Abuakwa North Municipality of Ghana's Eastern Region. Findings may not be generalised to other regions or educational tiers, as infrastructure, teacher training, and policy vary across contexts.
2. The study was restricted to six Senior High Schools in the Abuakwa North Municipality due to limited time, accessibility, and other related resources to carry out the research.

### **1.9 Definition of Terms**

**Intervention:** The innovation of introducing something new to improve a current situation in a research environment.

**Learning:** This is a continuous process through which individuals acquire new skills, attitudes, knowledge, or behaviour by engaging in experience or Instruction.

**Computer:** A computer is an electronic device designed to process, store, and retrieve data.

**Educational technologies:** The combination of instructional, developmental, managerial, and other technologies explicitly applied to solve the educational problem.

**Instructional Technology:** The application of educational technologies to solve specific instructional problems.

**Computer-Assisted Instruction:** This refers to the interactive instructional use of a computer to present instructional material and monitor the learning process according to instructions given to it in a variable program.

#### **1.10 Organization of the Rest of the Text**

Chapter Two consists of a review of relevant literature in the study. Chapter Three systematically explains the procedure (methodology) used to conduct the study. This chapter also includes the study design and instruments used. It documents the sample size and sampling procedures, and concludes with the data sources, analysis techniques, and ethical issues. Chapter Four entails data presentation, analysis, and discussion of the findings, while Chapter Five concludes the thesis with a summary, conclusions, and recommendations or suggestions for further studies.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Overview**

The study sought to investigate the use of Computer-Assisted Instruction in teaching Graphic Design in secondary schools and the barriers impeding its implementation in Abuakwa North Municipality of the Eastern Region of Ghana. This chapter reviews relevant related literature that underpins the study. This chapter also compares and contrasts the ideas of various authors on various topics. In addition, the chapter contains the opinions of the researcher on topics discussed.

#### **2.2 Purpose of the Literature Review**

This chapter presents a comprehensive review of scholarly literature relevant to the integration of Computer-Assisted Instruction (CAI) in education, with a specific focus on Graphic Design and the Ghanaian context. The primary purpose of this review is to situate the current study within the broader academic conversation, thereby establishing a solid foundation for the research. It aims to achieve this by synthesizing existing knowledge on key themes, including the theoretical underpinnings of CAI, its documented benefits and challenges, and the specific state of ICT integration in Ghanaian education. Furthermore, this chapter will critically examine empirical studies to identify consistencies, contradictions, and, most importantly, gaps in the existing research. By doing so, it will crystallize the unique contribution of this study to provide an in-depth, qualitative exploration of CAI usage and barriers in Graphic Design classrooms in the Abuakwa North Municipality, an area that remains underexplored in the current body of literature.

### 2.3 Mapping of the Review of Literature

This literature review is structured to provide a comprehensive and logical foundation for the study, moving from broad theoretical concepts to specific contextual issues relevant to Computer-Assisted Instruction (CAI) in Graphic Design education within Ghanaian Senior High Schools. The following table maps the key topics reviewed and summarizes the central focus of each section.

**Table 1: Thematic Map of Literature Review**

<b>Theme / Topic</b>	<b>Summary of the Review</b>
<b>Core Conceptual Definitions</b>	This theme clarifies key concepts that underpin the study, including teaching, learning, and Computer-Assisted Instruction (CAI). It establishes clear definitions to ensure conceptual clarity and aligns the study with established educational discourse.
<b>Teaching Methods, Learning Styles, and CAI</b>	This section examines the relationship between teaching approaches, learner diversity, and the use of CAI. It discusses how digital tools support different learning styles and promote interactive, learner-centred teaching methods that are appropriate for a visual subject such as Graphic Design.
<b>CAI in Graphic Design Education</b>	This theme focuses on the application of CAI within Graphic Design education. It reviews literature on the use of design software, digital project-based learning, and the role of CAI in enhancing both creative expression and technical skill development.
<b>Impacts and Challenges of CAI</b>	This section synthesises global and local studies on the effects of CAI on student engagement, learning outcomes, and achievement. It also identifies common infrastructural, pedagogical, and socio-cultural challenges that limit effective CAI integration across educational contexts.
<b>Ghana's ICT Policy in Education</b>	This theme situates the study within Ghana's educational policy context by reviewing the ICT for Accelerated Development (ICT4AD) policy and related initiatives. It examines policy intentions, implementation challenges, and the gap between policy expectations and classroom practice, particularly in non-STEM subjects such as Visual Arts.
<b>Empirical Review (Local and International)</b>	This section reviews empirical studies on CAI from both international and Ghanaian contexts. It highlights the limited focus on CAI in Visual Arts education within Ghana, thereby identifying the specific research gap addressed by the present study.
<b>Interconnected Thematic Areas</b>	This theme explores cross-cutting issues relevant to CAI integration, including digital pedagogy in the arts, teacher professional development, access to technology, curriculum alignment, educational leadership, assessment practices, and the influence of local culture on digital art education.

Note. The literature review progresses from foundational concepts to applied classroom practice and from global perspectives to the Ghanaian Senior High School context. This structure supports a comprehensive understanding of CAI and establishes the research gap that justifies the present study.

## **2.4 Theoretical Framework**

A theoretical framework is a foundational structure that guides academic research by providing a set of concepts, theories, and principles relevant to the topic under investigation. It serves as a lens through which the research problem is examined and interpreted, helping to connect empirical findings with established knowledge in the field (Creswell & Creswell, 2018). By anchoring a study in recognized theories, the theoretical framework not only clarifies the research focus but also aids in selecting appropriate methodologies and interpreting results (Grant & Osanloo, 2014). In educational research, the theoretical framework is particularly important as it shapes the understanding of learning processes and instructional strategies.

For this study on Computer-Assisted Instruction (CAI) in teaching Graphic Design in Senior High Schools, the theoretical framework is informed by two influential learning theories: Constructivism and behaviourism. These theories offer complementary perspectives on how students learn and how technology can be used to enhance educational outcomes.

### **2.4.1 Constructivism**

Constructivism is a dominant paradigm in contemporary educational theory that posits learning as an active, interpretive, and recursive process of building knowledge and meaning. Unlike transmission-based models where knowledge is passively received from an authority, constructivism asserts that learners actively construct their own understanding through experiences and reflection, integrating new information with their prior knowledge, beliefs, and cultural frameworks (Bruner, 1966; Fosnot & Perry, 2005). This theoretical perspective has profound implications for teaching and learning, particularly in a discipline as experiential and creative as Graphic Design.

The roots of constructivist thought are often traced to the cognitive developmental work of Jean Piaget and the sociocultural theory of Lev Vygotsky. Piaget's (1970) concept of schemas, assimilation, and accommodation emphasizes the individual's cognitive structuring and restructuring of knowledge through interaction with the environment. Vygotsky (1978), while agreeing on the active role of the learner, placed greater emphasis on the social dimension of learning. His concepts of the Zone of Proximal Development (ZPD) and More Knowledgeable Other (MKO) highlight how learning is scaffolded through social interaction, collaboration, and dialogue, whereby cultural tools and community practices shape individual understanding. These dual strands, the cognitive and the social, converge in modern constructivist pedagogy, which advocates for learner centred environments characterized by authentic tasks, problem solving, collaboration, and reflection.

In the context of Graphic Design education, constructivist principles are not merely applicable, they are fundamental to the discipline's core practices. Graphic Design is inherently about solving communicative problems through iterative exploration, experimentation, and the synthesis of concept, form, and technique. A constructivist approach aligns perfectly with this process. It moves instruction away from rote memorization of software commands or rigid design rules, and towards a pedagogy where students engage in authentic design challenges. In such an environment, learners act as junior designers who must research context, brainstorm concepts, create multiple iterations, solicit and incorporate feedback, and reflect on their creative decisions. Knowledge of principles like typography, colour theory, and composition is not delivered as abstract dogma but is constructed by the learner through the very act of designing and critically evaluating their work and the work of

others (Davis, 2023; Sanders & Albers, 2020). This process mirrors the professional design studio, making learning directly relevant to real world practice.

The integration of Computer Assisted Instruction (CAI) offers powerful affordances for realizing a constructivist pedagogy in Graphic Design. When conceptualized as more than a digital textbook or a drill-and-practice tool, CAI becomes a suite of cognitive tools or mindtools (Jonassen, 2000) that amplify the learner's capacity to explore, create, and collaborate. Software applications like Adobe Photoshop, Illustrator, and CorelDRAW provide a dynamic, malleable environment for visual experimentation. Students can rapidly test colour palettes, adjust layouts, manipulate images, and visualize typographic choices, observing the outcomes of their decisions in real time. This facilitates a cyclical process of hypothesis, action, and reflection that is central to constructivist learning. Furthermore, digital platforms enable collaboration beyond the physical classroom. Cloud based tools like Figma or shared digital workspaces allow for synchronous and asynchronous co-creation and peer critique, enacting Vygotskian social learning. CAI can also provide access to vast online repositories of professional work, design case studies, and tutorial resources, allowing learners to direct their own inquiry and build knowledge based on their specific project needs and interests.

### **Linking Constructivism to the Study's Objectives**

This constructivist lens provides a critical framework for investigating the core questions of this study, as outlined in the objectives:

- **Objective 1 (Investigating Available Instructional Technologies):** A constructivist evaluation of "available instructional technologies" goes beyond merely cataloguing hardware and software. It assesses their potential as tools for knowledge construction. Do the available computers and software (e.g.,

CoreIDRAW) allow for open-ended exploration and iteration, or are they limited to rigid, template-based exercises? Is there access to digital resources (e.g., online asset libraries, video tutorials) that support self-directed learning? This perspective shifts the inquiry from availability to pedagogical suitability.

- **Objective 2 (Exploring Current CAI Practices):** Viewing practices through a constructivist lens allows for a nuanced analysis of how CAI is being used. Are teachers employing software primarily for step-by-step demonstrations (more behaviorist), or are they facilitating design projects where students use digital tools to solve open-ended problems? Is CAI used to support collaborative projects and peer review? This objective directly examines the extent to which the observed pedagogical practices align with the active, student-driven learning that constructivism advocates.
- **Objective 3 (Assessing Barriers to CAI Adoption):** Constructivism helps identify barriers that are not just technical but also pedagogical and systemic. Beyond "lack of computers," barriers may include: a curriculum focused on final products rather than design processes, assessment methods that reward replication over innovation, large class sizes that inhibit individual mentorship and project-based work, or teachers' own training being more techno-centric than pedagogically grounded in constructivist principles. This theoretical framework ensures the study probes beneath surface-level challenges to uncover deeper impediments to meaningful technology integration.

However, implementing a robust constructivist pedagogy with CAI, especially in resource-constrained environments like many Ghanaian SHSs, presents significant challenges. It requires substantial time, flexible curriculum pacing, teacher facility with both technology and facilitative pedagogies, and often, a shift in institutional

culture regarding control and assessment (Ertmer & Newby, 2013; Kushiator et al., 2023). An over-reliance on discovery without adequate scaffolding can sometimes lead to frustration or gaps in foundational knowledge. Therefore, while constructivism provides the ideal framework for Graphic Design education, this study also acknowledges the pragmatic realities and tensions teachers face in its implementation, which will be explored through the complementary lens of behaviourism. in the following section.

#### **2.4.2 Behaviourism.**

Behaviourism. represents a foundational school of thought in psychology and education that emphasizes the objective, scientific study of observable behaviours, rejecting the focus on internal mental states that characterised earlier introspective methods. Emerging in the early 20th century through the work of John B. Watson and later profoundly shaped by B.F. Skinner, behaviourism. posits that learning is essentially a process of behavioural change shaped by environmental stimuli and consequences (Skinner, 1953; Watson, 1913). This perspective views the mind as a "black box" where internal processes are irrelevant to understanding learning; what matters are the inputs (stimuli) and outputs (responses). Learning, therefore, is defined as the acquisition of new behaviours or the strengthening/weakening of existing ones through mechanisms of conditioning, primarily operant and classical conditioning.

The core principles of behaviourism. that have permeated educational practice are reinforcement, punishment, repetition, and the careful sequencing of instructional content. Positive reinforcement, the presentation of a rewarding stimulus following a desired behaviour, is a cornerstone for increasing the likelihood of that behaviour recurring. This is evident in educational settings through praise, grades, or tokens. Conversely, punishment aims to decrease an undesired behaviour. The theory

advocates for breaking down complex knowledge and skills into smaller, discrete, and sequentially mastered units, a concept known as task analysis. Mastery learning, a direct descendant of behaviorist principles, insists that students must demonstrate competence in one unit before progressing to the next, ensuring a cumulative and error-minimized learning path (Bloom, 1968; Skinner, 1968). Instruction, therefore, is highly structured, teacher-directed, and focused on measurable outcomes. The learner's role is primarily to respond correctly to presented stimuli, with success being consistently reinforced.

In the context of Computer-Assisted Instruction (CAI), behaviorist principles find a natural and powerful application. CAI platforms are exceptionally well-suited for delivering the structured, repetitive, and feedback-driven experiences that behaviourism advocates. Common CAI modalities directly rooted in this theory include:

- **Drill and Practice Programs:** These provide repeated exercises for skills like arithmetic facts or vocabulary memorization, offering immediate feedback (correct/incorrect) and often incorporating reinforcement like points or progress sounds.
- **Tutorials:** Linear, step-by-step instructional sequences that present information in small chunks, test for comprehension with questions, and branch based on correct or incorrect answers, guiding the learner down a predetermined path to mastery.
- **Simulations with Structured Goals:** While simulations can be exploratory, a behaviorist approach uses them to practice specific procedures (e.g., a flight simulator practicing landing sequences) where performance is measured against strict criteria.

For a skill-based subject like Graphic Design, a behaviorist-informed CAI approach has clear utility in establishing foundational technical proficiency. Software tutorials that guide students, click by click, through the tools and menus of CorelDRAW or Adobe Illustrator embody this principle. Repetitive exercises designed to master the pen tool, memorise keyboard shortcuts, or apply specific colour harmonies (e.g., complementary, analogous) through structured tasks provide the reinforcement and practice necessary for automating basic technical operations. This aligns with the concept of "part-task training," where a complex skill like design software mastery is decomposed into its constituent parts for individual practice before integration (van Merriënboer & Kester, 2014). From a behaviorist perspective, this builds a reliable repertoire of technical responses, freeing cognitive resources for higher-order tasks later.

### **Linking Behaviourism. to the Study's Objectives**

Viewing the research landscape through a behaviorist lens provides a critical, complementary perspective for investigating the study's objectives:

- **Objective 1 (Investigating Available Instructional Technologies):** A behaviorist analysis would focus on the functional reliability of technologies to deliver consistent stimuli and reinforcement. Are the computers and software stable enough for uninterrupted drill and practice? Does the school's infrastructure (electricity, internet) support the predictable, sequential delivery of CAI content? The availability of technologies is assessed here for their capacity to support structured, uninterrupted, and individualised practice sessions, which are central to behaviorist pedagogy.
- **Objective 2 (Exploring Current CAI Practices):** This lens is crucial for identifying practices that may prioritise technical skill acquisition over

creative exploration. The research would investigate: Are teachers using CAI primarily for software tutorial demonstrations and repetitive practice exercises? Is student work assessed primarily on the correct replication of demonstrated techniques (e.g., "use the blend tool as shown") rather than on creative application? A behaviorist-informed practice would manifest in highly teacher-controlled lessons where the computer is used to demonstrate a "correct" procedure that students are then expected to emulate precisely, with feedback focused on technical accuracy.

- **Objective 3 (Assessing Barriers to CAI Adoption):** Beyond generic barriers, a behaviorist perspective highlights specific impediments to its own model of CAI integration. These include: insufficient numbers of computers for individualised, self-paced drill and practice; lack of CAI software designed for granular skill-building in Graphic Design (as opposed to creative suites); teacher time constraints that prevent the meticulous monitoring and reinforcement of individual student progress on technical tasks; or a curriculum that does not allocate dedicated time for building automated technical fluency before complex projects.

However, the application of strict behaviorist principles to Graphic Design education is fraught with significant and fundamental limitations. The primary critique is that its exclusive focus on observable behaviour and external reinforcement overlooks the internal cognitive and affective processes that are the very essence of creative work: ideation, conceptual thinking, aesthetic judgment, and personal expression (Ertmer & Newby, 2013). An over-reliance on drill, practice, and the replication of teacher-led examples can inadvertently stifle creativity, critical thinking, and problem-solving by promoting conformity and a fear of error (Amabile, 2023; Robinson, 2022). Graphic

Design is not merely a technical trade, it is a discipline of synthesis and innovation. A pedagogy that excessively rewards the "correct" placement of a drop shadow may fail to foster the ability to decide whether a drop shadow is conceptually appropriate. Therefore, while behaviourism offers a framework for building essential technical scaffolds, it is insufficient as a standalone theory for educating graphic designers. This tension between the need for structured skill acquisition (behaviorist) and the need for open-ended creative exploration (constructivist) lies at the heart of the pedagogical challenge in integrating CAI, a tension that the following section on integration will explore.

### **2.4.3 Integrating Theories in CAI**

The previous sections show that Constructivism and Behaviourism are not opposites, but rather two complementary approaches to learning. Effective Computer Assisted Instruction (CAI) in Graphic Design should not choose one theory over the other. Instead, it should strategically combine their strengths. This integrated view understands that learning involves both building reliable skills and encouraging creative thinking (Ertmer & Newby, 2013). For Graphic Design, which requires technical skill and creative innovation, this combination is essential. A good CAI strategy uses technology first to build foundational skills, then to support open ended creative projects.

Think of this integrated model as a learning journey with support at each stage. Early on, when students are new to a software tool, methods from Behaviourism are very useful. Step by step tutorials and practice exercises with instant feedback help build technical confidence and accuracy. For example, a CAI module might guide a student through each click needed to master the "Pen" tool in Illustrator. This teaches the "how." Once the basic skill is comfortable, the teaching can shift to a Constructivist

approach. Now, that same "Pen" tool is used in a real design task, like creating a poster. The computer becomes a digital workshop where students experiment, make decisions, and learn from trial and error. The technology supports both the initial skill training and the later creative application (Kirschner, 2022).

This combined approach solves a key problem in creative education: balancing technique with expression. Too much focus on drills can make technically good but unoriginal designers. Too much open exploration without strong basics can leave students unable to execute their ideas. The integrated model sees strong technical skills, built through careful practice, as the necessary foundation for truly creative work. CAI is perfect for this because it can provide structured lessons early on and then switch to being an open toolkit for projects.

### **How This Framework Connects to This Study's Goals**

This combined theory is not just an idea, it is the main lens for looking at all the findings in this study. It helps move the questions from "Is CAI being used?" to "How is it being used, and for what kind of learning?"

- **For Objective 1 (Available Technologies):** We must ask if the available tools support both kinds of learning. Does the school have software for structured tutorials *and* for full creative projects? Missing one type limits what teachers can do.
- **For Objective 2 (Current Teaching Practices):** This is where the framework is most useful. We can observe if teachers use CAI mostly for demonstrations and repetitive practice (Behaviorist), or for student led design projects (Constructivist). The ideal is a blend, where early skill building leads to creative projects. This framework lets us map the real teaching practices against this ideal.

- **For Objective 3 (Barriers to Adoption):** This lens reveals deeper challenges. Problems may not just be a lack of computers, but a system that does not support the integrated model. For example, if exams only test memorized steps, teachers are pushed to use CAI only for drills. If teachers are only trained on software basics, not on managing creative projects, they will stick to demonstrations. Big class sizes and short lessons can also make time intensive creative projects hard to run, forcing teachers into simpler, more controlled uses of technology.

This combined lens is especially important for understanding the situation in Ghanaian schools. The known challenges, like large classes, exam pressure, and limited resources (Kushiator et al., 2023), tend to push teaching toward more controlled, behaviorist uses of CAI because they are easier to manage. Therefore, this framework helps us analyze the gap between the ideal use of technology and the reality in the classroom. It positions this study to provide useful insights into how to move toward a more meaningful and effective use of CAI for Graphic Design

## **2.5 Teaching**

Teaching is a dynamic and multifaceted process that involves the deliberate facilitation of knowledge and skill acquisition. Kochhar (2004) conceptualises teaching as an intricate and demanding task rather than a mechanical activity, emphasising the professional judgement and creativity required of the teacher. Similarly, Farrant (1996) defines teaching as a process that facilitates learning, underscoring its functional role within the educational experience. This close relationship between teaching and learning has been described as inseparable, as learning cannot occur effectively without purposeful teaching (Amissah et al., 2002). These perspectives collectively position teaching as a creative and intentional act in

which the teacher's competence, attitude, and engagement significantly influence learner outcomes.

Over time, the role of the teacher has evolved from that of a sole transmitter of knowledge to a facilitator of learning experiences. Contemporary pedagogical approaches increasingly emphasise learner-centred instruction, collaboration, and guided discovery. As a result, teachers are expected to design learning environments that support individual and small-group learning while responding to diverse learner needs. This shift places greater responsibility on teachers to select appropriate instructional strategies and to utilise available teaching and learning resources effectively, particularly in practical and skill-based subjects such as Graphic Design.

In this context, the integration of technology through Computer-Assisted Instruction (CAI) has become an important component of modern teaching practice. CAI provides teachers with tools that support interactive demonstrations, visual explanations, and guided practice, which are especially relevant for visually oriented subjects (Cheung & Slavin, 2013; Jeddah, 2012). The availability and effective use of such technologies directly influence how teachers plan and deliver instruction, thereby linking teaching practice to the study's objective of examining available instructional technologies. Where adequate resources exist, CAI enables teachers to enrich lessons and support skill development. However, limited or outdated technologies constrain instructional choices and reinforce teacher-dominated approaches.

Beyond instructional delivery, CAI also shapes teaching practices by influencing how classroom time is managed and how students engage with learning tasks. The use of digital tools can reduce time spent on repetitive instructional routines, allowing teachers to focus more on monitoring student progress and providing targeted support

(Cheung & Slavin, 2013). This aligns with the study's objective of exploring current CAI practices, as it highlights how teaching methods adapt in response to both the possibilities and limitations of technology use in the classroom.

The introduction of computers into education since the early 1960s has expanded instructional possibilities and transformed teaching approaches across disciplines (Morrell, 1992). Research indicates that effective technology integration can enhance student motivation and learning outcomes, particularly when teachers align digital tools with clear pedagogical goals (Cotton, 2001; Owusu et al., 2010). CAI is especially beneficial for visual and auditory learners through the use of simulations, animations, and narrated demonstrations. However, Roblyer and Doering (2013) caution that learners who rely heavily on tactile, hands-on experiences may require structured guidance to benefit fully from screen-based instruction. This challenge is more pronounced in contexts where students and teachers have limited prior exposure to digital technologies.

In summary, teaching is a complex and evolving professional practice that is increasingly shaped by technological integration. The effectiveness of CAI in teaching Graphic Design depends not only on the teacher's pedagogical competence but also on the availability of appropriate instructional technologies and supportive learning environments. When these conditions are inadequate, teaching practices tend to remain teacher-centred, limiting opportunities for meaningful student engagement and skill development. This synthesis reinforces the relevance of examining both instructional resources and classroom practices, which are central to the objectives of the present study.

## 2.6 Teaching Methods in CAI and Graphic Design

Teaching methods refer to the deliberate strategies and procedures used to organise interactions among the teacher, learners, and subject content in order to facilitate learning. Singh and Rana (2004) describe instructional strategies as planned approaches that influence learning through structured engagement with subject matter.

In practice, effective teaching requires the careful selection of methods that align with learners' needs, instructional objectives, and the nature of the subject being taught.

In Graphic Design education, teaching methods have increasingly evolved in response to the integration of Computer-Assisted Instruction. As a practical and visually oriented subject, Graphic Design traditionally relied on lectures, manual demonstrations, and studio-based activities. However, CAI has expanded instructional possibilities by enabling more interactive, learner-centred approaches that emphasise visualisation, experimentation, and iterative design processes. This evolution reflects broader pedagogical shifts towards active learning and aligns with the present study's objective of examining current CAI practices in Senior High Schools.

One of the most common CAI-supported teaching methods in Graphic Design is demonstration-based instruction. Through digital projection and screen sharing, teachers can model design processes in real time using graphic software such as CorelDRAW. This approach allows abstract concepts, including layout structure, colour application, and tool manipulation, to be presented visually and sequentially. Learners are able to observe procedures step by step and engage in guided practice, which supports the development of procedural knowledge and technical competence (Jonassen & Carr, 2000). The effectiveness of this method, however, is closely tied to the availability of functional instructional technologies.

CAI also supports exploratory and simulation-based learning, which enables students to experiment with design elements in a flexible and low-risk environment. Digital tools allow learners to manipulate typography, colour, and composition while receiving immediate visual feedback. Such exploratory practices promote creativity, problem-solving, and independent learning, which are essential to Graphic Design education (Gambari et al., 2013; Sharma, 2017). These approaches are consistent with constructivist learning principles, as learners actively construct knowledge through interaction with digital media.

Project-based learning is another instructional approach enhanced by CAI in Graphic Design classrooms. Through digital design projects such as poster creation and logo development, students apply theoretical knowledge to authentic tasks that mirror professional practice. CAI facilitates research, design iteration, and presentation, while the teacher assumes the role of a facilitator who provides guidance and feedback throughout the process. Project-based learning supported by CAI has been shown to strengthen the connection between theory and practice and to promote deeper learning (Owston, 1997).

Although Graphic Design is inherently creative, CAI also enables structured drill and practice activities that support the acquisition of foundational skills. Interactive tutorials, exercises, and quizzes help reinforce software navigation, tool usage, and design terminology (Eyo, 2018). Such activities are particularly beneficial for students who are new to digital tools or require additional practice to build confidence in computer-based environments.

Collaborative learning is further enhanced through CAI, as digital platforms allow students to work together on shared design tasks and engage in peer critique. Collaborative tools support teamwork, communication, and reflective discussion,

which are central to the design process (Jonassen & Carr, 2000). In contexts where instructional resources are limited, collaborative CAI practices also help maximise access to available technologies.

In addition, blended learning approaches combine face-to-face instruction with online activities to extend learning beyond the classroom. Through platforms such as Google Classroom, teachers can provide instructional materials, assignments, and feedback, allowing students to engage with content at their own pace (Roblyer & Doering, 2013). This approach supports differentiated instruction and makes more efficient use of limited classroom time for practical activities.

In summary, CAI broadens the range of teaching methods available for Graphic Design instruction by supporting demonstration, exploration, project-based learning, collaboration, and blended learning approaches. The effective implementation of these methods depends largely on the availability of instructional technologies and teachers' capacity to adapt pedagogical strategies to contextual constraints. This synthesis underscores the close relationship between teaching methods, CAI practices, and resource availability, thereby reinforcing the relevance of the present study's objectives.

## **2.7 Learning and CAI Integration**

Learning has been defined as a relatively permanent change in behaviour, knowledge, or thinking skills that results from experience (Santrock, 2004). Santrock explains that not all human abilities are learned, as some capacities are innate. For example, basic biological functions such as swallowing are inborn rather than acquired through instruction. This distinction suggests that learning builds upon existing capacities, expanding what individuals already know and can do. In this sense, learning enhances behaviour and cognition by extending innate abilities through experience.

This view aligns with Senge's (1990) conception of learning as cited in Smith and Blake (2005), which defines learning as an increase in knowledge that enhances the capacity for effective action. Learning, therefore, is not merely the accumulation of information but the development of competence and understanding that enables meaningful application. Such perspectives challenge earlier behaviourist notions that viewed learners as passive recipients of information, often described metaphorically as "empty vessels" to be filled by teachers.

In contrast, constructivist perspectives emphasise that learners actively construct knowledge based on prior experiences and understanding (Smith & Blake, 2005). This shift recognises that students enter learning environments with existing ideas, skills, and perceptions that influence how new information is interpreted. Within this framework, teaching is expected to engage learners actively in the learning process rather than positioning them as passive listeners. This theoretical position is particularly relevant to the use of Computer-Assisted Instruction, which can support exploratory, interactive, and student-centred learning when appropriately implemented.

Understanding how learners differ in the ways they process information is also central to effective learning. Learners may demonstrate preferences for visual, auditory, or kinesthetic modes of learning, each of which has implications for instructional design. In Graphic Design education, where visual communication and demonstration are central, CAI offers significant advantages. Digital illustrations, animations, and real-time software demonstrations can support visual and auditory learners by making abstract concepts more concrete.

However, learners who rely heavily on tactile or hands-on experiences may face challenges in CAI-dominated environments if instruction is not carefully scaffolded. This challenge is heightened in contexts such as Ghanaian Senior High Schools, where unequal access to technology exists. While some students may have prior exposure to digital tools, others may lack basic ICT literacy due to limited access to computers and digital resources (Roblyer & Doering, 2013). As a result, CAI may unintentionally widen learning gaps if issues of access and learner readiness are not addressed.

This discussion highlights the importance of aligning CAI with learners' existing knowledge, learning styles, and contextual realities. It reinforces the relevance of the present study's objectives, particularly the examination of available instructional technologies and current CAI practices in Graphic Design classrooms. Effective learning through CAI depends not only on the availability of digital tools but also on how teaching strategies accommodate learner diversity and promote inclusive participation.

## **2.8 Learning Styles**

Learning styles describe the different ways individuals perceive, process, and interpret new information through their senses (Giles, Pitre, & Womack, 2003). These preferences, also referred to as perceptual styles or learning modalities, highlight the individualized nature of learning. Although learners may show natural inclinations toward certain styles, learning preferences are shaped over time by cultural background, personal experience, and developmental factors (Giles et al., 2003). Identifying learners' preferred styles can therefore guide instructional decisions aimed at improving creativity, academic performance, and attitudes toward learning.

The Perceptual Learning Styles Theory identifies several modes of learning, including visual, aural, tactile (haptic), and kinesthetic styles, which are among the most commonly observed in educational settings (Institute for Learning Styles Research, 2003; Giles et al., 2003). Visual learners benefit from diagrams, images, and demonstrations, while aural learners learn more effectively through spoken explanations and discussions. Tactile learners rely on touch and manipulation of materials, and kinesthetic learners learn best through movement and direct physical involvement in tasks (Giles et al., 2003). It is also widely acknowledged that many learners are multimodal, drawing on a combination of these styles rather than relying on a single approach (Giles et al., 2003).

An understanding of learning styles is particularly important in Graphic Design education, where visualisation, demonstration, and practical engagement are central to learning. Computer-Assisted Instruction offers strong support for visual and auditory learners through animations, simulations, and narrated demonstrations, making abstract design concepts more concrete (Roblyer & Doering, 2013). These affordances align closely with the demands of Graphic Design, where learners must observe processes, analyse visual relationships, and apply design principles using digital tools.

However, learners who depend heavily on tactile or kinesthetic experiences may find CAI less intuitive if instruction is not carefully scaffolded. Screen-based interaction may limit direct physical engagement unless complemented by structured guidance and opportunities for active practice (Roblyer & Doering, 2013). In contexts such as Ghanaian Senior High Schools, this challenge is compounded by unequal access to digital technologies. While some students may be familiar with computers and digital platforms, others may lack basic ICT literacy due to limited exposure, thereby

restricting their ability to benefit fully from CAI (Roblyer & Doering, 2013). These disparities highlight the need for instructional strategies that are sensitive to both learning preferences and contextual realities.

Although learning styles provide useful insights for instructional design, research cautions against relying on them as the sole basis for enhancing learning outcomes. Kratzig and Arbuthnott (2003) argue that effective learning also depends on the development of general cognitive and memory strategies that operate across different modalities. This perspective suggests the need for a balanced pedagogical approach that accommodates learner diversity while also strengthening transferable skills such as problem-solving, reflection, and independent learning.

In summary, understanding learning styles offers valuable guidance for the design and implementation of CAI in Graphic Design education. However, effective instruction requires more than matching teaching methods to preferred modalities. It also depends on equitable access to instructional technologies, appropriate scaffolding, and the development of broad cognitive skills. This synthesis reinforces the relevance of examining both instructional practices and resource availability, which are central to the objectives of the present study.

## **2.9 Computer-Assisted Instruction (CAI)**

Computer-Assisted Instruction refers to the use of computer technologies to support the delivery of educational content through interactive and learner-centred approaches. CAI represents a shift from traditional teacher-dominated instruction to technology-mediated learning environments that promote individual pacing, active engagement, and immediate feedback (Roblyer & Doering, 2013; Sharma, 2017). The concept is often used interchangeably with terms such as Computer-Based Instruction, Computer-Assisted Learning, and Computer-Based Training, all of which emphasise

the instructional use of digital technologies to enhance teaching and learning experiences (Okebukola, 2013).

At its core, CAI is designed to personalise learning by allowing learners to progress at their own pace, receive prompt feedback, and interact meaningfully with instructional content. It has been applied across educational levels and subject areas, including science, mathematics, and the arts (Fourie, 1999; Yusuf & Balogun, 2011). Within the Ghanaian educational context, CAI is increasingly viewed as a strategy for improving digital literacy and fostering creative thinking, particularly in visually oriented subjects such as Graphic Design, where learners benefit from visualisation, demonstration, and iterative practice (Owusu & Asare, 2022). This relevance directly aligns with the present study's focus on CAI integration in Graphic Design teaching at the Senior High School level.

CAI is distinguished by several key characteristics that set it apart from conventional instructional approaches. These include learner autonomy, which allows students to control the pace and sequence of learning; real-time feedback, which helps learners identify and correct errors promptly; and instructional adaptability, whereby learning paths can be adjusted based on learner performance (Barot, 2009; Edutech202, 2012). CAI also promotes interactivity through the integration of text, graphics, audio, and video, supporting diverse learning preferences and enabling both individual and collaborative learning experiences (Farooq, 1997; Andrews, 1998). The random-access nature of many CAI platforms further supports inquiry-based learning by allowing learners to explore content non-linearly (Pelgrum & Plomp, 2004).

The application of CAI varies depending on instructional goals and learning contexts. Common applications include drill-and-practice activities that reinforce foundational skills through repetition and feedback (Cotton, 2001); tutorials that introduce new

concepts through structured, step-by-step instruction (Bitter & Pierson, 1999); and simulations that model real-life processes in virtual environments, allowing learners to experiment without material or safety constraints (Roblyer & Doering, 2013). CAI is also used in the form of instructional games to enhance motivation and engagement, as well as cooperative and inquiry-based approaches that promote collaboration, problem-solving, and higher-order thinking skills (Adiutor, 2023; Sharma, 2017). In some cases, CAI functions as a supplemental tool that supports classroom instruction by providing additional resources and practice opportunities.

Despite its instructional potential, the implementation of CAI in Ghanaian Senior High Schools faces several challenges. Many schools lack reliable electricity, stable internet connectivity, and adequately equipped computer laboratories, which limits consistent access to digital learning tools (Yusuf & Balogun, 2011; Owusu & Asare, 2022). In addition, teachers often receive limited training on how to integrate CAI meaningfully into subject-specific pedagogy. As a result, the presence of technology does not always translate into improved instructional quality.

Another challenge relates to the contextual relevance of CAI materials. Many digital instructional programs are developed for Western educational settings and may not reflect local cultural realities or curriculum requirements. This misalignment can reduce learner engagement and limit the effectiveness of CAI in Ghanaian classrooms (Asunka, 2008). As Ahiatrogah and Barfi (2015) argue, technology alone cannot transform teaching and learning without adequate professional development, curriculum alignment, and institutional support.

In summary, CAI offers significant opportunities for enhancing teaching and learning through interactive, adaptive, and learner-centred approaches. However, its effectiveness in Graphic Design education depends on the availability of appropriate

instructional technologies, teacher capacity, curriculum alignment, and contextual relevance. This synthesis reinforces the importance of examining both CAI practices and the barriers to their effective adoption, which are central to the objectives of the present study.

### **2.10 Computer-Assisted Instruction in Graphic Design Education**

Graphic Design is a discipline that combines artistic creativity with technological application and plays an important role in cultural communication and skills development (Curriculum Research and Development Division, 2007). Because the subject relies heavily on visual representation, experimentation, and practical skill acquisition, its effective teaching requires instructional approaches that integrate modern digital tools. Computer-Assisted Instruction, defined as an interactive instructional approach in which computers present learning materials and support learner progress (Fourie, 1999), has therefore become increasingly relevant in Graphic Design education. This section reviews the application of CAI in teaching Graphic Design, its educational benefits, and the challenges associated with its implementation, particularly within Senior High School contexts.

#### **Applications and Teaching Methods of CAI in Graphic Design**

The integration of CAI into Graphic Design instruction supports learner-centred teaching approaches that align with how contemporary learners process visual information (Roblyer & Doering, 2013). Through CAI, teaching moves beyond traditional lecture-based methods towards more interactive and practice-oriented strategies. One commonly used approach is demonstration-based CAI, where teachers use design software such as CorelDRAW or Adobe Illustrator to model design processes in real time. Digital demonstrations allow students to observe procedures

clearly and sequentially and, where possible, to interact with tools directly, thereby supporting skill development (Jonassen & Carr, 2000).

CAI also enables exploratory and simulation-based learning, allowing students to experiment with design elements such as typography, colour, and composition in virtual environments. These simulations promote creative exploration and reduce the cost and risk associated with using physical materials, while providing immediate feedback on design decisions (Gambari et al., 2013; Sharma, 2017). In addition, project-based learning is supported through CAI, as students engage in authentic design tasks such as poster and logo creation using digital tools for research, idea development, and final production. Within this approach, teachers act as facilitators, guiding critique sessions and supporting iterative design processes (Owston, 1997).

CAI further supports practice and drill activities that reinforce foundational Graphic Design skills, including the application of design principles and mastery of software tools. Interactive exercises, quizzes, and tutorials help students build confidence and fluency, particularly those who require additional time to adapt to digital environments (Eyo, 2018). Collaborative learning is also enhanced through CAI, as digital platforms allow students to co-design projects and engage in peer critique, fostering teamwork and shared problem-solving (Jonassen & Carr, 2000). In addition, blended learning approaches combine face-to-face instruction with online resources, enabling teachers to maximise practical classroom time and accommodate diverse learning styles (Roblyer & Doering, 2013).

### **Benefits of CAI in Graphic Design Education**

The use of CAI in Graphic Design education offers several instructional benefits. CAI enhances skill development and creative exploration by allowing students to apply design concepts using professional software and to revise their work through iterative

processes with immediate feedback (Sebbeh, 2017). These features support deeper understanding and experimentation, which are essential in design learning.

CAI also increases student engagement and motivation, as learners often find technology-enhanced lessons more stimulating and interactive than traditional instruction (Driscoll, 2000; Silverman & Casazza, 2000). The ability to control learning pace and receive instant responses further contributes to sustained attention and participation. In addition, CAI supports personalised learning by accommodating individual differences in learning speed and ability, benefiting both advanced learners and those who require additional support (Andrews, 1998; Edutech202, 2012).

From the teacher's perspective, CAI can improve instructional efficiency by reducing time spent on routine tasks such as grading and feedback, thereby allowing greater focus on lesson planning and individual student support (Jeddah, 2012). CAI also provides opportunities for professional growth by enhancing teachers' digital competencies and encouraging reflective instructional practices (Lee & Kozma, 2014).

### **Challenges and Barriers to CAI Implementation**

Despite its instructional potential, the effective integration of CAI in Graphic Design education faces several challenges, particularly in Ghanaian Senior High Schools. A major constraint is inadequate ICT infrastructure, including limited access to computers, scanners, projectors, and reliable internet connectivity, which restricts consistent and equitable use of CAI (Chiafie, 2011; Palinkas et al., 2015). Although basic utilities such as electricity may be available, infrastructural gaps continue to hinder effective implementation.

Another significant barrier is insufficient teacher training. Many Graphic Design teachers lack sustained professional development focused on the pedagogical integration of digital design software, resulting in uneven readiness to implement CAI effectively (Adjei, 2021; Mensah, 2020). In addition, curriculum and policy frameworks, such as Ghana's ICT for Accelerated Development policy, have tended to prioritise STEM subjects, leaving Visual Arts with limited targeted support and training opportunities (Kushiator et al., 2023; Mangesi, 2007).

Cultural and contextual factors also affect CAI implementation. Many CAI programs are developed for Western educational contexts and may lack cultural relevance for Ghanaian learners, reducing engagement and instructional effectiveness (Yusuf & Balogun, 2011). Furthermore, time constraints caused by rigid school timetables and limited financial support from school management restrict teachers' ability to integrate CAI regularly into Graphic Design lessons (Ahiatrogah & Barfi, 2015).

Computer-Assisted Instruction offers a transformative approach to teaching Graphic Design by supporting interactive, student-centred, and practice-oriented learning. Its effective use enhances skill development, creativity, and learner engagement. However, the successful integration of CAI depends on addressing persistent challenges related to infrastructure, teacher training, curriculum alignment, and institutional support. Addressing these issues is essential for bridging the gap between policy intentions and classroom practice and for ensuring that Graphic Design students acquire the digital competencies required in contemporary design practice.

## **2.11 The Efficacy of Computer-Assisted Instruction in Graphic Design**

### **Education**

Recent pedagogical research has demonstrated that technology-enhanced learning approaches yield significant benefits for design education when implemented

strategically. This section examines the effectiveness of Computer-Assisted Instruction (CAI) through multiple lenses, with particular attention to developing world contexts like Ghana.

### **Pedagogical Advantages of CAI**

Contemporary studies reveal three primary benefits of CAI for design education:

1. **Enhanced Technical Skill Development:** Interactive software tutorials and virtual design studios enable students to master technical competencies more efficiently than traditional methods. Research by Addo and Mensah (2022) in Ghanaian technical institutes found that students using CAD software showed 28% greater precision in layout design compared to those learning through manual methods. The immediate feedback loops in digital design platforms allow for rapid iteration and refinement of technical skills (Boateng, 2021).
2. **Improved Conceptual Understanding:** Visualization tools in programs like Adobe Creative Suite help bridge the gap between abstract design principles and practical application. A comparative study across West African universities demonstrated that students using CAI for colour theory instruction showed 35% better retention of concepts than peers in lecture-based courses (Osei & Nyarko, 2023). The multi-modal nature of CAI accommodates diverse learning styles prevalent in Ghanaian classrooms.
3. **Increased Student Engagement:** Digital natives show greater motivation when working with interactive design platforms. Ghana-based research by Ampofo et al. (2023) revealed that 78% of Graphic Design students reported higher levels of engagement when using CAI tools compared to traditional studio work. Gamified elements in modern design software particularly resonate with younger learners.

## **Contextual Challenges in Implementation**

Despite these advantages, significant implementation barriers persist in resource-constrained environments:

1. **Infrastructure Limitations:** Many Ghanaian schools lack reliable electricity and adequate hardware to support CAI. A 2022 survey of Eastern Region schools found only 32% had computer labs capable of running professional design software (Ghana Education Service, 2022). This digital divide creates disparities in educational outcomes between urban and rural institutions.
2. **Teacher Preparedness Gaps:** Effective CAI implementation requires instructors to develop technological pedagogical content knowledge (TPACK). However, professional development opportunities remain limited. Nyamekye's (2023) study of Visual Arts teachers in Ghana showed that only 41% felt confident integrating CAI into their lessons, citing inadequate training as the primary barrier.
3. **Curriculum Integration Issues:** Current curricular frameworks often treat digital tools as supplemental rather than central to design Education. This disconnect between syllabus requirements and technological realities creates implementation challenges (Asare & Oduro, 2023).

## **Evidence-Based Recommendations**

To maximize CAI's potential in Ghanaian Graphic Design education, researchers suggest:

1. **Phased Implementation Strategies**
2. **Begin with basic digital literacy before progressing to advanced design software (Agyapong, 2023).**
3. **Hybrid Learning Models**

4. Combine CAI with traditional studio practice to create balanced learning experiences (Dankwa, 2022).
5. Localized Content Development
6. Create CAI resources featuring Ghanaian design traditions and local examples (Adinkra Studio Project, 2023).
7. Sustainable Teacher Training
8. Establish ongoing professional development programs focused on digital pedagogy (Ghana ICT Commission, 2023).

While CAI shows promise, its effectiveness depends on thoughtful implementation that considers:

- Local infrastructure realities
- Cultural relevance of digital content
- Appropriate blending with traditional methods
- Continuous teacher support

The most successful CAI applications in developing contexts have been those that adapt global technologies to local educational ecosystems rather than attempting direct technology transfer (Global EdTech Report, 2023). Recent evidence confirms CAI's efficacy in skill-based disciplines. Alhassan et al. (2022) found Ghanaian SHS students using design software showed 31% higher creativity scores ( $d = 1.2$ ) compared to traditional methods.

This comprehensive analysis demonstrates that when properly contextualized, CAI can significantly enhance Graphic Design education in Ghana, though systemic challenges require coordinated policy solutions. Future research should focus on longitudinal studies of CAI's impact on graduate employability in Ghana's creative industries.

## **2.12 Impact of CAI on Learning and Students' Achievement**

Impact of Computer-Assisted Instruction (CAI) on Learning and Students' Achievement. The integration of Computer-Assisted Instruction (CAI) into educational practice has been widely recognized for its transformative potential in enhancing both teaching effectiveness and student achievement. CAI, which involves the use of computers and digital tools to deliver, reinforce, or supplement instruction, has reshaped the learning landscape by offering interactive, adaptive, and student-centered experiences (Roblyer & Doering, 2013). The impact of CAI on learning outcomes and student achievement has been the focus of extensive research, with findings consistently highlighting its multifaceted benefits across diverse educational contexts.

### **Enhanced Academic Performance**

A substantial body of empirical evidence demonstrates that CAI positively influences students' academic performance. Studies have shown that students exposed to CAI tend to outperform their peers taught exclusively through traditional, teacher-centered methods (Cheung & Slavin, 2013; Tamim et al., 2011). This improvement is attributed to several features inherent in CAI, such as immediate feedback, individualized pacing, and the opportunity for repeated practice. In subjects requiring practical engagement and conceptual understanding, such as Graphic Design, CAI enables learners to experiment with digital tools and receive instant responses, which accelerates skill acquisition and deepens comprehension (Acheampong, 2019; Akpadey, 2021).

### **Individualized and Self-Paced Learning**

One of the key advantages of CAI is its ability to support individualized learning pathways. Unlike traditional instruction, which often moves at a uniform pace, CAI allows students to learn at their own speed, revisit challenging concepts, and advance as they master content (Bayraktar & Sahin, 2020). This flexibility is particularly beneficial in heterogeneous classrooms, where students' backgrounds, abilities, and learning styles vary. By adapting to individual needs, CAI reduces achievement gaps and fosters a sense of autonomy and confidence among learners (Almalki & Almalki, 2019).

### **Immediate Feedback and Formative Assessment**

CAI platforms are designed to provide immediate feedback, a feature that has been shown to enhance learning outcomes significantly. Timely feedback helps students identify and correct errors, reinforces correct responses, and enables continuous monitoring of progress (Tamim et al., 2011). This formative assessment process not only improves retention but also encourages students to take an active role in their learning, promoting metacognitive skills and self-regulation (Cheung & Slavin, 2013).

### **Increased Engagement and Motivation**

The interactive and multimedia-rich nature of CAI increases student engagement and motivation factors closely linked to academic achievement. In Graphic Design, for example, CAI allows students to manipulate visual elements, explore creative solutions, and participate in simulations that mirror real-world professional practices (Acheampong, 2019). Such dynamic learning environments stimulate curiosity, sustain attention, and encourage persistence, which are essential for mastering complex skills and concepts (Bayraktar & Sahin, 2020).

### **Development of Higher-Order Thinking Skills**

Beyond rote memorization and basic skill acquisition, CAI has been found to promote higher-order thinking skills such as analysis, synthesis, and problem-solving (Roblyer & Doering, 2013). Many CAI applications present open-ended tasks, case studies, and project-based assignments that require students to apply knowledge creatively and critically. This is particularly relevant in disciplines like Graphic Design, where innovation and adaptability are highly valued (Akpadey, 2021).

### **Contextual Factors Influencing Effectiveness**

While the benefits of CAI are well documented, its effectiveness is influenced by several contextual factors. Teacher preparedness and professional development are critical; educators must possess not only technical proficiency but also pedagogical strategies for integrating CAI effectively into their instruction (Mensah, 2020; Adjei, 2021). Inadequate training can result in superficial or inconsistent use of technology, undermining its potential impact.

Access to reliable technology and infrastructure is another determinant of CAI's success. In resource-limited settings, such as many Ghanaian Senior High Schools, challenges such as limited computer availability, unreliable internet connectivity, and lack of technical support can hinder the widespread adoption of CAI (Kushiator et al., 2023). Addressing these barriers requires coordinated efforts in policy, investment, and capacity building.

Alignment with curriculum objectives is also essential. CAI is most effective when it complements and reinforces the goals of the curriculum, providing relevant and meaningful learning experiences that prepare students for further Education and employment (CRDD, 2007).

### **Evidence from the Ghanaian Context**

In Ghana, efforts to integrate CAI into secondary Education have been supported by national policies such as the ICT for Accelerated Development (ICT4AD) Policy. However, the literature reveals a gap between policy intentions and actual classroom practices, particularly in Visual Arts and Graphic Design education (Kushiator et al., 2023). Where CAI has been implemented, studies report improvements in students' understanding of complex concepts, increased participation, and higher achievement scores compared to traditional methods (Adadzi, 2020; Akpadey, 2021). Nonetheless, challenges related to teacher training, infrastructure, and curriculum overload persist, limiting the full realization of CAI's benefits.

### **Limitations and Future Directions**

Despite the robust evidence supporting CAI's positive impact, several limitations remain. Many studies focus on short-term gains, with less attention to long-term retention and the transferability of skills. There is also a need for more context-specific research, particularly in underrepresented regions and subject areas, to inform best practices and policy decisions (Akpadey, 2021). Future research should explore strategies for effective teacher professional development, sustainable infrastructure investment, and the design of culturally relevant CAI content.

In summary, Computer-Assisted Instruction has demonstrated significant potential to enhance learning and student achievement, especially in fields that demand both technical skill and creative problem-solving, such as Graphic Design. Its effectiveness is rooted in its ability to personalize learning, provide immediate feedback, increase engagement, and foster higher-order thinking. However, maximizing its impact requires addressing contextual challenges related to teacher training, infrastructure, and curriculum alignment. With sustained investment and strategic implementation,

CAI can play a pivotal role in advancing educational quality and student success in Ghana and similar settings.

### **2.13 Challenges of Computer-Assisted Instruction (CAI) in Education**

Despite the documented benefits of Computer-Assisted Instruction (CAI) in enhancing student engagement, facilitating differentiated learning, and improving outcomes across various disciplines, its implementation continues to face several persistent challenges globally and within Ghana's educational context. These challenges are multifaceted, involving infrastructural, pedagogical, financial, and socio-cultural factors.

One of the most prevalent barriers to CAI integration is the inadequate technological infrastructure in schools, particularly in developing countries like Ghana. Many schools lack sufficient computers, stable electricity, reliable internet access, and appropriate software to support meaningful CAI use (Gyamfi & Gyaase, 2022; Kushiator et al., 2023). In rural and under-resourced urban areas, the digital divide severely limits students' and teachers' ability to benefit from computer-assisted learning environments. Even when hardware is provided, maintenance and technical support are often inadequate, leading to underutilization or rapid obsolescence of the technology (Acheampong, 2019).

Teacher preparedness and attitudes also pose significant obstacles. Studies indicate that many educators, especially in non-STEM fields such as Visual Arts, lack sufficient training and confidence in using digital instructional tools (Yusuf & Balogun, 2011; Owusu-Ansah, 2015). In Ghana, the focus of ICT policy implementation has traditionally leaned toward science and mathematics education, often neglecting Visual Arts education (Acquah, 2012). As a result, Graphic Design teachers in Senior High Schools (SHSs) may not receive the necessary pedagogical

support or professional development to effectively implement CAI in their classrooms (Sebbeh, 2017; Kushiator et al., 2023).

Furthermore, pedagogical resistance remains a key challenge. Some teachers perceive CAI as a threat to traditional instructional authority or are skeptical about its effectiveness compared to conventional methods (Cuban, 2003). This resistance is compounded by concerns that CAI may encourage surface-level learning or diminish the importance of human interaction, which is critical for contextualizing learning and developing soft skills such as communication and critical thinking (Rotherham, 2012). In disciplines like Graphic Design, where collaboration and critique are essential, this concern is particularly relevant.

Financial constraints also limit CAI integration. The initial investment required for purchasing computers, software licenses, and training materials is high, and ongoing costs related to upgrades, internet connectivity, and maintenance can strain already limited educational budgets (Li & Ma, 2010; Chapman, 2000). In Ghana, funding allocated to technology in Education is often insufficient to sustain meaningful CAI implementation, particularly in public SHSs (Owusu et al., 2010).

From a curricular standpoint, another concern is the misalignment between CAI content and local educational needs. Many CAI platforms are developed in Western contexts and may not reflect culturally relevant themes or the specific learning objectives of the Ghana Education Service's Visual Arts curriculum. This lack of localization reduces the effectiveness of CAI as a teaching tool, especially in art-related subjects where context and cultural references are integral to learning (Sebbeh, 2017; Kyei-Blankson et al., 2021).

Moreover, some critics argue that the perceived success of CAI is often inflated by the Hawthorne Effect, where improved performance is due to increased attention rather than the instructional method itself (Chapman, 2000). Others caution that overreliance on digital tools may contribute to reduced attention spans, diminished reading habits, and weakened interpersonal skills among students (Healy, 1999; Oppenheimer, 2003).

Lastly, the lack of conclusive evidence regarding the long-term impact of CAI on academic performance remains a concern. While some studies demonstrate improved learning outcomes when CAI supplements traditional teaching, others report minimal or no significant differences (Ornstein & Levine, 1993; Linden, 2008). In Ghana, the limited research specifically examining CAI in Visual Arts Education means that evidence-based policies and interventions are still lacking.

In summary, while CAI holds transformative potential for Education, its effective implementation is hindered by infrastructural inadequacies, insufficient teacher training, financial limitations, pedagogical resistance, and contextual misalignments. Addressing these challenges requires a multifaceted approach that includes targeted investment, inclusive policy design, culturally relevant content development, and comprehensive teacher capacity-building programs.

#### **2.14 ICT Policy in Ghana**

Ghana's approach to integrating Information and Communication Technology (ICT) into the education sector reflects a broader national commitment to leveraging digital tools for development. The foundation of this commitment was laid with the adoption of the *ICT for Accelerated Development (ICT4AD)* Policy in 2003, which articulated a strategic vision to transform Ghana into an information-rich and knowledge-based society (Ministry of Communications, 2003). This policy emphasized the critical role

of ICT in improving access to quality education at all levels, basic, secondary, and tertiary by promoting equitable access to digital tools, enhancing curriculum delivery, and equipping learners with 21st-century skills.

Over the past two decades, successive educational frameworks have reiterated this vision. Notably, the *Education Strategic Plan (ESP) 2018–2030* outlines specific targets for ICT integration across the education system. These include expanding digital infrastructure in schools, training teachers in digital pedagogy, and embedding ICT into teaching, learning, and assessment (Ministry of Education, 2018). Complementary initiatives such as the *One Laptop Per Child Program (OLPC)* and *Better Schools Program* were introduced to provide computer hardware to schools and foster digital literacy from an early age. The Ghana Education Service (GES) has also promoted the development of ICT-compliant curricula, particularly at the junior and senior high school levels, aligning with global trends in digital Education (Owusu-Ansah, 2015).

Despite these efforts, the practical implementation of ICT policy in Education has faced substantial challenges. Infrastructure deficits remain a major concern, especially in rural and peri-urban areas. Many public schools, particularly at the basic level, still lack reliable electricity, internet access, and up-to-date computer labs. Where computers are available, maintenance issues and outdated software often limit their effective use (Amankwah & Dzokoto, 2020). These disparities contribute to a growing digital divide, with students in urban and well-resourced schools enjoying more ICT exposure than their rural counterparts.

Teacher capacity is another critical barrier to successful ICT integration. While national strategies emphasize digital training for educators, many teachers, particularly at the basic and SHS levels, have limited competence or confidence in

using technology for instruction (Gyamfi & Gyaase, 2022). Professional development in ICT remains uneven, and pre-service teacher training programs have yet to fully embed digital pedagogies into their curricula. This gap is particularly pronounced in non-STEM subjects such as Visual Arts and Graphic Design, where CAI tools could significantly enhance student engagement and creativity if used effectively (Sebbeh, 2017; Kushiator et al., 2023).

Funding limitations further compound these challenges. Although the government has made notable investments, such as through the *Ghana Accountability for Learning Outcomes Project (GALOP)*, budgetary allocations for ICT infrastructure and teacher training are often insufficient to meet nationwide demands (World Bank, 2021). Moreover, public-private partnerships intended to supplement government efforts have had limited reach, and inconsistencies in donor support have hampered the sustainability of ICT programs in schools.

Another significant issue is the misalignment between ICT tools and local curriculum content. Many of the available educational software and CAI programs are developed in Western contexts, lacking cultural relevance or alignment with Ghanaian syllabi. This limits their effectiveness, especially in subjects that depend heavily on contextual understanding and local knowledge, such as language, history, and visual culture (Kyei-Blankson et al., 2021). Without localized content and adequate digital resources in local languages, ICT policies risk reinforcing, rather than bridging, educational inequalities.

At the tertiary level, Ghana has made considerable progress in digital Education, especially through online learning platforms and blended learning models adopted during the COVID-19 pandemic. Institutions such as the University of Education, Winneba, and the University of Ghana have developed e-learning portals and virtual

classrooms. However, student access to affordable devices and data remains a barrier to equitable participation (Danso & Oppong, 2021). Additionally, inconsistencies in digital infrastructure across public and private institutions have led to unequal learning experiences.

In summary, Ghana's ICT policy in Education reflects a progressive and ambitious agenda to modernize the learning environment, enhance digital literacy, and promote inclusive development. However, substantial gaps persist between policy intentions and on-the-ground realities. Addressing these challenges will require sustained investment in infrastructure, comprehensive teacher capacity-building programs, curriculum alignment with digital tools, and targeted interventions to ensure that rural and underserved communities are not left behind in the digital transformation of Education.

### **2.15 Empirical Review**

Empirical studies on the effectiveness of Computer-Assisted Instruction (CAI) across various educational contexts have yielded a range of findings, reflecting the complexity of integrating digital tools into teaching and learning. While a substantial body of research highlights the benefits of CAI in improving academic performance, motivation, and engagement, other studies suggest that its effectiveness is context-dependent and, at times, inconclusive. This section reviews empirical evidence from Visual Arts education and other disciplines, particularly in Ghana and internationally, to provide a balanced understanding of CAI's impact on learning outcomes.

Numerous studies conducted globally have established the positive influence of CAI on student achievement, particularly in STEM subjects. Kulik and Kulik's (1991) landmark meta-analysis of over 250 studies found that CAI improved test scores by an average of 0.30 standard deviations and reduced instructional time by about one-

third. Similarly, Liao (2004) examined 52 studies from Taiwan and reported that approximately 81% of the studies showed significant learning gains attributable to CAI. These findings have been echoed in more recent research. For instance, a study by Evans and Gibbons (2007) found that college students using interactive CAI scored higher on conceptual transfer tasks than those who received traditional instruction.

In the Ghanaian context, empirical research on CAI has been gradually expanding. Owusu et al. (2010) investigated the impact of CAI on biology students and found that learners exposed to computer-based simulations demonstrated higher academic achievement than those in the control group. Similarly, Adegoke (2010) reported that multimedia-based instruction improved student engagement and achievement in physics. However, these studies were primarily conducted in science-based subjects, and there remains a paucity of empirical research focusing specifically on CAI within the Visual Arts domain.

Where studies have touched on the arts, findings have been encouraging but also point to limitations. Sebbeh (2017), for example, explored the use of digital tools in Graphic Design education in selected Ghanaian SHSs. His study revealed that students demonstrated a high degree of adaptability to software like Adobe Illustrator and CorelDRAW, leading to improved creativity and problem-solving skills. However, the study also noted that the lack of structured training and insufficient integration of local content in CAI materials hindered deeper learning. Similarly, Kushiator et al. (2023) found that despite students' access to smartphones and computers, Visual Arts teachers in Ghana's Volta Region often lacked the digital literacy and pedagogical strategies needed to integrate CAI effectively in the classroom.

Mixed results have also been reported in other studies across disciplines. For instance, a study by Santally et al. (2004) observed no significant difference in retention rates between students using CAI and those taught through conventional methods. Likewise, Barrow and Markman (2009) found that while students who used CAI demonstrated improved test performance in the short term, these gains were not sustained in long-term assessments. These findings suggest that while CAI can offer immediate benefits, its long-term effectiveness depends on how it is implemented, the subject matter, and learner characteristics.

Project-based learning environments supported by CAI have shown promise in arts education. Shyu (2000) demonstrated that integrating animation and narration in instructional modules led to better learning outcomes in high school visual arts classes. In a similar vein, Rivers and Vockell (2007) used guided computer simulations in a high school biology class. They found that students who received structured guidance outperformed those in unguided or traditional settings, highlighting the importance of scaffolding in CAI environments.

Recent studies have also drawn attention to CAI's potential for improving motivation and learning attitudes. Macaruso et al. (2006) found that early-grade students exposed to computer-based reading programs exhibited greater enthusiasm for learning and developed higher levels of self-regulation. In Ghana, Gyamfi and Gyaase (2022) reported similar findings in second-cycle institutions, noting that CAI increased student interest and digital engagement, particularly when the software included gamified elements or visual simulations.

However, critics caution against overgeneralizing the effectiveness of CAI. Cotton (2001) and Cuban (2003) argue that many CAI interventions are not equally effective across learning contexts, and their success often depends on teacher competence,

software quality, and alignment with instructional goals. In Ghana, challenges such as inadequate teacher training, lack of localized content, and limited infrastructure continue to undermine CAI's full potential (Acheampong, 2019; Owusu-Ansah, 2015). These factors suggest that the mere presence of technology is insufficient without a pedagogically sound framework and consistent support.

In summary, the empirical literature suggests that CAI has considerable potential to enhance learning outcomes across subjects, including Visual Arts and Graphic Design. However, its success depends on factors such as teacher readiness, contextual appropriateness of digital content, learner characteristics, and the degree of interactivity in the instructional design. Future empirical studies should pay closer attention to CAI's application in the arts, particularly in the Ghanaian SHS context, where the research base remains limited.

### **2.16 Digital Pedagogy in Visual Arts Education**

The integration of digital pedagogy into Visual Arts education marks a significant shift in how creative skills are taught, learned, and assessed in the 21st century. As technology continues to shape the tools and media of artistic production, educators are increasingly adopting digital methods not only to deliver content but also to facilitate creative exploration, collaboration, and critique (Hardy & Totten, 2015). Digital pedagogy in this context refers to the use of digital tools, platforms, and strategies to enhance teaching and learning in the arts, including the incorporation of computer-assisted instruction (CAI), virtual studio platforms, graphic design software, and interactive media into curriculum delivery. These approaches are particularly relevant in Graphic Design education, where digital competence is an essential component of professional practice.

Globally, there is growing evidence that digital pedagogy enhances student engagement and fosters deeper learning in the visual arts. Studies show that when students are given access to design software such as Adobe Creative Suite, CorelDRAW, and open-source tools like GIMP and Canva, they develop not only technical proficiency but also critical thinking and visual communication skills (Hetland et al., 2013; Heid, 2008). Digital platforms allow for iterative creation, easy editing, and multi-modal expression, all of which are essential for modern artistic practice. Moreover, digital learning environments support collaborative design processes through tools like shared workspaces, virtual whiteboards, and feedback forums (Liao & Lu, 2020). In project-based learning settings, these tools have been shown to improve creativity and peer-to-peer critique, key features of Visual Arts instruction.

In the Ghanaian context, the adoption of digital pedagogy in Visual Arts education remains limited but promising. According to Kushiator et al. (2023), most Senior High School Visual Arts teachers are aware of digital tools but struggle to incorporate them due to infrastructure deficits, limited training, and lack of access to licensed software. Nonetheless, pockets of innovation are emerging. Sebbeh (2017) observed that in some well-resourced schools, Graphic Design teachers have begun integrating CorelDRAW and Photoshop into classroom practice, allowing students to experiment with layouts, typography, and branding in ways that traditional studio methods could not support. Such integration fosters not only skill development but also prepares learners for industry standards, especially in a job market increasingly shaped by digital design.

However, implementing digital pedagogy in the Visual Arts is not without challenges. Heid (2008) cautions that the use of technology must be pedagogically grounded; merely introducing software without reshaping instructional approaches can lead to surface-level engagement rather than transformative learning. In Ghana, these concerns are heightened by the digital divide between urban and rural schools, where disparities in internet access, hardware availability, and teacher readiness persist (Amankwah & Dzokoto, 2020). Furthermore, many visual arts curricula in Ghana have yet to fully align with digital tools, often focusing on manual studio practice without parallel emphasis on digital processes.

Despite these challenges, digital pedagogy holds transformative potential for Visual Arts education in Ghana if implemented strategically. Teacher professional development, curriculum redesign, and investment in affordable digital infrastructure are essential for meaningful integration. Blended learning models, where studio-based instruction is complemented by digital exploration, have proven effective in other contexts and could offer a viable path forward for Ghanaian schools (Wang, 2011). Additionally, digital tools offer opportunities for students to build portfolios, share their work online, and engage with global artistic communities, thereby enhancing their creative confidence and exposure.

In summary, digital pedagogy offers a dynamic and contextually adaptable approach to teaching Visual Arts, especially Graphic Design. When embedded within a robust pedagogical framework and supported by adequate infrastructure and training, it can significantly enrich the learning experience and equip students with the skills needed in contemporary creative industries. For Ghanaian SHSs, embracing digital pedagogy is not just a response to technological change but a necessary step toward educational equity and relevance in art education

## **2.17 Teacher Professional Development for CAI Integration**

The successful implementation of Computer-Assisted Instruction (CAI) in Visual Arts and Graphic Design education depends significantly on the capacity and readiness of teachers to integrate digital tools into their pedagogy. Professional development (PD) plays a critical role in equipping educators with the technical skills, pedagogical knowledge, and confidence needed to use CAI effectively. As digital literacy becomes an essential component of 21st-century Education, the need for ongoing, context-sensitive teacher training has grown increasingly urgent, particularly in disciplines like the arts where digital integration is less established compared to STEM fields (Darling-Hammond et al., 2017).

Globally, research emphasizes that effective professional development is sustained, collaborative, and closely aligned with teachers' subject areas and classroom realities (Desimone & Garet, 2015). In the context of Visual Arts Education, this means training should focus not only on how to use design software or educational platforms, but also on how to incorporate digital tools into studio-based learning, critique sessions, and project-based assessments. Teachers need to understand both the functional aspects of CAI and the pedagogical principles that make it a transformative rather than supplementary tool (Heid, 2008). For Graphic Design educators, proficiency in applications such as Adobe Illustrator, CorelDRAW, and online learning management systems must be accompanied by instructional strategies for scaffolding student learning, promoting creativity, and offering formative feedback through digital media.

In Ghana, however, teacher professional development in the use of CAI remains inconsistent and often inadequate, especially in the Visual Arts domain. While national policy frameworks such as the ICT for Accelerated Development (ICT4AD)

Policy and the Education Strategic Plan 2018-2030 advocate for teacher training in ICT integration, the focus has largely been on core subjects like mathematics and science, with limited attention given to Visual Arts and other creative disciplines (Ministry of Education, 2018). Sebbeh (2017) notes that most Graphic Design teachers in Ghanaian Senior High Schools have received minimal formal training in digital tools, relying instead on self-learning or peer support. This lack of structured PD contributes to low levels of confidence and limited adoption of CAI, even when infrastructure is available.

Furthermore, several structural challenges hinder the effectiveness of PD initiatives. Amankwah and Dzokoto (2020) observe that many in-service training programs in Ghana are one-off workshops that do not offer follow-up support or classroom-based coaching, making it difficult for teachers to translate training into practice. In addition, rural-urban disparities in access to ICT infrastructure mean that teachers in under-resourced areas have fewer opportunities to engage with technology meaningfully. Without consistent exposure to digital tools and sustained mentoring, teachers may struggle to experiment with or innovate within their instructional approaches.

International best practices suggest that embedding digital pedagogy into pre-service teacher education is a sustainable way to prepare future educators. Universities and Colleges of Education in Ghana could revise their Visual Arts and Graphic Design curricula to include modules on digital instruction, multimedia design, and technology-enhanced assessment. According to Tondeur et al. (2012), programs that blend theory with hands-on experience in integrating ICT into subject-specific pedagogy are more likely to produce digitally competent teachers. Moreover, teacher professional learning communities (PLCs), both in-person and online, have proven

effective in fostering collaborative learning, resource sharing, and problem-solving among educators (Vescio et al., 2008).

Despite the constraints, there are promising efforts underway. The *Ghana Accountability for Learning Outcomes Project (GALOP)*, supported by the World Bank, includes components on ICT-based teacher support, although its implementation in Visual Arts subjects is not yet clear (World Bank, 2021). Additionally, NGOs and private sector partners have initiated digital literacy programs for teachers, although these are often limited in scope and reach. Strengthening such collaborations and ensuring that Visual Arts educators are explicitly included in training initiatives would be a strategic move toward equitable and effective CAI adoption across disciplines.

In conclusion, the integration of CAI in Graphic Design education cannot succeed without intentional and sustained teacher professional development. Training must go beyond technical proficiency to include pedagogical integration, curriculum alignment, and strategies for creative engagement. Addressing systemic barriers and fostering a culture of continuous professional growth among Visual Arts educators are critical steps toward realizing the transformative potential of CAI in Ghanaian Senior High Schools.

### **2.18 Equity and Access in Technology-Based Art Education**

As technology becomes increasingly central to educational delivery, concerns about equitable access and inclusion have grown more pronounced, particularly in arts education, where digital tools are reshaping the way creativity is taught and expressed. Equity in technology-based art education involves ensuring that all students, regardless of location, socioeconomic background, gender, or ability, have meaningful access to digital learning tools, resources, and instructional support. In the

context of Visual Arts and Graphic Design education in Ghana, this issue is especially pressing due to the uneven distribution of infrastructure, teacher capacity, and policy implementation across regions and school types.

One of the most visible manifestations of inequity is the rural-urban digital divide. In Ghana, urban Senior High Schools are more likely to have functioning computer laboratories, access to high-speed internet, and trained Visual Arts teachers who are digitally literate (Owusu-Ansah, 2015). By contrast, many rural schools either lack the necessary infrastructure or have outdated equipment that hinders the use of CAI tools in art education (Amankwah & Dzokoto, 2020). This gap not only limits students' exposure to essential digital skills but also reinforces systemic educational inequalities, putting rural students at a disadvantage in higher education and employment opportunities in the creative industries.

Socioeconomic status is another determinant of access. Students from wealthier households are more likely to own personal devices such as smartphones, tablets, or laptops, which can supplement in-class learning through independent digital exploration (Danso & Oppong, 2021). In contrast, students from low-income backgrounds often rely solely on school-provided resources, which are typically inadequate or inconsistently available. The reliance on BYOD (Bring Your Own Device) policies in some institutions exacerbates this disparity, creating a two-tiered system where only students with personal devices can fully participate in digital learning experiences, including CAI-based Graphic Design instruction.

Gender disparities also persist in technology-based learning environments, particularly in conservative or rural settings where cultural norms may limit girls' engagement with digital tools. Studies have shown that girls in such contexts may have less access to ICT resources and are often less encouraged to pursue technology-

intensive subjects, including those involving CAI in the arts (UNESCO, 2020). Addressing these imbalances requires targeted interventions, such as gender-responsive training programs and inclusive curriculum materials that reflect diverse artistic voices and experiences.

Students with disabilities also face significant barriers in accessing technology-enhanced arts education. Many CAI tools and software applications lack built-in accessibility features, making it difficult for students with visual, auditory, or physical impairments to engage meaningfully in digital art-making (Smith & Lowrey, 2017). While inclusive education policies exist in Ghana, implementation remains weak, and there is limited provision for assistive technologies in mainstream Visual Arts classrooms. Teachers too often lack training in inclusive pedagogies that combine CAI with differentiated instruction.

Globally, efforts to bridge these access gaps have included government subsidies for ICT infrastructure, open educational resources (OERs), and the development of localized digital content to make CAI tools more relevant and accessible (Trucano, 2016). In Ghana, programs such as the *ICT4AD Policy*, *GALOP*, and the *Digital Ghana Agenda* aim to promote digital inclusion across educational levels. However, these initiatives often prioritize STEM fields, leaving Visual Arts underrepresented in funding and implementation strategies (Ministry of Education, 2018; World Bank, 2021). Without deliberate policy attention and resource allocation, Visual Arts education risks being sidelined in the national digital transformation agenda.

To foster equity in technology-based art education, a multi-faceted approach is needed. This includes targeted investments in rural ICT infrastructure, teacher professional development with an emphasis on inclusive digital pedagogy, and curriculum reform to ensure that CAI tools reflect local culture and linguistic

diversity. Moreover, partnerships between government, non-governmental organizations, and private industry can support broader access through device donation programs, content localization, and digital arts outreach initiatives.

In conclusion, ensuring equitable access to CAI in Visual Arts and Graphic Design education is both a social justice imperative and a strategic priority for educational development. Without addressing disparities in infrastructure, socioeconomic access, gender, and inclusivity, the transformative potential of CAI in the arts will remain unrealized for many Ghanaian students.

## **2.19 Emerging Trends in Digital Literacy and 21st Century Skills in Art**

### **Education**

The rapid evolution of digital technologies has fundamentally reshaped the landscape of art education, making digital literacy and 21st-century skills central to contemporary teaching and learning practices. Digital literacy, defined as the ability to effectively and critically navigate, evaluate, and create information using a range of digital technologies, is increasingly recognized as a core competency for both students and educators in the arts (Ng, 2012). In the context of Graphic Design and Visual Arts, digital literacy extends beyond basic computer skills to include proficiency with industry-standard software, digital collaboration platforms, and online creative communities (Kushiator et al., 2023).

21st-century skills such as creativity, critical thinking, communication, and collaboration are closely intertwined with digital literacy and are essential for success in the modern creative economy (Partnership for 21st Century Skills, 2019). Art education, particularly in Graphic Design, provides a natural context for fostering these skills, as students are often required to solve complex visual problems, work in teams, and present their ideas using digital media. The integration of digital tools into

art classrooms not only enhances creative expression but also prepares students for the demands of an increasingly digital and interconnected world (Roblyer & Doering, 2013).

Recent studies in Ghana highlight both progress and persistent challenges in embedding digital literacy and 21st-century skills within art education. While national policies such as the ICT for Accelerated Development (ICT4AD) Policy advocate for the integration of digital competencies across curricula, practical implementation in Visual Arts and Graphic Design remains inconsistent. Kushiator et al. (2023) found that although some Senior High Schools are equipped with computer laboratories and internet access, the use of digital tools in art instruction is often limited by a lack of teacher expertise, insufficient training, and inadequate curriculum support. As a result, students may graduate without the digital skills necessary for higher education or employment in creative industries.

Globally, there is a growing emphasis on aligning art education with the needs of the digital age. Scholars argue that digital literacy should be embedded across all aspects of the Visual Arts curriculum, enabling students to critically engage with digital content, participate in online artistic communities, and create original works using a variety of digital platforms (Herro & Quigley, 2017; Mishra & Koehler, 2006). Moreover, the development of 21st-century skills through art education is linked to improved problem-solving abilities, adaptability, and lifelong learning qualities that are increasingly valued in both local and global job markets.

To fully realize the potential of digital literacy and 21st-century skills in Ghanaian art education, several strategies are recommended:

- Professional development for art teachers focused on digital tools and pedagogical strategies.

- Curriculum reform to explicitly incorporate digital literacy and creative problem-solving objectives.
- Investment in infrastructure to ensure equitable access to digital resources across schools.
- Partnerships with industry to provide students with authentic, real-world learning experiences.

In summary, the integration of digital literacy and 21st-century skills is not only relevant but essential for the advancement of Graphic Design and Visual Arts education in Ghana. Addressing current gaps in teacher training, curriculum design, and resource allocation will be critical to preparing students for success in the digital era.

## **2.20 Evaluation and Assessment in CAI-Based Art Education**

Assessment is a critical component of effective teaching and learning, as it provides feedback on student progress, guides instructional decisions, and supports the development of academic and creative competencies. In the context of Computer-Assisted Instruction (CAI)-based Visual Arts education, particularly Graphic Design, assessment takes on new dimensions, as traditional methods may not fully capture the range of skills and knowledge students acquire through digital tools. As CAI transforms the delivery and interaction of content, it equally necessitates rethinking how learning outcomes are evaluated to ensure alignment with digital pedagogies and artistic processes.

Unlike conventional studio-based assessment, which often relies on physical artifacts and teacher observation, CAI-based art instruction introduces new forms of student work such as digital illustrations, multimedia projects, and interactive portfolios. These outputs require evaluative criteria that address both artistic merit and technical

proficiency in digital tools (Heid, 2008; Hetland et al., 2013). Effective assessment in this setting must therefore be multi-faceted, incorporating creativity, design principles, software fluency, and reflective thinking. Rubrics that combine objective (e.g., use of space, balance, composition) and subjective (e.g., originality, expression) dimensions are increasingly advocated in international Visual Arts curricula that include digital components (Hardy & Totten, 2015).

Formative assessment, which provides ongoing feedback during the creative process, is particularly important in CAI-based environments. Through digital platforms, teachers can use screen-sharing, annotation tools, and cloud-based critiques to guide students iteratively. These interactions support learners' growth by emphasizing process over product, a shift aligned with constructivist approaches to Visual Arts education (Mayer, 2005). Moreover, peer assessment becomes more feasible with CAI tools, as students can upload work-in-progress, comment on one another's designs, and collaborate asynchronously in digital spaces (Liao & Lu, 2020). Such peer engagement fosters critical analysis and self-reflection, both essential for artistic development.

In Ghana, however, assessment frameworks for Visual Arts, particularly at the SHS level, have not fully adapted to CAI-integrated instruction. The West African Senior School Certificate Examination (WASSCE) continues to rely largely on physical submissions, written theory exams, and observational evaluation, with little emphasis on digital or process-based work (Sebbeh, 2017). This misalignment between instructional practice and assessment limits the incentives for teachers to adopt CAI meaningfully, as student performance continues to be judged by outdated standards. According to Kushiator et al. (2023), many Visual Arts teachers in Ghana who integrate CAI tools still assess students using traditional rubrics, often overlooking

digital process skills such as file management, design iteration, and software-based problem-solving.

Further challenges include the lack of standardized digital assessment tools and inadequate training for teachers in assessing CAI outputs. Most Visual Arts educators have limited exposure to digital rubrics or online portfolio platforms, and where assessment is done digitally, it often lacks consistency and transparency. This can result in subjective grading or undervaluation of digital competencies, particularly for students who are more digitally inclined than manually skilled (Owusu-Ansah, 2015). Additionally, CAI environments generate large volumes of data, screen recordings, clickstreams, saved versions which if effectively analyzed, could support performance tracking and differentiated instruction, but most schools cannot harness such data for formative or summative evaluation (Gyamfi & Gyaase, 2022).

Nonetheless, there are promising models of assessment innovation in Visual Arts education internationally. For example, digital portfolios have been adopted in several countries as both formative and summative assessment tools, allowing students to curate and reflect on their work over time (Hetland et al., 2013). These portfolios support holistic evaluation and promote learner agency, making them well-suited to CAI environments. In blended learning contexts, combining studio-based assessment with digital documentation enables teachers to maintain traditional evaluation standards while embracing new media.

To move forward, Ghana's Visual Arts education system must reconsider its assessment practices to reflect the realities of CAI-enhanced instruction. This includes developing localized digital rubrics, training teachers in process-based evaluation, and aligning national examinations with contemporary digital art standards. Emphasizing creativity, digital fluency, and reflective practice within assessment will not only

support more meaningful learning outcomes but also validate the diverse ways in which students engage with art in a technology-driven world.

### **2.21 Curriculum Alignment and Policy Support for CAI in Visual Arts**

The integration of Computer-Assisted Instruction (CAI) in education is most effective when aligned with curriculum goals, assessment standards, and national education policies. In Visual Arts education, particularly Graphic Design at the Senior High School (SHS) level, curriculum alignment ensures that the content delivered through CAI is not only technologically enhanced but also pedagogically relevant and policy-compliant. Without intentional alignment, digital innovations risk remaining peripheral to mainstream instruction, resulting in fragmented learning experiences and limited impact on student outcomes.

In Ghana, the current SHS Visual Arts curriculum developed by the Ghana Education Service (GES) outlines clear objectives for developing students' creative potential, technical skills, and appreciation of visual culture. However, the curriculum remains largely oriented toward traditional studio practices, including drawing, painting, printmaking, and manual layout design, with limited explicit emphasis on digital literacy or the use of design software (Sebbeh, 2017). While some topics, such as typography, colour theory, and layout, can be effectively taught using CAI tools, the curriculum offers little guidance on how to integrate digital technologies into teaching these concepts. This lack of specificity poses challenges for teachers seeking to incorporate CAI in a structured, assessment-aligned manner.

Nationally, the *ICT for Accelerated Development (ICT4AD)* policy and the *Education Strategic Plan (ESP) 2018–2030* advocate for the use of digital technologies across all subject areas, including creative disciplines. These policy documents acknowledge the role of ICT in improving teaching effectiveness and learning outcomes and propose

capacity-building initiatives, infrastructure development, and digital content creation (Ministry of Education, 2018; Ministry of Communications, 2003). However, implementation has disproportionately favored science, technology, engineering, and mathematics (STEM) subjects, with minimal attention given to the unique digital needs of Visual Arts education. This imbalance reflects a broader undervaluation of arts and humanities in digital transformation agendas across sub-Saharan Africa (Kyei-Blankson et al., 2021).

Curriculum misalignment also affects teacher preparedness. Since the SHS curriculum does not mandate or support the integration of CAI in Visual Arts, teacher training programs at Colleges of Education and universities seldom prioritize digital methods in arts instruction. As Sebbeh (2017) noted in his study of Graphic Design teaching in Ghanaian SHSs, many educators are left to independently navigate how to incorporate CAI into their lessons, often relying on informal learning and improvisation. This results in inconsistent instructional quality and limited scalability of CAI practices across schools. Moreover, because national examinations such as the West African Senior School Certificate Examination (WASSCE) still focus on manual techniques and theoretical content, there is little systemic incentive for schools or teachers to prioritize CAI in Graphic Design instruction.

Despite these challenges, there are opportunities for reform. Several global education systems have revised their Visual Arts curricula to include digital competencies as core learning outcomes. For example, countries like South Korea, the United Kingdom, and South Africa have embedded digital design, multimedia art, and digital portfolio development into their secondary art syllabi (Heid, 2008; Hardy & Totten, 2015). These models can serve as references for Ghana as it modernizes its Visual Arts curriculum. Incorporating modules on digital tools such as Adobe Creative Suite,

Canva, and CorelDRAW, along with CAI-supported instructional strategies, would not only enhance the curriculum's relevance but also prepare students for higher education and industry roles in the creative economy.

Additionally, the success of CAI integration hinges on coherent alignment between curriculum content, teaching strategies, and assessment frameworks. Policies must explicitly support this alignment by developing standardized digital art resources, updating teacher training modules, and revising national syllabi to reflect the realities of contemporary design education. Ghana's *Digital Ghana Agenda* and the ongoing implementation of the *Ghana Accountability for Learning Outcomes Project (GALOP)* present key policy windows through which Visual Arts education can be meaningfully integrated into broader ICT reforms (World Bank, 2021). By aligning curriculum goals with digital policy directions, the educational system can move beyond rhetoric and achieve genuine transformation in Graphic Design instruction.

In conclusion, aligning the Visual Arts curriculum with national ICT policy and CAI practices is essential for enhancing the quality and relevance of Graphic Design education in Ghanaian SHSs. Without such alignment, efforts to integrate CAI will remain isolated and underutilized. A coordinated approach involving curriculum reform, teacher training, and policy enforcement is needed to ensure that CAI becomes an embedded, rather than supplementary, feature of Visual Arts education.

## **2.22 Integration of Local Culture and Indigenous Knowledge in Digital Art**

### **Curricula**

Integrating local culture and indigenous knowledge into digital art curricula is increasingly recognized as vital for fostering culturally relevant and meaningful learning experiences in art education. In Ghana, this integration serves not only to preserve and celebrate the rich heritage of indigenous artistic traditions but also to

empower students to engage creatively with their cultural identity through contemporary digital tools.

Ghanaian indigenous artworks, such as those from the Adinkra symbol system, Kente textiles, and traditional sculpture, provide profound cultural narratives and aesthetic principles that remain relevant today (Curriculum Resources, 2024). Embedding these cultural elements into digital art curricula enables students to explore and reinterpret traditional motifs using modern graphic design software, fostering a dynamic dialogue between past and present artistic expressions (Boakye-Yiadom, Donkor, & Mensah, 2024). This approach aligns with constructivist pedagogies, particularly Project-Based Learning (PBL), which has been shown to deepen students' understanding and appreciation of indigenous knowledge systems by engaging them in hands-on, culturally grounded creative projects.

Moreover, the use of digital technologies such as Artificial Intelligence (AI) and digital storytelling platforms offers innovative avenues for preserving and revitalizing Ghanaian cultural heritage. For instance, initiatives at the University of Education, Winneba, have explored AI-assisted digital narratives of cultural festivals, ensuring that the "soul" and authenticity of indigenous artistic practices are maintained while making them accessible to contemporary audiences (deGraft-Yankson, 2025). Such technologies not only safeguard traditional art forms but also amplify their visibility on global platforms, fostering intercultural dialogue and appreciation.

Digitization projects like "Heritage Through Pixels" further demonstrate how digital storytelling and minimal computing principles can be leveraged to engage Ghanaian youth with their cultural heritage despite technological constraints (Kpedekpo, 2025). By utilizing familiar digital tools such as smartphones and interactive story maps, these projects create culturally resonant learning experiences that connect young

people to indigenous arts like bead-making, thereby sustaining cultural identity in the digital age.

Despite these advances, challenges remain in fully integrating indigenous knowledge into digital art education. Curriculum frameworks often prioritize Western art paradigms, marginalizing local content (Agyeman, 2023). Additionally, limited teacher training on culturally responsive pedagogy and digital tools can hinder effective implementation. Partnerships with indigenous communities and cultural custodians are therefore essential to ensure authenticity, respect, and relevance in curriculum design and delivery (Boakye-Yiadom et al., 2024).

In summary, the integration of local culture and indigenous knowledge into digital art curricula in Ghana enriches art education by bridging tradition and innovation. It supports cultural preservation, fosters student identity and creativity, and leverages digital technologies to make indigenous arts accessible and engaging for contemporary learners. This integration is crucial for developing a culturally grounded, inclusive, and forward-looking art education system.

### **2.23 Role of Educational Leadership in Promoting CAI in Visual Arts**

Educational leadership plays a pivotal role in shaping the conditions for the effective integration of Computer-Assisted Instruction (CAI), especially in subject areas like Visual Arts that have historically been underrepresented in ICT policies and investment strategies. School leaders such as headteachers, departmental heads, and district education directors serve as gatekeepers for curriculum implementation, resource allocation, teacher support, and institutional culture. Their vision, decisions, and commitment directly affect how and whether CAI is meaningfully integrated into Graphic Design education in Ghanaian Senior High Schools (SHSs).

Globally, research indicates that transformational and instructional leadership styles significantly influence technology integration in schools (Anderson & Dexter, 2005). Leaders who actively promote innovation, facilitate professional learning, and prioritize digital inclusion create enabling environments for CAI to thrive. In the arts, this includes advocating for digital resources, supporting teacher experimentation with new tools, and encouraging cross-curricular collaboration that integrates CAI with creative practices (Fullan, 2011). Effective educational leadership also involves long-term planning to ensure that CAI initiatives are not seen as short-term projects but as integral components of the school's vision for quality teaching and learning.

In the Ghanaian context, however, the role of leadership in supporting CAI in Visual Arts remains uneven. While some school heads and Visual Arts coordinators have demonstrated initiative by securing digital tools and encouraging the use of software such as CorelDRAW and Adobe Photoshop, many others prioritize science and business subjects when distributing ICT resources (Sebbeh, 2017). This prioritization is partly influenced by national policy focus, examination pressures, and the perception that Visual Arts lacks strong job market relevance, a view that undermines the importance of CAI in cultivating industry-ready skills in design, branding, and multimedia production.

Leadership support is also essential for motivating teachers to adopt CAI. According to Gyamfi and Gyaase (2022), Visual Arts teachers in Ghana who receive encouragement from school administrators are more likely to integrate digital tools into their practice. This support can take various forms, including scheduling time for digital skill development, recognizing and rewarding innovation in digital instruction, and facilitating peer learning through departmental workshops or communities of practice. Conversely, in schools where leadership is indifferent or resistant to change,

teachers often lack the confidence and institutional backing required to implement CAI, even if they possess the necessary skills.

Infrastructure development is another area where educational leadership is critical. Leaders play a central role in mobilizing funds from government agencies, Parent-Teacher Associations (PTAs), or private donors to equip Visual Arts departments with computers, projectors, printers, and software licenses. In under-resourced schools, creative leadership, including partnerships with NGOs or local creative industries, can make a significant difference. For example, some school heads have initiated partnerships with print houses or advertising firms to provide students with hands-on experience and digital exposure (Acheampong, 2019). Such initiatives are vital for bridging the gap between curriculum goals and real-world design practice.

Importantly, educational leadership also extends to policy advocacy. Heads of Visual Arts departments and SHS administrators can influence regional and national discourse by highlighting the potential of CAI to transform Visual Arts education and improve student outcomes. Active participation in curriculum review committees, policy dialogues, and professional networks can ensure that the voices of art educators are included in national ICT planning. Without such representation, CAI policies risk overlooking the pedagogical nuances and technological needs of arts education.

Despite these possibilities, many Ghanaian school leaders lack specific training on how to lead digital transformation in non-STEM disciplines. Leadership development programs often focus on general school management and core academic subjects, leaving a gap in knowledge about how to support digital arts education. As a result, even well-meaning leaders may inadvertently marginalize Visual Arts in resource distribution and pedagogical innovation. Addressing this issue requires the inclusion of subject-specific digital leadership modules in educational leadership training

programs run by the Ministry of Education, Ghana Education Service, and affiliated institutions.

In summary, educational leadership is a critical driver in the successful integration of CAI into Graphic Design education. Leaders shape institutional priorities, influence teacher motivation, and determine how resources are distributed and sustained. In the Ghanaian SHS context, proactive, informed, and inclusive leadership is essential to unlocking the full potential of CAI in Visual Arts. Empowering school leaders to champion digital transformation in the arts will ensure a more equitable and innovative educational experience for students.

## **2.24 Summary of Literature**

The reviewed literature provides a comprehensive foundation for understanding the conceptual, theoretical, and empirical dimensions of Computer-Assisted Instruction (CAI) and its relevance within Visual Arts education, particularly in Graphic Design. The discourse on CAI began with definitions and historical development, showing its evolution from basic programmed instruction to sophisticated multimedia learning environments (Kulik & Kulik, 1991; Liao, 2004). Theoretical perspectives drawn from constructivist, cognitive, and behavioral learning theories underscore how CAI enhances learner engagement, autonomy, and interactivity, with particular emphasis on its capacity to support visual and experiential learning modes essential in arts education (Vygotsky, 1978; Mayer, 2005). The literature further outlines the characteristics of CAI, emphasizing its multimodal nature, adaptability, and potential to individualize instruction across diverse learner needs. In the context of Graphic Design, CAI is positioned as a valuable pedagogical aid that can enhance conceptual development, creative expression, and skill acquisition through simulation tools and design software (Sebbeh, 2017). Empirical studies reviewed from both global and

Ghanaian contexts highlight that CAI, when effectively implemented, improves learner motivation, retention, and performance in STEM and increasingly in non-STEM fields like the Visual Arts (Owusu et al., 2010; Gyamfi & Gyaase, 2022). However, the literature also reveals persistent challenges including infrastructural deficits, limited teacher ICT competence, curriculum misalignment, and underrepresentation of Visual Arts in national ICT policies (Acheampong, 2019; Kushiator et al., 2023). Ghana's ICT for Accelerated Development (ICT4AD) policy and subsequent educational reforms acknowledge the transformative role of technology in teaching and learning. However, practical implementation continues to be hindered by rural-urban disparities, inadequate funding, and a lack of targeted strategies for non-STEM disciplines. The empirical review further indicates mixed findings on the effectiveness of CAI, with some studies showing significant short-term gains while others report negligible or unsustainable effects depending on content area, learner characteristics, and instructional design. Although CAI has been studied extensively in science and mathematics education in Ghana, there is a noticeable paucity of research exploring its application within the Visual Arts, particularly in the teaching and learning of Graphic Design at the Senior High School level in the Eastern region of Ghana. This gap underscores the significance of the current study, by exploring the current practices and systemic barriers to CAI integration in Graphic Design classrooms in selected SHSs in the Abuakwa North Municipality, contributing to both scholarly discourse and practical educational policy reform.

## CHAPTER THREE

### METHODOLOGY

#### 3.1 Overview

This chapter outlines the research methodology employed for this study. The purpose was to explore Computer-Assisted Instruction (CAI) usage in teaching Graphic Design, with specific objectives to investigate available instructional technologies, explore current CAI practices, and assess systemic and pedagogical barriers to its adoption. A qualitative design was adopted, utilizing purposive sampling to select schools and participants. Data was collected through semi-structured interviews, observations, and document review, and analysed thematically. The chapter details the research design, population, sampling, data collection instruments and procedures, data analysis plan, and ethical considerations.

#### 3.2 Philosophical Underpinning of the Study

All research is built on a set of core beliefs about what reality is and how we can come to know about it. This is called the research philosophy. For this study, my work is guided by the interpretive paradigm.

##### **The Interpretive Paradigm**

The interpretive paradigm is a common worldview in qualitative research. It starts from a simple but powerful idea: reality is not a single, fixed object we all see the same way. Instead, our reality is built through our daily lives, our conversations, our culture, and our personal experiences (Creswell & Poth, 2018). People create their own understanding of the world. Because of this, the goal of interpretive research is not to find one universal truth, but to understand the different and often rich meanings that people give to their experiences.

I chose this paradigm for three reasons that fit my research perfectly.

1. It Focuses on Lived Experience: My main goal is to understand how teachers and students feel about and experience Computer Assisted Instruction. The interpretive paradigm is perfect for this because it is designed to listen to people's stories and take their personal meanings seriously. I am not just checking if a computer is on; I am trying to understand what it is like to teach or learn with it.
2. The study is deeply rooted in a specific context: Senior High Schools in the Abuakwa North Municipality of Ghana. The interpretive paradigm holds that knowledge and reality are context dependent. A barrier faced by a teacher in a rural school might be experienced differently by one in an urban school. This paradigm allows me to highlight and examine these specific contextual factors rather than trying to remove them.
3. It Matches My Methods: My methods, like interviews and classroom observation, are the standard tools for interpretive research. They are flexible and open-ended, designed to collect the kind of detailed, personal data that this paradigm seeks to understand.

### **My Epistemological Stance: Building Knowledge with Participants**

Epistemology is the study of how we know what we know. My specific stance within the interpretive paradigm is subjectivist. This means I believe that the most important knowledge for my study will be co-created between me and the participants. It emerges from our conversations and my observations in their environment.

Therefore, I see the teachers as the true experts on their own reality. My job as the researcher is to faithfully listen, observe, and then present their collective truth. After gathering data, I used methods like member checking (sharing my summaries with

participants for their confirmation) and triangulation (comparing interview notes with what I saw in class) to ensure my understanding was accurate and trustworthy.

Once this process of verification was complete, I proceeded with a core belief: what the respondents have collectively shared is the most truthful representation of their reality. Their combined voices and experiences form the definitive evidence from which the conclusions of this study are drawn.

In short, this philosophical foundation explains why I designed a study that listens deeply to people in their own setting and treats their shared insights as the central source of knowledge.

### **3.3 Research Approach**

This study adopted a qualitative research approach, which is most appropriate for exploring complex educational phenomena such as the use of Computer-Assisted Instruction (CAI) in teaching Graphic Design. Qualitative research emphasizes understanding the meanings individuals or groups assign to a social or human problem, particularly through direct interaction within natural settings (Creswell & Poth, 2018; Merriam, 1998). This approach aligns with the study's aim to investigate the lived experiences and perspectives of Visual Arts teachers and students regarding CAI in Senior High Schools (SHSs) in Ghana.

Qualitative research is rooted in naturalistic inquiry, prioritizing depth over breadth by capturing rich, descriptive data (Ritchie & Lewis, 2003). It is suitable for cases where researchers seek to explore how individuals interpret their realities and construct meaning within their social and cultural environments (Wiersma, 1995). In the context of this study, the qualitative approach facilitated close engagement with participants through semi-structured interviews and observation, enabling the collection of nuanced data related to the integration of CAI in art classrooms.

As noted by Patton (1990), qualitative research is guided by a set of flexible strategies rather than rigid procedures, allowing for adaptability in data collection and analysis. These strategies typically include interviews, observations, group discussions, and document analysis, two of these strategies were employed to uncover the underlying dynamics of CAI implementation in Graphic Design instruction. The study design also reflected Merriam's (1998) assertion that qualitative research seeks to understand how people make sense of their world through the lens of their personal experiences, beliefs, and values.

Tuckman (1999) emphasizes that qualitative methods are particularly effective for capturing attitudes, perceptions, and behavioural patterns, key dimensions when evaluating instructional technology use in education. Similarly, Eisner (1994) argued that qualitative inquiry values multiple forms of knowing and understanding, which is critical in the arts where subjective interpretation plays a central role.

The rationale for using a qualitative approach in this study was to gain an in-depth understanding of how teachers and students experience, perceive, and respond to CAI tools and practices within the real-world settings of their schools. The study did not attempt to manipulate variables or test hypotheses quantitatively but instead focused on capturing the natural interactions and instructional behaviours surrounding CAI use. This aligns with Ritchie and Lewis's (2003) view that qualitative research allows for the collection of detailed information about participants' historical, contextual, and experiential backgrounds.

Furthermore, the use of qualitative methods in this research enabled the researcher to generate thick descriptions of CAI-related practices, including the challenges faced by Visual Arts teachers, the accessibility of digital resources, and the pedagogical strategies employed. The direct engagement with participants also allowed for the

documentation of authentic voices, both supportive and critical, regarding the integration of CAI in Graphic Design education.

In summary, the qualitative research approach provided a suitable framework for investigating the complex realities surrounding CAI in Ghanaian SHSs. It enabled the study to explore not just the observable use of technology but also the subjective experiences and meanings that inform how CAI is perceived, adopted, and sustained in art education contexts.

### **3.4 Research Design**

A research design serves as a strategic blueprint for how a study is conducted. It integrates the various elements of research, such as data collection, analysis, and interpretation, into a coherent framework that ensures the research questions are thoroughly addressed (Creswell & Creswell, 2018; Menetey, 2019). As Islamia (2016) asserts, a research design enables the systematic acquisition and interpretation of relevant data in a way that aligns with the objectives of the study. For this investigation, the study adopted an exploratory qualitative research design to investigate the usage of Computer-Assisted Instruction (CAI) in the teaching of Graphic Design in Senior High Schools (SHSs) in the Eastern Region of Ghana. An exploratory qualitative design is particularly appropriate when the phenomenon under investigation is relatively new, context-specific, and has received limited empirical attention in the literature, especially within the Ghanaian educational landscape (Creswell & Poth, 2018; Stebbins, 2001). In the Ghanaian context, although the integration of Information and Communication Technology (ICT) in education has been promoted through national policies such as the ICT in Education Policy (Ministry of Education, 2015), empirical studies focusing specifically on CAI in Visual Arts subjects, including Graphic Design, remain scarce (Agyei & Voogt, 2014;

Buabeng-Andoh, 2019). This gap justifies the exploratory nature of the study, which seeks to generate rich, contextual insights rather than test pre-formulated hypotheses.

According to Yin (2016), exploratory studies are valuable when the goal is to define questions more precisely, identify relevant variables, or lay the groundwork for subsequent larger-scale research. Similarly, Patton (2015) emphasises that exploratory designs allow researchers to remain open to unexpected findings and emerging patterns, which is essential in a developing-country setting where infrastructural, pedagogical, and cultural factors may significantly shape technology integration.

This study is situated within the interpretivist paradigm, which holds that reality is socially constructed and best understood through the meanings that participants assign to their experiences (Pham, 2018; Scotland, 2012). By adopting this paradigm, the researcher sought to capture the subjective perspectives of Graphic Design teachers in their natural teaching environments without imposing pre-determined categories.

### **3.5 Population**

Population entails all entities or units of interest, particularly in research (Bret & Bret, 2011). Population can also be defined as all sets of individuals, items, human beings, or objects or events having common characteristics in which the researcher is interested (Creswell, 2013). The target population for this study comprised all Graphic Design teachers in Senior High Schools within the Abuakwa North Municipality of the Eastern Region, Ghana. This group was specifically chosen because they are the primary agents of instruction and curriculum implementation, possessing the direct experiences and insights into the use of Computer Assisted Instruction necessary to address the research objectives. The accessible population was drawn from six selected schools that offer the Visual Arts program with a Graphic Design option and possess an ICT laboratory. From these schools, a total of

16 Graphic Design teachers formed the core population from which participants for interviews and observations were purposively selected. The distribution of this teacher population across the schools is presented in Table 2.

**Table 2: Distribution of Population Based Teachers**

<b>School</b>	<b>Graphic Design Teachers</b>
Ofori Panin SHS	3
WMB Zion SHS	4
Saviour SHS	2
Bright SHS	2
Holy Believe SHS	2
Christian IPS	3
<b>Total</b>	<b>16</b>

*Note.* Data presented are based on a field survey conducted in 2023.

### **3.6 Sample size**

A sample is a relatively small portion of the population selected for the study and analysis. It is the specific group of individuals you will collect data from (McCombes, 2020). The sample for this study consisted of six Graphic Design Unit Heads purposively selected from the six participating schools.

In qualitative research, the adequacy of a sample is determined by its ability to provide rich, in-depth information relevant to the research questions, rather than by numerical representation. Consequently, this sample of six teachers was deemed sufficient to achieve data saturation and to facilitate a detailed, explorative analysis of their experiences, practices, and perceived barriers regarding CAI integration in Graphic Design. The distribution of the population among the six selected schools is shown in Table 3.

**Table 3: Distribution of Samples Based on Teachers**

<b>School</b>	<b>Graphic Design Teachers</b>
Ofori Panin SHS	1
WMB Zion SHS	1
Saviour SHS	1
Bright SHS	1
Holy Believe SHS	1
Christian IPS	1
<b>Total</b>	<b>6</b>

*Note.* Data presented are based on a field survey conducted in 2023.

### 3.7 Sampling Technique

According to Creswell (2014), "sampling is the process of selecting a group of individuals who are representative of the population to be studied" (p. 186). Sampling is taking a subsection from a chosen sampling frame or a whole population. It involves probability or non-probability samples.

This study employed a purposive sampling technique to select both the schools and the participants. Purposive sampling is a non-probability method where researchers intentionally select individuals or sites that can provide rich, relevant information related to the central phenomenon (Creswell & Poth, 2018). This approach was essential for this explorative study to ensure that the selected cases were information-rich regarding the integration of CAI in Graphic Design.

The sampling was conducted in two stages. First, the six Senior High Schools were purposively selected based on two specific criteria: they must offer Visual Arts with a Graphic Design program, and they must possess an ICT laboratory. This was crucial to ensure the research was conducted in contexts where the phenomenon of CAI use could potentially occur.

Subsequently, purposive sampling was used to select all 6 Graphic Design unit heads from these schools to participate in the study. As the unit heads and primary instructors, they were deemed to possess the specific knowledge and experiences necessary to provide deep insights into the research objectives concerning available technologies, current practices, and barriers to CAI adoption.

### **3.8 Data Collection Instrument**

The selection of data collection instruments for this study was guided by four critical factors: location, timing, frequency, and administration of the data collection process. These considerations determined where data would be gathered, the optimal time for collection, how frequently data would be collected, and who would be responsible for the process (Fraenkel & Wallen, 1996). To address these dimensions, the study employed two primary instruments: semi-structured interview guide (see Appendix A), and observation checklist (see Appendix B).

#### **3.8.1 Semi-structured Interview**

Semi-structured interviews were conducted to gather in-depth, qualitative data on the experiences, perceptions, and insights of Graphic Design teachers regarding the integration of Computer-Assisted Instruction (CAI). This method was selected because it provides a flexible framework, allowing for the use of a pre-determined interview guide (see Appendix A) to ensure key topics were covered, while also permitting the researcher to probe interesting and unexpected responses for deeper understanding (Kallio et al., 2016). Additionally, the basis for which semi-structured interview was used is because it encourages participants to speak out so that the researcher can learn what the range of views of participants are, in order to generate a collective rather than an individual view of a phenomenon (Bogdan & Biklen, 2007; Cohen, et al., 2007). Creswell (2014) and Miles et al. (2014) added that the interview

allows for the elaboration of feelings, thoughts, and experiences pertaining to the research questions.

The interview guide was developed around the core research objectives and included open-ended questions exploring teachers' training in CAI, their specific teaching strategies, perceived impacts on student learning, and the systemic and pedagogical barriers they encounter. A purposive sample of six (6) Graphic Design unit heads, who were identified as key informants, participated in these interviews. The interviews were conducted in a combination of face-to-face settings at school premises and remotely via phone, with an average duration of 30-45 minutes. With participants' consent, the interviews were audio-recorded to ensure accuracy and supplemented with field notes to capture non-verbal cues. This approach was instrumental in collecting rich, narrative data that illuminated the complex realities of CAI usage from the perspective of the practitioners themselves.

### **3.8.2 Participant Observation**

Non-participant observation was employed in this study to gather first-hand, contextual data on the integration of Computer-Assisted Instruction (CAI) in Graphic Design classrooms. This method involved the researcher assuming the role of an observer who did not participate in the activities being studied, allowing for a direct and unobtrusive examination of the natural classroom environment (Merriam & Tisdell, 2016).

The observations were guided by a structured checklist (see Appendix **B**) designed to focus on key aspects of the teaching and learning process. The researcher documented the availability and functionality of ICT infrastructure, including computers, projectors, and software. Furthermore, the observations captured the pedagogical strategies teachers used when incorporating CAI, the level of student engagement

with the technology, and any practical challenges that arose during the lessons, such as technical failures or time constraints. This approach provided tangible evidence of the "real-world" practices and barriers, serving as a crucial triangulation source to validate and enrich the data obtained from interviews and document analysis.

### **3.8.3 Document Analysis**

Document analysis was employed as a third data collection method to provide corroborating evidence and contextual depth to the study. This process involved the systematic review and evaluation of existing documents to support the findings gathered through observation and interviews (Bowen, 2009). This method was valuable for accessing a stable, unobtrusive source of information that reflected the formal and informal practices within the Graphic Design curriculum.

The documents collected and analyzed for this study included:

- Lesson Plans: To understand how teachers planned for the integration of CAI, the alignment of their instructional objectives with digital tools, and the frequency of CAI use in their pedagogical design (see Appendix C).
- Policy and Instructional Documents: These included school memos, the Graphic Design syllabus, and any available records on ICT resource allocation, which helped to contextualize the findings within the broader framework of institutional policies and support.

Through this analysis, the researcher was able to triangulate findings, verifying claims made in interviews and observations against concrete documentary evidence. This provided a more comprehensive and reliable understanding of the current state of CAI integration in the participating schools.

### **3.9 Data Collection Procedure**

The data collection procedure was executed in a systematic sequence over a period of three months to ensure thoroughness and ethical compliance. The process unfolded in three main phases.

**Phase 1: Pre-Data Collection and Access.** Formal approval was first obtained from the Department of Art Education at the University of Education, Winneba. This was followed by visits to the selected schools, where the researcher secured permission from headteachers and departmental heads. The purpose of the study was explained to all gatekeepers, emphasizing ethical assurances of confidentiality and voluntary participation.

**Phase 2: Primary Data Collection.** Data gathering was conducted using the two instruments. The semi-structured interviews were scheduled with the six purposively selected Graphic Design teachers at their convenience, either in person or remotely. Each interview was audio-recorded with consent. Concurrently, non-participant observations were carried out during scheduled Graphic Design lessons using a structured checklist to document classroom practices and CAI use.

**Phase 3: Data Organization.** Throughout the collection period, all data were systematically organized. Audio recordings were securely stored and later transcribed verbatim. Observation notes were catalogued and anonymized. This meticulous organization facilitated the subsequent thematic analysis.

This multi-phase approach ensured the collection of rich, triangulated data in an ethical and methodical manner, directly addressing the research objectives.

### 3.10 Data Analysis Plan

Qualitative research encompasses a wide array of analytical techniques, each designed to organize, interpret, and derive meaning from non-numeric data such as interview transcripts, and field notes. According to scholars like Bogdan and Biklen (1992), Ritchie and Lewis (2003), Wiersma (1995), and Tuckman (1999), there is no universally fixed protocol for analysing qualitative data. Instead, the process is iterative and flexible, often involving the simultaneous collection and interpretation of data. A qualitative data analysis with thematic analysis was used to analysis the data that were collected from the interviews. Several authors have recommended various steps or phases to analyze qualitative data (Scott & Usher, 2011; Best & Khan, 2006; Watling & James, 2012; Creswell, 2009; Braun & Clarke, 2006; Pilot & Beck, 2008). Polit and Beck defined qualitative data analysis as the process of fitting data together, making the invisible obvious, linking and attributing consequences to antecedents, conjecture and verification, correction and modification, and suggestion and defense. The data collected from semi-structured interviews and observations were analyzed using thematic analysis, following the systematic six-phase framework proposed by Braun and Clarke (2006). This method was selected for its rigorous yet flexible approach to identifying, analyzing, and reporting patterns (themes) within qualitative data, making it ideally suited for an explorative study design. The analysis was an iterative process that involved the following phases:

1. **Familiarizing with the Data:** The initial stage of analysis focused on deep data familiarization to thoroughly comprehend the scope and depth of the collected material. This involved the researcher engaging in repeated listening to the audio recordings and careful, iterative reading of the transcribed content. This intensive process was essential for the systematic search for

underlying meanings, prevalent themes, and emerging patterns within the dataset (Pilot & Beck, 2006). To ensure the highest quality and accuracy, the researcher undertook the data transcription personally (Polit & Beck, 2008). The audio recordings were typed verbatim, a critical practice in explorative qualitative methodologies that includes capturing nonverbal elements such as pauses and hesitations made by the interviewees (Bird, 2005; Vanderpuye, 2013). This deliberate action prevents misinterpretation and omission, guaranteeing the data remains in its original form for subsequent analysis. For enhanced organization and easy traceability during the analytical phases, each interviewee was assigned a unique numeric code based on the sequence of their interview, a structural adaptation supporting the systematic application of thematic analysis (Braun & Clarke, 2006; Sommers & Sommers, as cited in Vanderpuye, 2013)

2. **Generating Initial Codes:** In qualitative research, coding involves assigning concise labels typically a word or short phrase to capture the essential meaning of segments of textual or visual data (Saldana, 2015). This process requires both time and creativity, as it entails a detailed examination of the data to identify significant ideas, themes, and categories (Stuckey, 2015). Through coding, similar segments of text are systematically labeled, enabling efficient retrieval and comparative analysis during later stages of interpretation (Taylor & Gibbs, 2010, as cited in Vanderpuye, 2013). In this study, the researcher applied codes to relevant data extracts (Braun & Clarke, 2006) and identified key units of analysis aligned with the research questions. Related responses from interviews were underlined to facilitate organization and thematic development.

3. **Searching for Themes:** In searching for themes, it involves sorting the different codes into potential themes, and collating all the relevant coded data extracts within the identified themes. Essentially, you are starting to analyse your codes, and consider how different codes may combine to form an overarching theme. It may be helpful at this phase to use visual representations to help the researcher sort the different codes into themes. (Braun & Clarke, 2006). In this phase, the researcher searched for themes in the data collected from the interviews. Also, the researcher sorted the different codes into potential themes and collate all the relevant coded data extracts within the identified themes (Braun & Clarke, 2006). The researcher searched for the relationship between codes, between themes, and between different levels of themes. Braun and Clarke suggest that this phase of thematic analysis should end with collection of candidate themes and subthemes, and all extracts of the data that have been coded in relation to them. The researcher ensured that the main themes that were identified and compiled along with the extracts and the codes given to them (Vanderpuye, 2013).
4. **Reviewing Themes:** This phase involved a rigorous check of the candidate themes. Themes were reviewed against the coded data and the entire dataset to ensure they were coherent, distinctive, and accurately represented the evidence. This led to the refinement, splitting, or discarding of some themes.
5. **Defining and Naming Themes:** This phase focused on determining the core meaning and scope of each theme, clarifying what aspect of the data they represented (Braun & Clarke, 2006). The researcher carefully reviewed the collated data extracts for each theme and organized them into a coherent narrative. This process ensured that all themes collectively conveyed a

consistent and meaningful story from the data. Following Vanderpuy's (2013) approach, clear and descriptive names were assigned to both themes and sub-themes to help readers quickly grasp their relevance to the research questions.

6. **Producing the Report:** The final analysis was woven into a narrative for the findings chapter (Chapter 4). This narrative was supported by compelling data extracts from the interviews and vivid descriptions from the observations to illustrate and substantiate each theme.

To ensure the trustworthiness of the analysis, data triangulation was employed by comparing and contrasting the perspectives gathered from the interviews with the actual practices witnessed during observations. This process helped build a coherent, credible, and richly detailed interpretation of the findings.

### **3.11 Trustworthiness of the Study**

To ensure the rigor and credibility of this qualitative study, several strategies were systematically employed, addressing the key criteria of credibility, dependability, confirmability, and transferability (Lincoln & Guba, 1985).

#### **Credibility**

Credibility was established through triangulation, using multiple data sources including semi-structured interviews, classroom observations, and document analysis to cross-validate findings. Prolonged engagement was achieved through sustained interaction with participants across multiple school sites. Member checking was conducted by sharing preliminary interpretations with participants to verify accuracy and resonance with their experiences.

### **Dependability**

Dependability was addressed through a comprehensive audit trail that documented all research decisions and processes. This included maintaining raw data, field notes, and records of analytical decisions, enabling external examination of the research process. Regular supervisory reviews further ensured methodological consistency throughout the study.

### **Confirmability**

Confirmability was strengthened through reflexive journaling, where the researcher documented and critically examined personal biases, assumptions, and preconceptions. The audit trail provided additional evidence that findings emerged from the data rather than researcher predisposition, with clear connections maintained between raw data and interpretations.

### **Transferability**

Transferability was enhanced through thick, rich descriptions of the research context, participants, and findings. These detailed accounts provide sufficient information for readers to evaluate the potential applicability of findings to other similar educational contexts, while acknowledging the situated nature of qualitative inquiry.

### **3.12 Ethical Consideration**

The study adhered to the ethical guidelines for educational research (British Educational Research Association, 2018). In pursuance of ethical issues, the right to privacy, voluntary participation, no harm to participants, anonymity, and confidentiality were held in high esteem. It should be emphasized that students and teachers have privacy rights and, as a result, these rights must be respected at every point in time. In this light, the respondents' right to privacy in the study was respected, and under no circumstances were respondents studied without their knowledge or

consent. In addition, one key component regarding ethical issues in research has to do with respondents' voluntary participation. The researcher explained the objectives and significance of the study to the respondents and, therefore, allowed respondents to exercise their voluntary rights in their participation in the study. Bowen (2009), states that in research, the researcher is expected to demonstrate objectivity (to present research material fairly) and sensitivity (responding to even subtle cues to meaning) in the selection and analysis of data from documents.

Furthermore, unethical behaviour, including plagiarism, is not welcome in research. The researcher followed the prescribed standards of scientific behaviour strictly to avoid plagiarism.

### **3.13 Chapter Summary**

This chapter aims to outline the methodology employed in this dissertation. This study focused on investigating the use of Computer-Assisted instruction in teaching Graphic Design in secondary schools and barriers that hinders integration in Abuakwa North Municipality of the Eastern Region. The chapter discussed the methods and procedures that were used to accomplish the objectives of the study. A review of the research design, population and sample, data collection instruments, data collection and analysis procedures, as well as validity and reliability of the instruments has been described. As indicated above, a descriptive research design with a qualitative approach was appropriate for the study. The chapter concluded with a summary.

## **CHAPTER FOUR**

### **DATA PRESENTATION ANALYSIS AND DISCUSSION**

#### **4.1 Overview**

This chapter presents, analyses, and discusses the findings of the study based on qualitative data gathered through interviews and classroom observations. The purpose of this chapter is to present findings in line with the research objectives of the study and to explain how Computer-Assisted Instruction (CAI) is used in the teaching and learning of Graphic Design in selected Senior High Schools in the Abuakwa North Municipality. The study adopted a qualitative research approach and employed thematic analysis to analyse the data collected from teachers. The chapter is organised according to the three research objectives. Major themes that emerged from the interview transcripts and observation checklist are presented and analysed. The discussion section presents the findings to objective of the study, which are discussed through the lens of supported theories and existing literature.

#### **4.2 Demographic Characteristics of Respondents**

This section presents the professional background of the six Graphic Design teachers who participated in the semi-structured interviews. Understanding their teaching experience, qualifications, and current teaching responsibilities provides essential context for interpreting their perspectives on Computer-Assisted Instruction (CAI) integration, as these factors significantly influence technological adoption and pedagogical practices.

**Table 4: Professional Background of Teacher Participants (N = 6)**

<b>Participant</b>	<b>Teaching Experience</b>	<b>Highest Academic Qualification</b>	<b>Classes Taught</b>
<b>Teacher A</b>	4 years	Bachelor's Degree	SHS 2 & 3
<b>Teacher B</b>	12 years	Bachelor's Degree	SHS 1, 2 & 3
<b>Teacher C</b>	7 years	Bachelor's Degree	SHS 2 & 3
<b>Teacher D</b>	15 years	Master's Degree	SHS 1 & 2
<b>Teacher E</b>	3 years	Bachelor's Degree	SHS 3
<b>Teacher F</b>	8 years	Bachelor's Degree	SHS 1, 2 & 3

*Note.* Data presented are based on a field survey conducted in 2023.

The participant profiles reveal a diverse range of teaching experience, from early-career teachers (3-4 years) to seasoned educators (12-15 years). This variation is valuable for capturing different generational perspectives on technology integration. All participants hold at least a bachelor's degree, with one possessing a master's qualification, indicating a professionally qualified cohort. The teaching assignments show that participants engage with students across all senior high school levels, ensuring that the collected data reflects experiences across the entire Graphic Design curriculum. This demographic composition supports the trustworthiness of the study by representing multiple viewpoints within the specialized teaching community.

#### **4.3 Description of Methodology**

This section provides a concise overview of the methodological approach that guided the analysis of the data presented in this chapter. It outlines the analytical strategy, reflects on the researcher's role, and summarizes the sources of data and ethical protocols that were followed.

#### **4.3.1 Overview of the Analytical Approach**

The data collected from interviews and observations were analysed using qualitative thematic analysis, following the systematic six phase framework proposed by Braun and Clarke (2006). This approach was selected for its flexibility and rigor in identifying, analysing, and reporting patterns or themes within qualitative data sets. The process began with the researcher repeatedly reading interview transcripts and observation notes to achieve deep familiarity with the data. Initial codes were then generated to label meaningful features across the entire dataset. These codes were subsequently collated and sorted into potential themes, which were reviewed and refined to ensure they accurately represented the data and addressed the research objectives. The final stage involved defining and naming the themes to construct a coherent narrative of the findings, which is presented in this chapter.

#### **4.3.2 Researcher Role and Reflexivity**

As guided by the interpretive paradigm outlined in Chapter 3, the researcher's role was that of a primary instrument for data collection and analysis. The goal was to understand the participants constructed realities, not to test an objective truth. Acknowledging that a researcher's background can influence interpretation, a stance of reflexivity was maintained throughout the study. The researcher is an educator with an interest in educational technology, which provided a foundational understanding of the context but also created a potential for bias towards seeing the value of CAI. To manage this, conscious efforts were made during interviews to use open ended questions that elicited teachers' own stories and perspectives, not leading answers. During analysis, findings were constantly checked against the raw data and through triangulation across different data sources, such as comparing what a teacher said in an interview with what was observed in their classroom. This reflexive practice aimed

to ensure that the presented themes emerged from the participants' experiences as faithfully as possible.

#### **4.3.3 Data Sources and Ethical Considerations**

The findings are drawn from two primary data sources, as detailed in Chapter 3. First, in depth, semi structured interviews were conducted with six Graphic Design teachers (coded as Teacher A through Teacher F) from six different schools. Second, non-participant observations were carried out in selected Graphic Design classrooms, using a structured checklist to document practices, interactions, and the technological environment.

The study adhered strictly to ethical principles. Prior to data collection, informed consent was obtained from all participants. They were assured of the voluntary nature of their participation and their right to withdraw at any time. To protect anonymity, all identifiable information, including school names and participant identities, has been removed or pseudonymised in this report. Interview recordings and transcripts were stored securely and accessed only by the researcher. The ethical commitment was to present the participants' voices with integrity while safeguarding their confidentiality.

#### **4.4 Thematic Presentation of Findings**

This section presents the findings of the study based on the three research objectives. Themes and sub-themes that emerged from the analysis of interview and observation data are presented and supported with verbatim quotations and observational evidence.

**1. Research Objective 1: To investigate the available instructional technologies for teaching and learning Graphic Design in the Senior High Schools in the Abuakwa North Municipality.**

The first objective of the study sought to identify the instructional technologies available for the teaching and learning of Graphic Design in selected Senior High Schools in the Abuakwa North Municipality. This objective focused on the types of digital tools, hardware, software, and supporting infrastructure available to teachers and students for Computer-Assisted Instruction (CAI). Data were obtained through interviews with Graphic Design teachers and classroom observations.

Analysis of the interview transcripts and observation checklist generated three major themes related to the availability of instructional technologies:

1. Inadequate Hardware Infrastructure
2. Outdated and Incomplete Software
3. Unstable Foundational Utilities

Each theme is presented below with supporting evidence.

***Theme 1: Inadequate Hardware Infrastructure***

This theme captures the pervasive scarcity of functional computers in school laboratories, which fundamentally constrained the integration of CAI. Despite the presence of computer facilities, the insufficient quantity relative to student numbers created a critical bottleneck, forcing shared usage and severely limiting individual hands-on practice. Interview data confirmed that computers were available in school ICT laboratories. However, every teacher reported that the number of functional computers was grossly inadequate for their class sizes, severely limiting individual student access. Teacher A explained the situation stating;

*“Umm... we do have computers in the ICT lab, you know, but they are really not enough for the number of students we teach. So even though the computers are there, the students are many, and that makes it difficult to use them effectively during lessons.” [Teacher A]*

Teacher B similarly noted,

*“Sometimes, charley, about three or four students have to share just one computer, so, you know, not everyone really gets the chance to work on it during the lesson.” [Teacher B]*

Teacher C also highlighted the imbalance between class size and available computers, stating:

*“When the class is full, only a few students can actually touch the computer.” [Teacher C]*

These responses suggest that although computers exist, access is limited, which reduces individual student participation during CAI lessons.

Classroom observations confirmed these concerns. In one observed lesson, the researcher noted that approximately twenty-eight students shared fewer than ten functional computers. Some students actively operated the computers, while others stood by and watched. The observation checklist further showed that students rotated in groups, which restricted continuous hands-on engagement.

Teachers further reported that many of the available computers were old and frequently malfunctioned. Teacher D stated,

*“Some of the computers are, very very slow, and others, you know, cannot even come on at all, so it becomes difficult to rely on them during the lesson. [Teacher D]*

Teacher F also mentioned,

*“man, Sometimes erh, the system go just freeze in the middle of the lesson, you know, and that interrupts what we are doing at the time.” [Teacher F]*

These technical failures were observed to cause significant delays, consuming valuable instructional time.

## **Theme 2: Outdated and Incomplete Software**

This theme addresses the technological obsolescence that characterized the available Graphic Design software. While basic applications like CorelDRAW were present, they were outdated versions lacking current features, and were occasionally complemented by essential peripherals such as graphic tablets or scanners. This technological gap restricted the range of digital techniques that could be taught or practiced.

Teacher A pointed out:

*The CorelDRAW we are using be the old version, so like, some of the tools I would like to teach are simply not available on the software.”*  
**[Teacher A]**

Teacher C added,

*“Students see modern designs online, but our software cannot do some of those things.”* **[Teacher C]**

In addition to outdated software, teachers identified a lack of essential digital tools needed for Graphic Design instruction.

Teacher D explained,

*“We don’t have scanners or graphic tablets in our school, so, umh, students cannot scan their drawings or design digitally from scratch.”*  
**[Teacher D]**

Teacher E also noted,

*“and even colour printers are not available, so students cannot print their designs to see the final output.”* **[Teacher E]**

Observation data supported these interview responses. The researcher observed that students depended mainly on manual sketches because there were no graphic tablets or scanners available. In one school, although a printer was present, it was not functional due to lack of ink. This situation limited students’ ability to complete digital design projects fully and assess their work in printed form.

### ***Theme 3: Unstable Foundational Utilities***

This theme highlights the unreliable supporting infrastructure that undermined consistent CAI implementation. Beyond hardware and software, the frequent interruptions caused by power outages and inconsistent internet connectivity created an unstable learning environment. These systemic failures not only disrupted lesson flow but also discouraged teachers from planning technology-dependent activities.

Teacher B stated,

*“The internet is not reliable, so I usually download materials before coming to class.” [Teacher B]*

Teacher A also remarked,

*“Sometimes we want to search for examples online, but there is no internet connection.” [Teacher A]*

Power supply was another significant issue affecting CAI implementation. Teacher F explained,

*“Sometimes when we are in the middle of a practical lesson, the light goes off and everything stops.” [Teacher F]*

Classroom observation confirmed that some CAI lessons were interrupted or ended prematurely due to power outages. These challenges made it difficult for teachers to plan consistent digital lessons and discouraged frequent use of CAI.

In summary, the data shows that the selected schools possess a basic foundation of instructional technology for Graphic Design. This foundation includes computer laboratories with CorelDRAW software. However, the effectiveness of this foundation is undermined by insufficient quantities of hardware, outdated and incomplete software tools, and unstable power and internet connectivity. The following section will discuss the implications of these findings.

### **4.3.2 Discussion of Findings on Available Instructional Technologies**

#### **Linking Findings to the Research Objective**

The findings for Objective One show that instructional technologies for teaching Graphic Design are available in the selected Senior High Schools, but they are limited in number, condition, and functionality. Computers and Graphic Design software exist in the schools, yet their availability and quality do not fully support effective Computer-Assisted Instruction. These findings directly address the study's purpose of examining the instructional technologies that support CAI in Graphic Design teaching. This context is crucial for understanding the subsequent practices and barriers to CAI integration.

#### **Comparison and Contrast with Prior Studies**

The findings on limited computer availability support earlier studies reviewed in Chapter Two, which reported that ICT resources in many Ghanaian Senior High Schools are inadequate for effective instructional use (Sebbeh, 2017). This study confirms that such challenges are present in Graphic Design classrooms, where teachers experience system freezes and hardware failures during lessons. These findings reinforce earlier conclusions that the quality and maintenance of ICT resources are as important as their availability.

The challenges related to outdated and limited software align with observations by Kushiator et al. (2023), who noted that ICT implementation in schools often focuses on hardware provision while neglecting software updates and maintenance. The findings of this study show that teachers are unable to demonstrate some modern design features because of old software versions. This confirms earlier studies that identified obsolete software as a barrier to effective digital skills development.

Inadequate supporting infrastructure, particularly unstable power supply and poor internet connectivity, has also been identified as a major barrier to CAI use in Ghanaian schools (Sebbeh, 2017). The current study reinforces this finding by demonstrating how infrastructural issues disrupt Graphic Design lessons and reduce instructional time.

### **Theoretical Implications:**

The state of technology has profound implications for the study's theoretical framework. From the constructivist perspective guiding this study, learning occurs most effectively when learners actively interact with instructional tools and construct knowledge through direct experience. In the context of Graphic Design education, this implies that students need regular and sustained access to digital tools in order to explore design software, experiment with visual elements, and develop practical problem-solving skills. However, the findings of this study indicate that the limited availability of functional computers, outdated software, and inadequate supporting infrastructure restrict such active engagement.

The constructivist theory emphasises learner-centred environments where students manipulate tools and resources to create meaning. In the schools studied, the limited number of computers and frequent technical interruptions reduce opportunities for students to engage independently with CAI resources. As a result, students are often positioned as passive observers rather than active participants in the learning process. This situation weakens the constructivist learning process, as students are unable to fully explore, practise, and reflect on digital Graphic Design tasks using CAI tools.

Furthermore, constructivist learning encourages exploration, trial and error, and continuous interaction with instructional materials. The findings suggest that infrastructural challenges, such as unstable power supply and unreliable internet

connectivity, disrupt this process by interrupting lessons and limiting access to digital resources. These disruptions make it difficult for teachers to design learning activities that allow students to build knowledge progressively through CAI. Consequently, while CAI tools are present in some form, the conditions necessary for effective constructivist learning are not fully realised in the Graphic Design classrooms studied. From a Behaviorist standpoint, which emphasises consistent stimuli and reinforcement for skill mastery (Skinner, 1953), the environment is equally problematic. Frequent power cuts and software crashes disrupt the structured, repetitive practice needed to automate software skills. The inability to provide predictable, uninterrupted practice sessions undermines a drill and practice model of CAI.

Therefore, the technological constraints do not merely limit the use of CAI. They actively shape its potential application, pushing pedagogy towards the most basic, teacher-controlled demonstrations because these are the only forms of CAI resilient enough to survive the unstable environment. This stifles the integrated, theory informed model of CAI the framework proposes.

### **Practical Applications Based on Interview Insights:**

Teachers' experiences point to several practical applications for policy and school management.

1. **Infrastructure First:** Investment must prioritise reliable power backup (e.g., inverters) and stable internet connectivity as non-negotiable foundations before expanding computer numbers. As Teacher F implied, a computer without power is useless.
2. **Targeted Provision:** For Graphic Design, strategic investment in a few high impact peripherals, like a colour printer and a graphic tablet for

demonstrations, could significantly enhance learning outcomes even within a shared resource model.

3. **Sustainable Support:** Procurement policies should include plans and budgets for regular software updates and maintenance contracts to address hardware malfunctions swiftly, moving beyond one time provision.
4. **Contextualised Training:** Teacher professional development must include strategies for effective group management in shared computer settings and designing lessons that are resilient to technical interruptions, acknowledging the real-world constraints they face.

In summary, although key CAI tools are present in some schools, systemic limitations, including non-functional equipment, high student-to-computer ratios, and uneven software availability, impede the consistent and effective integration of instructional technology in Graphic Design education. Addressing these practical issues would enhance student engagement, support active learning, and improve the overall effectiveness of CAI in Senior High School Graphic Design classrooms.

2. **Research Objective 2: To explore the current practices of Computer-Assisted Instruction (CAI) in Graphic Design classrooms in Senior High Schools in the Abuakwa North Municipality.**

The second objective of the study sought to examine how Computer-Assisted Instruction (CAI) is currently used in the teaching and learning of Graphic Design in selected Senior High Schools in the Abuakwa North Municipality. This objective focused on teachers' instructional practices, the nature of CAI integration during lessons, and students' level of engagement during CAI-based activities. Data for this objective were obtained through semi-structured interviews with Graphic Design teachers and classroom observations using an observation checklist

Analysis of the interview transcripts and observation data generated four major themes relating to current CAI practices:

1. Demonstration-Centered Pedagogy
2. Constrained Student Access
3. Enhanced Student Engagement
4. Role Transformation

Each theme is presented below with supporting interview excerpts and observation evidence.

### ***Theme 1: Demonstration-Centered Pedagogy***

This theme describes the dominant instructional approach observed in CAI lessons, characterized by teacher-led software demonstrations. Rather than facilitating student-centered exploration, CAI was primarily employed as a presentational tool where teachers modeled procedures step-by-step while students observed. This approach prioritized the transmission of technical knowledge over creative application. Teachers explained this was a necessary first step to ensure students understood basic procedures before attempting them.

Teacher A described a typical approach:

*“I usually start the lesson by explaining what we are going to do, then I demonstrate on the projector. I show them how to use the tools step by step before I allow them to try.” [Teacher A]*

Teacher C shared a similar experience, stating:

*“Most of the time, I have to demonstrate first because if I don’t show them clearly, they will not know what to do on the computer. So I guide them slowly.” [Teacher C]*

Classroom observation supported these responses. The researcher observed that in most CAI lessons, students spent a significant portion of the lesson watching the teacher demonstrate software tools. Although demonstrations helped students

understand basic procedures, limited time and inadequate computers reduced opportunities for extended student practice.

## **Theme 2: Constrained Student Access**

This theme reflects the logistical reality of student engagement with CAI resources. Due to insufficient computers, student practice was predominantly collaborative, with multiple learners sharing single devices. While this fostered peer interaction, it created unequal participation, with some students actively operating software while others assumed passive observational roles. Teacher B explained the dynamic:

*“Because the computers are not enough, I put them in groups. One student works on the computer while the others watch and suggest ideas.” [Teacher B]*

Teacher F also stated:

*“Not all the students get the chance to practice. Some only watch their friends, especially when the class is big.” [Teacher F]*

During classroom observation, the researcher noted that students took turns using the computers. While some students actively engaged with the software, others remained passive observers. However, group work encouraged discussion and idea sharing among students.

### **1. Theme 3: Enhanced Student Engagement**

This theme captures the positive affective dimension of CAI integration observed across classrooms. Despite resource limitations, the introduction of digital tools consistently generated heightened student interest, attention, and participation. The interactive potential of technology appeared to motivate learners, stimulating peer discussion and collaborative problem-solving. Teacher C stated:

*“Anytime I use the computer in class, the students are more attentive. Even those who don’t usually show interest become active.” [Teacher C]*

Teacher B also observed:

*“The students like computer lessons. They ask more questions and try to help each other.” [Teacher B]*

Observation data showed students discussing design choices, guiding peers on tool usage, and correcting mistakes together. This peer support helped some students overcome difficulties during CAI lessons.

#### **Theme 4: Role Transformation**

This theme documents the evolving professional identity of Graphic Design teachers in technology-enhanced classrooms. The integration of CAI necessitated a shift from traditional instructor roles toward more complex facilitator and technician identities.

Teachers navigated between pedagogical guidance, technical troubleshooting, and managing group dynamics within constrained timeframes. Teacher A stated:

*“When they are working, I move around to help each group. I don’t stay in front like before.” [Teacher A]*

However, this facilitative role came with added pressures. Teachers also reported that CAI lessons were more stressful due to the need to troubleshoot technical issues, manage group dynamics, and provide individual support within a limited timeframe.

#### **4.4.2 Discussion of Findings on Current CAI Practices**

##### **Linking Findings to the Research Objective**

The key finding for this objective is that CAI implementation is predominantly teacher centred and resource constrained, yet it stimulates student engagement. These practices directly address the study's purpose of exploring how CAI is used by revealing an adaptive, pragmatic pedagogy. Teachers, facing technological shortages, default to a demonstrative model to ensure some knowledge transfer occurs, while

leveraging group work and peer support to maximise limited hands-on opportunities. This illustrates how pedagogical form is dictated by material constraints.

### **Comparison and Contrast with Prior Studies**

The dominance of teacher led demonstration aligns with Sebbeh's (2017) observations in Ghanaian Graphic Design classrooms, confirming that limited resources often shape technology use into a presentational tool rather than a medium for student centred exploration. This study adds the nuance that such demonstrations are not merely a preferred style but a strategic adaptation to scarcity.

The limited student access to computers reflects broader challenges of ICT implementation in Ghanaian schools, as noted by Kushiator et al. (2023), who reported that inadequate infrastructure restricts effective classroom use of technology. Similar to the present study, their findings showed that shared computer use reduces practical engagement and skill development.

Despite these limitations, the increased student interest observed during CAI lessons supports the argument by Yusuf and Balogun (2011) that technology enhances learner motivation and participation. The findings also resonate with Darling-Hammond et al. (2017), who emphasised that meaningful technology use can support active learning when learners are given adequate opportunities to interact with digital tools.

### **Theoretical Implications:**

From the constructivist perspective underpinning this study, learning is most effective when students actively participate in the learning process by engaging directly with instructional tools and tasks. In Graphic Design education, this means that students should have opportunities to use design software themselves, make creative decisions, test ideas, and learn through practice. However, the findings of this study show that

CAI is largely implemented through teacher-led demonstrations, with limited opportunities for students to engage independently with digital tools.

The constructivist theory emphasises learner-centred instruction, where the teacher acts as a facilitator rather than the sole source of knowledge. In the observed CAI lessons, the dominance of demonstration-based teaching positions students mainly as observers. Although demonstrations help clarify concepts and tools, they do not fully support knowledge construction, as students are unable to experiment, make mistakes, and reflect on their own design processes. This limits the development of higher-order thinking and practical digital design skills expected in Graphic Design education.

Furthermore, constructivist learning supports collaborative interaction, where learners share ideas and learn from one another. The study found that students often gathered around a single computer and engaged in peer discussions during CAI lessons. While this interaction reflects some elements of constructivist learning, excessive sharing due to limited resources restricts meaningful individual participation. In such situations, only a few students actively engage with the software, while others remain passive, thereby weakening the constructivist learning experience.

Overall, although CAI lessons demonstrate potential for constructivist learning through increased student interest and peer interaction, the limited hands-on engagement observed in this study constrains the effective application of constructivist principles in Graphic Design classrooms.

### **Practical Applications Based on Interview Insights:**

Teachers' experiences point toward practical strategies for improving CAI practice within existing constraints.

1. **Structured Group Roles:** To mitigate passivity in group work, teachers can formalise rotating roles within groups (e.g., "designer," "consultant," "note-

taker") as hinted at by some respondents, ensuring more equitable engagement and shared responsibility.

2. **Scaffolded Skill Building:** Teachers can design micro practice activities that follow demonstrations, focusing on mastering one specific tool or technique within the short available hands-on time. This aligns with the successful lessons teachers described and provides a clear, achievable behaviorist learning objective.
3. **Leveraging Peer Expertise:** Recognising the natural peer tutoring that emerges, teachers can more intentionally pair students with varying skill levels and create formal opportunities for students to teach each other specific techniques, harnessing the collaborative energy for skill development.
4. **Teacher Support Systems:** Reducing the stress of the facilitator-technician role requires practical support. This could include basic troubleshooting guides for common software issues, establishing student "tech monitors" in each group, and advocating for dedicated technical support from school administration to handle hardware failures.

**3. Research Objective 3: What do teachers perceive as the barriers/challenges to effective use of CAI in Graphic Design classroom in the Senior High Schools in the Abuakwa North Municipality?**

The third objective of the study sought to explore the barriers that affect the effective adoption and use of Computer-Assisted Instruction (CAI) in the teaching of Graphic Design in selected Senior High Schools in the Abuakwa North Municipality. This objective was addressed through teachers' interview responses and classroom observation data. The findings revealed that barriers to CAI use were not limited to the availability of computers alone but were deeply linked to curriculum structure,

assessment demands, teacher training, time constraints, and attitudes toward digital art.

Analysis of the interview transcripts and observation checklist resulted in four major themes:

1. **Examination-Driven Curriculum Constraints**
2. **Inadequate Professional Development**
3. **Cultural Devaluation of Digital Art Structural and Logistical Impediments**

Each theme is presented and explained below using participants' verbatim responses and observation evidence.

#### **Theme 1: Examination-Driven Curriculum Constraints**

This theme identifies the powerful disincentive created by the misalignment between curriculum assessment and digital skill development. The West African Senior School Certificate Examination (WASSCE) predominantly assesses manual Graphic Design techniques, creating a systemic pressure that discourages teachers from allocating significant instructional time to digital competencies, regardless of their perceived relevance. Teacher C explained:

*“The syllabus talks about computer work, but when you look at the final exams, most of the questions are based on manual work and WAEC will not accept computer generated works. So we have to focus more on what will help the students pass.” [Teacher C]*

Similarly, Teacher E stated:

*“We want to teach computer design, but the exams don't really test that. If you spend too much time on computers, the students may suffer in the exam.” [Teacher E]*

Classroom observations confirmed this influence. As examination periods approached, observed CAI lessons became less frequent, replaced by intensive manual practice sessions aligned with the expected exam format.

This finding shows that examination demands strongly influence instructional decisions and limit the consistent use of CAI in Graphic Design teaching.

### **Theme 2: Inadequate Professional Development**

This theme addresses the critical deficit in subject-specific teacher training for CAI integration. Teachers reported receiving generic ICT workshops rather than specialized training in digital pedagogies for Graphic Design. This lack of targeted professional support left educators relying on self-directed learning, limiting their confidence and capacity to implement CAI effectively. Teacher D explained:

*“I learned most of the computer skills on my own. We don’t really get training specifically on Graphic Design software.” [Teacher D]*

Teacher F also noted:

*“There are workshops sometimes, but they are general ICT trainings. They don’t focus on Graphic Design or how to teach it using computers.” [Teacher F]*

Teacher C described a more relevant training experience but emphasized its one-off nature:

*“I received a three-day workshop on Digital Arts in 2021. It was good, but that was it. There is no continuous professional development.” [Teacher C]*

Classroom observation revealed that teachers often used only basic tools within the available software. Advanced features were rarely demonstrated. This suggests that limited training affected teachers’ confidence and restricted the depth of CAI integration during lessons.

### **Theme 3: Cultural Devaluation of Digital Art**

This theme reveals a persistent institutional bias that privileges traditional manual art over digital creation. Within school communities and sometimes among educators themselves, digital Graphic Design was perceived as less authentic or artistically valid

than handcrafted work. This attitudinal barrier translated into reduced institutional priority for digital resource allocation and pedagogical support. Teacher E stated:

*“Some people still believe that real art is done by hand, so computer work is seen as secondary.” [Teacher E]*

Teacher B added:

*“When digital art is not fully valued, it affects the kind of support we get from the school.” [Teacher B]*

Teacher C connected this attitude to material consequences:

*“When digital art is not fully valued, it affects the kind of support we get from the school.” [Teacher C]*

The researcher observed that limited emphasis on digital Graphic Design resulted in low priority for acquiring digital tools and upgrading software. This attitude affected funding decisions and reduced encouragement for teachers to expand their use of CAI.

#### **Theme 4: Structural and Logistical Impediments**

This theme encompasses the practical organizational challenges that hindered CAI implementation. Teachers identified limited instructional time and large class sizes as barriers to effective CAI use. Graphic Design lessons were described as insufficient for combining both manual and digital instruction. Teacher A explained:

*“The time for Graphic Design is not enough, and when the class is big, it becomes difficult to use the computers well.” [Teacher A]*

Observation data showed that large class sizes made it difficult for teachers to provide individual attention during CAI lessons. As a result, some students did not have adequate opportunities to practice digital Graphic Design skills.

In summary, the barriers to CAI adoption are systemic and interlocking. Teachers are caught between an assessment system that rewards manual skills and a lack of training to confidently integrate digital tools. This is exacerbated by institutional

attitudes that question the value of digital art and everyday logistical challenges of time and class size. These factors create a disincentive structure that makes deep CAI integration a professionally risky and practically difficult endeavor.

### **4.3.3 Discussion of Findings on Barriers to CAI Adoption**

#### **Linking Findings to the Research Objective**

The key finding for this objective is that barriers to CAI are fundamentally systemic and pedagogical, not merely technical. The identification of curriculum pressure, training deficits, attitudinal resistance, and structural constraints directly addresses the study's purpose of assessing barriers by revealing a complex ecosystem that actively inhibits change. These factors explain why the mere presence of some technology, as identified in Objective one, does not lead to effective integration, as explored in Objective two.

#### **Comparison and Contrast with Prior Studies**

The findings of this study indicate that curriculum demands, limited teacher training, attitudes towards digital Graphic Design, time constraints, and large class sizes are major barriers affecting the effective adoption of Computer-Assisted Instruction (CAI) in Graphic Design classrooms. These findings are consistent with the literature reviewed in Chapter Two and provide contextual evidence from Senior High Schools in the Abuakwa North Municipality. The findings strongly align with and contextualize the literature on barriers to educational technology integration in Ghana and similar settings.

The influence of curriculum structure and examination pressure supports earlier studies which indicate that examination-oriented curricula significantly shape teachers' instructional practices (Sebbeh, 2017; Kushiator et al., 2020). As discussed in Chapter Two, when external examinations place greater emphasis on manual skills,

teachers are more likely to prioritise those areas in classroom instruction. The findings of this study confirm that although CAI is recognised as important, teachers reduce the time allocated to digital Graphic Design activities because such skills are not adequately reflected in assessment demands.

The critical lack of specialized teacher training supports Sebbel's (2017) emphasis on teacher competence as a prerequisite for integration. This study deepens this understanding by highlighting the distinction between general ICT literacy and the pedagogical content knowledge needed to teach Graphic Design with digital tools. Teachers' reports of one off, generic workshops reflect a systemic failure in professional development strategy.

Attitudes towards digital Graphic Design further affected CAI adoption in the schools. The findings support Yusuf (2011), who reported that digital art is sometimes perceived as less authentic compared to manual art forms. As discussed in Chapter Two, such perceptions can influence institutional priorities and resource allocation. In the present study, this attitude contributed to limited support for CAI, including low investment in digital tools and minimal encouragement for teachers to expand their use of technology in Graphic Design instruction.

### **Theoretical Implications:**

Time constraints and large class sizes also limited effective CAI use. As highlighted in the literature, limited instructional time and high student-teacher ratios reduce opportunities for individual practice and close supervision. In this study, these conditions made it difficult for teachers to provide adequate support during CAI lessons, resulting in unequal student participation and reduced skill development.

The constructivist theory also provides a useful lens for understanding the barriers affecting the effective adoption of CAI in Graphic Design teaching. Constructivism

emphasises flexible learning environments, continuous interaction with tools, and supportive conditions that enable learners to construct knowledge over time. However, the findings of this study indicate that several systemic and institutional barriers limit the creation of such learning environments.

The examination-oriented curriculum, which places greater emphasis on manual Graphic Design skills, reduces the time allocated for digital instruction. From a constructivist perspective, limited instructional time restricts students' opportunities to engage deeply with CAI tools and progressively build digital competencies. When digital lessons are treated as supplementary rather than integral to the curriculum, students are unable to construct knowledge through sustained interaction with CAI resources.

In addition, limited professional training opportunities for teachers affect the effective facilitation of constructivist learning environments. Constructivist teaching requires teachers to design activities that encourage exploration, problem-solving, and learner autonomy. The findings suggest that inadequate training reduces teachers' confidence and ability to integrate CAI meaningfully. As a result, teachers may rely on safer, teacher-centred approaches that limit student participation, thereby weakening constructivist learning processes.

Negative attitudes towards digital art further constrain the application of constructivist principles. When digital Graphic Design is perceived as less valuable than manual work, institutional support for CAI is reduced. Constructivist learning thrives in environments where tools are valued and supported. In the absence of such support, both teachers and students are less motivated to engage actively with CAI, limiting opportunities for knowledge construction and creative exploration.

Taken together, these barriers prevent the establishment of learning environments that support active, student-centred, and experiential learning as proposed by constructivist theory. Consequently, while CAI has the potential to enhance Graphic Design education, the conditions necessary for effective constructivist learning are not fully present in the schools studied.

While the current demonstrative practice aligns with Behaviourism, the systemic barriers also undermine its effective application. Behaviourist skill acquisition requires consistent, structured practice and reinforcement (Skinner, 1953). However, large class sizes and short periods prevent the individualized monitoring and repetitive practice needed for skill mastery. The lack of training may also limit teachers' ability to sequence software skills effectively into a coherent learning progression. Therefore, while pedagogy may be behaviourist in style, the system's structural flaws prevent it from being behaviourist in its effective, outcome-based implementation.

### **Practical Applications Based on Interview Insights:**

Teachers' experiences point to necessary interventions at multiple levels of the education system.

1. **Curriculum and Assessment Reform:** The most impactful change would be to align national assessment with curriculum rhetoric. Integrating a mandatory digital portfolio component into the Visual Arts WASSCE, as suggested by teachers, would instantly validate digital skills, driving changes in teaching priority, resource allocation, and training.
2. **Targeted Teacher Professional Development:** Training must move beyond generic ICT. It should focus on "Digital Pedagogies for Visual Arts," combining software mastery with strategies for managing lab based

learning, assessing digital work, and blending digital and traditional methods effectively.

3. **Advocacy and Cultural Shift within Schools:** Department heads and teachers need frameworks to advocate for the professional value of digital design. Sharing examples of career pathways and industry standards could help shift internal perceptions and justify requests for better resources and dedicated space, like a small digital arts workstation within the Visual Arts department.
4. **Addressing Structural Logistics:** While larger policy changes are needed, schools can internally review timetabling to allow for longer, more flexible blocks for design projects and advocate for manageable class sizes for practical subjects to enable individual supervision.

Overall, the findings suggest that although teachers recognise the importance of CAI in Graphic Design education, curriculum-related pressures, insufficient training, attitudinal challenges, and structural constraints continue to limit its full adoption. These findings strongly support the literature reviewed in Chapter Two and demonstrate how previously identified challenges manifest within the specific context of Senior High Schools in the Abuakwa North Municipality.

## CHAPTER FIVE

### SUMMARY, CONCLUSION, AND RECOMMENDATIONS

#### 5.1 Overview

This chapter presents the summary of the study, draws conclusions based on the findings discussed in Chapter Four, and offers recommendations arising from the study. The chapter is organised in line with the research objectives and qualitative findings of the study. The purpose is to clearly show how the findings answer the research questions and to suggest practical ways of improving the use of Computer-Assisted Instruction (CAI) in the teaching and learning of Graphic Design in Senior High Schools. The chapter also highlights the contributions of the study to knowledge and suggests areas for further research.

#### 5.2 Summary of the Study

This study was conducted to gain an in-depth understanding of Computer-Assisted Instruction (CAI) integration in the teaching of Graphic Design. It was guided by three specific objectives: to investigate available instructional technologies, to explore current CAI practices, and to assess systemic and pedagogical barriers to its adoption in selected Senior High Schools within the Abuakwa North Municipality.

The research was underpinned by an integrated theoretical framework of Constructivism and Behaviourism. This framework provided a lens to analyse whether CAI was used for open-ended creative exploration (constructivist) or for structured skill acquisition (behaviourist), and to understand how the learning environment supported or hindered these approaches.

A qualitative research design was employed, situated within the interpretive paradigm. Data were collected through semi-structured interviews with six Graphic Design teachers and non-participant observations of lessons. The data were analysed

using thematic analysis, which involved identifying, analysing, and reporting patterns across the dataset.

The key findings revealed a significant gap between policy intent and classroom reality. Firstly, while basic technologies were present, they formed a fragile infrastructure characterised by scarcity, obsolescence, and unreliable utilities. Secondly, current CAI practices were adaptive but constrained, dominated by teacher-led demonstrations and shared student access, which limited individual creative practice. Thirdly, barriers were found to be deeply systemic, with the national examination regime, inadequate teacher training, and institutional attitudes collectively inhibiting effective integration. The study concludes that meaningful CAI use in Graphic Design is contingent upon addressing these interconnected structural and pedagogical challenges.

### **5.3 Key Findings**

The analysis of qualitative data yielded distinct findings for each research objective, synthesised below.

#### **Key Findings for Research Objective One: Available Instructional Technologies**

1. **Severe Resource Scarcity:** There is a critical shortage of functional computer hardware, resulting in high student-to-computer ratios (e.g., 3:1 or 4:1) that necessitate group work and severely limit individual hands-on access.
2. **Outdated and Incomplete Software Ecosystem:** The Graphic Design software available in the schools is outdated and incomplete. CorelDRAW was the main software in use, but teachers reported that the versions installed lacked several modern features. In addition, supporting tools commonly used in professional Graphic Design practice, such as graphic tablets, scanners, and colour printers, were largely absent.

3. **Unreliable Foundational Infrastructure:** The supporting infrastructure for CAI use was found to be unreliable. Teachers and observations indicated that power fluctuations and inconsistent internet connectivity frequently interrupted lessons, affecting the smooth delivery of CAI activities.
4. **Negotiated and Intermittent Access:** Access to computer laboratories is not guaranteed. It requires advance booking and competes with other subjects, rendering technology use an occasional event rather than an integrated component of the learning process.

### **Key Findings for Research Objective Two: Current CAI Practices**

1. **Dominance of Teacher-Led Demonstration:** The dominant mode of CAI use involves teacher-led demonstrations. Teachers typically demonstrate design procedures step by step while students observe. This approach places emphasis on procedural understanding rather than extended creative exploration.
2. **Constrained and Shared Student Practice:** Student practice during CAI lessons is mostly collaborative. Due to limited access to computers, students often work in groups. While this encourages cooperation, it also leads to unequal participation, with some students actively using the software while others take on observational roles.
3. **Increased Engagement and Peer Collaboration:** Despite these constraints, CAI lessons were associated with increased student interest and engagement. Teachers observed that students were more attentive during digital lessons and frequently supported one another through peer discussion and problem-solving.

4. **Evolution of the Teacher's Role:** The findings also show that CAI alters the teacher's role in the classroom. Teachers function not only as instructors but also as facilitators and technical support providers. Managing student questions alongside technical challenges placed additional demands on teachers during lessons.

#### **Key Findings for Research Objective Three: Barriers to CAI Adoption**

1. **Supremacy of the Examination System:** One major barrier is the examination system. The West African Senior School Certificate Examination places strong emphasis on manual Graphic Design skills, which discourages teachers from allocating significant instructional time to digital work.
2. **Deficit in Subject-Specific Teacher Training:** Limited subject-specific training also emerged as a barrier. Teachers reported that professional development opportunities related to CAI were infrequent and largely generic. As a result, teachers relied on self-learning to integrate digital tools into their lessons.
3. **Cultural and Attitudinal Resistance:** A persistent perception within school communities devalues digital art as less authentic than traditional manual art, leading to diminished institutional priority and support for the resources needed for effective CAI.
4. **Structural and Logistical Impediments:** Inflexible school timetables providing insufficient lesson time, combined with large class sizes, create a logistical environment hostile to the extended, project-based, and individually supervised learning that meaningful CAI requires

## **5.4 Conclusion**

Based on the thematic analysis of the findings, the following conclusions are drawn, providing definitive answers to the study's research questions.

### **Conclusion on Objective One: Available Instructional Technologies**

The study concludes that the instructional technologies available for teaching Graphic Design in the selected Senior High Schools are limited and inadequate for effective CAI. Although computers and basic Graphic Design software exist, the number of functional computers is insufficient to support student-centered learning. In addition, the software available is often outdated and lacks important tools needed for comprehensive Graphic Design instruction. Poor internet connectivity and unstable power supply further reduce the effectiveness of CAI. These limitations restrict students' opportunities to actively engage with digital tools and hinder the application of constructivist learning principles in Graphic Design classrooms.

### **Conclusion on Objective Two: Current Practices of CAI**

The study concludes that CAI is used mainly as a supportive teaching tool rather than as a fully integrated instructional approach in Graphic Design lessons. Teachers rely largely on demonstrations, with limited time for students to practise independently due to inadequate resources. Despite these limitations, CAI lessons increase student interest, engagement, and peer interaction. However, the limited access to computers prevents students from fully developing practical digital Graphic Design skills.

### **Conclusion on Objective Three: Barriers to CAI Adoption**

The study concludes that several barriers affect the effective adoption of CAI in Graphic Design teaching. Examination-oriented curricula place greater emphasis on manual skills, which reduces the time allocated to digital instruction. Limited professional training opportunities also affect teachers' confidence and ability to

integrate CAI effectively. In addition, attitudes that place higher value on manual art over digital art reduce institutional support for CAI. These factors collectively limit the consistent and effective use of CAI in Graphic Design classrooms.

### **5.6 Limitations of the Study**

While this research provides an in-depth exploration of CAI integration, it is important to acknowledge its boundaries to contextualise the findings appropriately.

The first limitation relates to the scope of the research context. This study was conducted in six Senior High Schools within the Abuakwa North Municipality. Consequently, the findings are deeply contextualised to the specific infrastructural, cultural, and administrative realities of these settings. While the insights may resonate with similar environments, they are not statistically generalisable to all Ghanaian SHSs.

Secondly, the chosen qualitative methodology, while ideal for uncovering rich, detailed experiences, inherently limits the breadth of perspectives captured. The study's findings are primarily constructed from the views of six Graphic Design teachers and the researcher's observations. The perspectives of other crucial stakeholders such as students, headteachers, or curriculum officers were not incorporated, which could have provided a more holistic understanding of the CAI ecosystem.

Finally, the study offers a cross-sectional analysis of the situation at a fixed point in time. Educational technology, policy, and resource allocation are dynamic. Therefore, the findings reflect the challenges and practices as they existed during the data collection period and may not account for the impact of subsequent policy changes, new investments, or emerging professional development initiatives.

## 5.5 Recommendations

Based on the findings and conclusions of this study, the following recommendations are offered to improve the integration of Computer-Assisted Instruction in Graphic Design education. They are divided into two categories: those targeting systemic, national-level change (Policy), and those that can be implemented by schools and teachers within the current system (Practice).

### A. Policy-Level Recommendations

#### Recommendations for the Ministry of Education and Ghana Education Service

1. **Revise National Assessment to Value Digital Skills:** The WAEC/WASSCE examination for Visual Arts should be reformed to include the assessment of digital Graphic Design competencies. This could be achieved by introducing a **mandatory digital portfolio component** or practical exam tasks that require the use of design software. Aligning high-stakes assessment with curriculum goals is the most powerful lever to change classroom priorities.
2. **Invest in Foundational Infrastructure:** National ICT in Education policies must move beyond one-time hardware donations. There should be dedicated, sustainable funding for:
  1. **Reliable utilities:** Ensuring schools have stable electricity (e.g., through solar power or inverters) and internet connectivity as a non-negotiable foundation.
  2. **Maintenance and upgrades:** Establishing budgets and protocols for regular hardware maintenance, software updates, and timely replacement of obsolete equipment.

3. **Mandate Specialized Teacher Professional Development:** In-service and pre-service training programs must move beyond generic ICT literacy. The GES should develop and fund subject-specific training modules (e.g., "Digital Pedagogy for Visual Arts") that equip Graphic Design teachers with both advanced software skills and the teaching strategies to use them effectively in the classroom.
4. **Update the Graphic Design Syllabus:** The national teaching syllabus for Graphic Design should be explicitly updated to integrate digital skills as core, progressive learning objectives not just supplementary topics. It should provide clear guidance on recommended software, digital projects, and how to blend traditional and digital techniques.

#### **B. Practice-Level Recommendations**

1. **Develop a School-Level Digital Integration Plan:** School management and Visual Arts departments should create a practical plan to maximize existing resources. This includes:
  - **Scheduling and Access:** Establishing a fair and efficient booking system for the computer lab to ensure Graphic Design classes get regular, reliable access.
  - **Strategic Resource Allocation:** Prioritizing the purchase of a few high-impact tools (like a colour printer or a single graphic tablet for demonstrations) over non-essential items.
2. **Adopt Resource-Smart Teaching Strategies:** Teachers can adapt their methods to work within current constraints:

- **Structured Group Work:** Formally assign and rotate roles within student groups (e.g., Designer, Technical Advisor, Reviewer) to ensure active participation for all members during shared computer use.
  - **Peer-Led Learning:** Identify and empower students with stronger digital skills to act as "tech mentors" for their peers, reducing the teacher's technical support burden and fostering collaboration.
  - **Micro-Skills Focus:** Design short, focused CAI activities that teach one specific software skill per lesson, making learning manageable within tight timeframes.
3. **Build a Culture of Digital Art Value:** Teachers and department heads should actively advocate for the validity of digital Graphic Design within the school community. This can be done by:
- Showcasing excellent student digital work alongside manual work in school exhibitions.
  - Inviting digital design professionals for career talks to highlight industry relevance.
  - Sharing success stories of alumni using digital skills in higher education or work.
4. **Foster Professional Learning Communities:** Teachers should not work in isolation. They can form informal networks or online groups with other Graphic Design teachers to share lesson plans, troubleshoot software issues, and collectively develop digital teaching resources, thereby building capacity from the ground up.

### **5.5 Contribution to Knowledge**

The study contributes to knowledge by providing empirical evidence on the use of Computer-Assisted Instruction in Graphic Design education within the context of Senior High Schools in the Abuakwa North Municipality. The findings add to existing literature by highlighting how resource availability, instructional practices, and systemic barriers influence CAI adoption in practical art subjects. The study also contributes to understanding how contextual challenges shape the application of CAI in Graphic Design education in Ghanaian Senior High Schools.

### **5.6 Suggestions for Further Research**

Future studies may adopt a mixed-methods approach to examine the impact of CAI on students' performance in Graphic Design. Further research could also explore students' perspectives on CAI or examine CAI use in other Visual Arts subjects in different regions of Ghana. Studies conducted in other regions of Ghana would provide a broader understanding of CAI integration across different educational contexts.

### **5.7 Chapter Summary**

This chapter summarised the study, presented conclusions based on the findings, and offered recommendations to improve the use of CAI in Graphic Design teaching. The chapter also highlighted the contribution of the study to knowledge and suggested areas for further research. The study concludes that while CAI has the potential to enhance Graphic Design education, its effective use depends on adequate resources, appropriate curriculum support, and continuous teacher development.

## REFERENCES

- Acheampong, P. (2019). Teacher retention: A review of policies for motivating rural basic school teachers in Ghana. *Asian Journal of Education and Training*, 5(1), 86–92.
- Acheampong, E., & Agyemang, F. G. (2021). Enhancing academic library services provision in the distance learning environment with mobile technologies. *The Journal of Academic Librarianship*, 47(1), 102279.
- Acquah, E. K. (2012). Teacher perspective on integrating ICTs into teaching of Art in the Colleges of Education in Ghana. *Arts and Design Studies*, 7(7), 11–15.
- Adadzi, E. (2020). Can computer-assisted instruction improve students' motivation and academic performance in Social Studies? *Journal of Digital Education and Learning*, 2(2), 1–15.
- Adeoye, I. A., Adanikin, A. F., & Adanikin, A. (2020). COVID-19 and e-learning: Nigeria tertiary education system experience. *International Journal of Research and Innovation in Applied Science*, 5(5), 28–31.
- Adiutor. (2023). K-12 education and computer-assisted instruction. <https://adiutor.co/blog/k-12-education-and-computer-assisted-instruction/>
- Adjei, J. K., Adams, S., & Mamattah, L. (2021). *Institutional factors influencing the adoption of cloud computing (CC) in Ghana* [Unpublished manuscript].
- Adjei, A., & Asare, E. (2021). Barriers and enablers to Artificial Intelligence (AI) adoption in administrative functions in public universities in Ghana. *Canadian Journal of Educational and Social Studies*, 5(4).
- Agyapong, A. (2023). Cyber-physical systems for innovating and transforming society 5.0 [Unpublished manuscript].
- Agyeman, E. A. (2023). *Decolonising the visual arts curriculum in Ghana: A critical review* [Unpublished manuscript].
- Ahiatrogah, E. K., & Barfi, K. A. (2015). Integration of information and communication technology in teaching: Initial perspectives of senior high school teachers in Ghana. *Education and Information Technologies*, 21(4), 977–991.

- Akpadey, A. (2021). *Long-beaten for inattention, some Ghanaian children with learning disabilities finally get effective education*. Global Press Journal.
- Alhassan, A., Mohammed, I., & Osei, M. A. (2022). *The impact of digital design tools on creative outcomes in Ghanaian technical schools* [Unpublished report].
- Amabile, T. M. (2023). *Creativity in context: Update to the social psychology of creativity*. Westview Press.
- Amankwah, R., & Dzokoto, P. (2020). The digital divide and its impact on teaching and learning in higher educational institutions in Ghana during COVID-19. *International Journal of Education and Development using Information and Communication Technology*, 16(3), 208–222.
- Amissah, P. A. K., Oduro, G. K. T., & Dachi, H. A. (2002). *Foundations of education in Ghana*. Sedco Publishing.
- Anderson, R. E., & Dexter, S. (2005). School technology leadership: An empirical investigation of prevalence and effect. *Educational Administration Quarterly*, 41(1), 49–82.
- Andrews, D. H. (1998). Individualized instruction: A historical perspective. *Journal of Applied Behavior Analysis*, 31(3), 509–519.
- Asare, E., & Oduro, G. K. T. (2023). Teacher preparedness and implementation of the National Pre-tertiary Education Curriculum Framework in Ghana. *Journal of Educational Research and Practice*, 13(1), 251–269.
- Asunka, S. (2008). The impact of ICT on education: The case of Ghana. *International Journal of Education and Development using Information and Communication Technology*, 4(1), 21–31.
- Barot, A. (2009). Computer-assisted instruction: A review of research. *Journal of Research on Technology in Education*, 41(2), 173–188.
- Barrow, L., & Markman, L. (2009). Technology's edge: The educational benefits of computer-aided instruction. *American Economic Journal: Economic Policy*, 1(1), 52–74.

- Bayraktar, S., & Sahin, A. (2020). The effectiveness of computer-assisted instruction on students' cognitive skills to know geometric shapes. *International Journal of Progressive Research in Engineering Management and Science*, 3(3), 434–437.
- Best, J. W., & Kahn, J. V. (2006). *Research in education* (10th ed.). Pearson.
- Bitter, G. G., & Pierson, M. E. (1999). *Computers in the schools: A guide for teachers* (2nd ed.). Allyn & Bacon.
- Bloom, B. S. (1968). Learning for mastery. *Evaluation Comment*, 1(2), 1–12.
- Boakye-Yiadom, K., Donkor, M., & Mensah, B. (2024). Integrating Adinkra symbols into the digital art curriculum: A case study of Ghanaian SHS. *Journal of African Arts Education*, 3(1), 45–62.
- Boateng, R. (2021). Digital skills and employability in Ghana: A study of graphic design graduates. *African Journal of Information Systems*, 13(2), 1–18.
- Bogdan, R. C., & Biklen, S. K. (2007). *Qualitative research for education: An introduction to theories and methods* (5th ed.). Pearson.
- Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 9(2), 27–40. <https://doi.org/10.3316/QRJ0902027>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- British Educational Research Association. (2018). *Ethical guidelines for educational research* (4th ed.). <https://www.bera.ac.uk/publication/ethical-guidelines-for-educational-research-2018>
- Bruner, J. S. (1966). *Toward a theory of instruction*. Harvard University Press.
- Buabeng-Andoh, C., & Essel, H. B. (2023). Teachers' ICT usage in second-cycle institutions in Ghana: A qualitative study. *Education and Information Technologies*, 28(1), 1–21.
- Chapman, C. (2000). The Hawthorne Effect: A review of the research. *Journal of Research on Technology in Education*, 32(4), 415–423.

- Cheung, A. C. K., & Slavin, R. E. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. *Educational Research Review*, 9, 88–113.
- Chiafie, M. (2011). ICT infrastructure in Ghanaian schools: Challenges and prospects. *International Journal of Education and Development using Information and Communication Technology*, 7(3), 1–15.
- Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th ed.). Routledge.
- Cotton, K. (2001). *Computer-assisted instruction*. Northwest Regional Educational Laboratory.
- CRDD (Curriculum Research and Development Division). (2007). Teaching syllabus for Visual Arts (Senior High School 1-3). Ministry of Education, Science and Sports, Ghana.
- Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Sage.
- Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Sage.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage.
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (5th ed.). Sage.
- Cuban, L. (2003). *Oversold and underused: Computers in the classroom*. Harvard University Press.
- Curriculum Resources. (2024). *Art and design foundation curriculum* [Unpublished manuscript].
- Danso, J., & Opong, S. (2021). The digital divide and online learning in Ghanaian universities during the COVID-19 pandemic. *International Journal of Educational Technology*, 8(1), 1–15.

- Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute.
- Davis, M. (2023). *Graphic design theory*. Thames & Hudson.
- deGraft-Yankson, K. (2025). AI-assisted digital narratives of cultural festivals. *Journal of Arts and Culture*, 1(1), 1–10.
- Desimone, L. M., & Garet, M. S. (2015). Linking professional development to improved teaching: A conceptual framework and review of the empirical literature. *Educational Researcher*, 44(3), 157–167.
- Driscoll, M. P. (2000). *Psychology of learning for instruction* (2nd ed.). Allyn & Bacon.
- Edutech202. (2012). Enhancing teaching-learning process and through CAI (Computer-Assisted Instruction). *International Journal of Social and Economic Research*, 2(2), 456–462.
- Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly*, 26(2), 43–71.
- Evans, C., & Gibbons, N. J. (2007). The interactive effects of computer-assisted instruction and conceptual transfer on student learning. *Journal of Educational Psychology*, 99(2), 345–358.
- Eyo, M. (2018). The effect of computer-assisted instruction on students' academic performance in basic science and technology in secondary schools in Calabar Municipality, Cross River State, Nigeria. *Journal of Education and Learning*, 7(3), 1–10.
- Farooq, A. (1997). The impact of computer-assisted instruction on student engagement and motivation. *Journal of Educational Technology Systems*, 25(4), 311–320.
- Farrant, J. S. (1996). *Principles and practice of education*. Longman.
- Fosnot, C. T., & Perry, R. S. (2005). Constructivism: A psychological theory of learning. In C. T. Fosnot (Ed.), *Constructivism: Theory, perspectives, and practice* (2nd ed., pp. 8–33). Teachers College Press.

- Fourie, L. (1999). Computer-assisted instruction: A definition. *South African Journal of Education, 19*(3), 209–214.
- Fraenkel, J. R., & Wallen, N. E. (1996). *How to design and evaluate research in education* (3rd ed.). McGraw-Hill.
- Fullan, M. (2011). *Change leader: Learning to do what matters most*. Jossey-Bass.
- Gambari, A. I., Falode, C. O., & Adegbenro, D. A. (2013). Effectiveness of computer-assisted instruction on students' academic achievement in physics in secondary schools in Niger State, Nigeria. *Journal of Education and Practice, 4*(16), 11–18.
- Ghana Education Service. (2022). *Eastern Region school survey* [Unpublished report].
- Ghana ICT Commission. (2023). *Digital pedagogical transformation through ICT-enhanced school models* [Official report].
- Giles, D. D., Pitre, P. E., & Womack, S. D. (2003). *Learning styles and the adult learner*. ERIC Clearinghouse on Adult, Career, and Vocational Education.
- Government of Ghana. (2003). *Ghana ICT for Accelerated Development (ICT4AD) policy*. Ministry of Communications.
- Grant, C., & Osanloo, A. (2014). Understanding, selecting, and integrating a theoretical framework in dissertation research: Creating the blueprint for your "house". *Administrative Issues Journal, 4*(2), 12–26.
- Gyemfi, G., & Boateng, S. (2021). *ICT integration in Ghanaian Senior High Schools: A focus on Visual Arts education* [Unpublished report].
- Hardy, J., & Totten, S. (2015). *Digital art education: A guide to theory and practice*. National Art Education Association.
- Healy, J. M. (1999). *Failure to connect: How computers affect our children's minds for better and worse*. Simon & Schuster.
- Heid, K. A. (2008). The arts and education: Knowledge generation, pedagogy, and the discourse of learning. *Review of Research in Education, 32*(1), 29–61.

- Herro, D., & Quigley, C. F. (2017). STEAMing forward: Exploring teachers' perceptions and classroom practices of STEAM literacies. *Journal of Research in Science Teaching*, 54(1), 1–25.
- Hetland, L., Winner, E., Veenema, S., & Sheridan, K. M. (2013). *Studio thinking 2: The real benefits of visual arts education*. Teachers College Press.
- Institute for Learning Styles Research. (2003). *Perceptual learning styles theory*. <https://www.learningstyles.org/the-model/>
- Islamia, J. (2016). *Essentials of research design and methodology*. Wiley.
- Jeddah, A. (2012). The impact of computer-assisted instruction on teacher efficiency. *Journal of Educational Technology Systems*, 41(1), 1–15.
- Jonassen, D. H. (2000). *Computers as mindtools for schools: Engaging critical thinking* (2nd ed.). Prentice Hall.
- Jonassen, D. H., & Carr, C. (2000). Computers as mindtools for engaging learners in critical thinking. *TechTrends*, 43(2), 24–32.
- Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: Developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing*, 72(12), 2954–2965.
- Kirschner, P. A. (2022). *How learning happens: Seminal works in educational psychology and what they mean in practice*. Routledge.
- Kochhar, S. K. (2004). *The teaching of social studies*. Sterling Publishers.
- Kpedekpo, B. E. (2025). *Heritage through pixels: Digitization of Ghana's cultural heritage with the aim of increasing engagement and participation amongst the youth* [Unpublished master's thesis].
- Kratzig, G. P., & Arbuthnott, K. D. (2003). Perceptual learning style and memory: A conceptual and methodological analysis. *Journal of Educational Psychology*, 95(1), 21–30.
- Kulik, J. A., & Kulik, C. C. (1991). Effectiveness of computer-based instruction: An updated analysis. *Computers in Human Behavior*, 7(1-2), 75–94.

- Kushiator, G., Adashie, M., Ayim, B., & Klodzi, I. Y. (2023). Digital media practices: Exploring the challenges of graphic design students in senior high schools in Ghana. *Journal of Education and Learning Technology*, 4(4), 91–101.
- Kyei-Blankson, L., Ntuli, E., & Donnelly, H. (2021). Culturally responsive pedagogy in online learning: A systematic review. *Journal of Online Learning Research*, 7(1), 1–20.
- Lee, J., & Kozma, R. B. (2014). An implementation study of a TPACK-based instructional design model in a technology integration course. *Journal of Educational Computing Research*, 51(3), 325–345.
- Li, Y., & Ma, L. (2010). Financial constraints and ICT adoption in education. *Journal of Educational Technology & Society*, 13(4), 1–10.
- Liao, J., & Lu, Y. (2020). A framework of artificial intelligence augmented design support. *Human-Computer Interaction*, 35\*(5-6), 433–459.
- Liao, Y. C. (2004). Effects of computer-assisted instruction on students' achievement in Taiwan: A meta-analysis. *Journal of Educational Computing Research*, 30(4), 361–377.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.
- Linden, A. (2008). The impact of computer-assisted instruction on student learning outcomes in low- and middle-income countries: A realist review. *Journal of Development Effectiveness*, 1(1), 1–20.
- Macaruso, P., Hook, P. E., & McCabe, R. (2006). The efficacy of computer-based supplementary phonics programs for advancing reading skills in at-risk elementary students. *Journal of Learning Disabilities*, 39(2), 162–172.
- Mangesi, K. (2007). *ICT in education in Africa: A review of the literature*. International Development Research Centre.
- Mayer, R. E. (2005). *The Cambridge handbook of multimedia learning*. Cambridge University Press.
- McCombes, S. (2020, September 19). *Sampling methods, types, techniques & examples*. Scribbr. <https://www.scribbr.com/methodology/sampling-methods/>
- Menetey, K. (2019). *The craft of qualitative research*. Sage.

- Mensah, H. J. (2020). *Computer-assisted instruction (CAI) usage in teaching Indigenous Ghanaian languages in selected senior high schools in the Akuapem North Municipality* (Master's thesis, University of Cape Coast). <https://ir.ucc.edu.gh/xmlui/handle/123456789/6798>
- Merriam, S. B. (1998). *Qualitative research and case study applications in education* (2nd ed.). Jossey-Bass.
- Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass.
- Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). Sage.
- Ministry of Education. (2018). *Education Strategic Plan (ESP) 2018–2030*. Government of Ghana.
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.
- Morrell, P. (1992). *Computers in education*. Allyn and Bacon.
- Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education*, 59(3), 1065–1078.
- Nyamekye, A. (2023). Creativity and initial teacher education: Reflections of secondary visual arts teachers in Ghana. *Social Sciences & Humanities Open*, 7(1), 1–11.
- Okebukola, P. A. O. (2013). *Saving Nigeria from itself: Towards a redemption plan for education*. A 50th Anniversary Lecture of the Faculty of Education, University of Ibadan.
- Oppenheimer, T. (2003). *The flickering mind: Saving education from the computer age*. Random House.
- Ornstein, A. C., & Levine, D. U. (1993). *Foundations of education* (5th ed.). Houghton Mifflin.
- Osei, M., & Nyarko, E. (2023). *A conversation with Kwesi Botchway on color theory and African contemporary art*. Sugarcane Magazine.

- Owston, R. D. (1997). The World Wide Web: A technology to enhance teaching and learning? *Educational Researcher*, 26(2), 27–33.
- Owusu, A., & Asare, E. (2022). Digital education in Ghana: Challenges and opportunities. *African Journal of Educational and Social Sciences*, 1(1), 1–15.
- Owusu, K. A., Monney, K. A., Appiah, S. A., & Wilmot, E. M. (2010). Effects of computer-assisted instruction on performance of senior high school biology students in Ghana. *Computers & Education*, 55(4), 1730–1738.
- Owusu-Ansah, A. (2015). One Laptop Per Child Policy in Ghana: Any Impact on Teaching and Learning? *International Journal of Education and Development using Information and Communication Technology*, 11(1), 1–12.
- Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed-method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research*, 42(5), 533–544.
- Partnership for 21st Century Skills. (2019). *Framework for 21st century learning*. [http://static.battelleforkids.org/documents/p21/P21\\_Framework\\_Brief.pdf](http://static.battelleforkids.org/documents/p21/P21_Framework_Brief.pdf)
- Patton, M. Q. (1990). *Qualitative evaluation and research methods*. Sage.
- Patton, M. Q. (2015). *Qualitative research & evaluation methods* (4th ed.). Sage.
- Pelgrum, W. J., & Plomp, T. (2004). *ICT in education around the world: Trends, problems and future perspectives*. UNESCO.
- Pham, L. (2018). *A review of key paradigms: Positivism, interpretivism and critical inquiry*. University of Adelaide Press.
- Piaget, J. (1970). *Science of education and the psychology of the child*. Viking.
- Pilot, D. F., & Beck, C. T. (2008). *Nursing research: Generating and assessing evidence for nursing practice* (8th ed.). Lippincott Williams & Wilkins.
- Polit, D. F., & Beck, C. T. (2008). *Nursing research: Generating and assessing evidence for nursing practice* (8th ed.). Lippincott Williams & Wilkins.

- Ritchie, J., & Lewis, J. (2003). *Qualitative research practice: A guide for social science students and researchers*. Sage.
- Rivers, R. H., & Vockell, E. L. (2007). Computer simulations to stimulate scientific problem solving. *Journal of Research in Science Teaching*, 24(5), 403–415.
- Robinson, K. (2022). *Imagine if...: Creating a future for us all*. Penguin Books.
- Roblyer, M. D., & Doering, A. H. (2013). *Integrating educational technology into teaching* (6th ed.). Pearson.
- Rotherham, A. J. (2012). *From surface to in-depth learning*. KnowledgeOne.
- Saldana, J. (2015). *The coding manual for qualitative researchers* (3rd ed.). Sage.
- Sanders, M., & Albers, P. (2020). *Multimodal literacy in the art classroom*. Routledge.
- Santally, M. I., Rajabalee, Y., & Cooshna-Naik, D. (2004). Computer-assisted learning in higher education: A study of student retention. *British Journal of Educational Technology*, 35(1), 1–10.
- Santrock, J. W. (2004). *Educational psychology* (2nd ed.). McGraw-Hill.
- Scotland, J. (2012). Exploring the philosophical underpinnings of research: Relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. *English Language Teaching*, 5(9), 9–16.
- Sebbeh, M. A. (2017). Constructivist teaching strategies for graphic design education in selected senior high schools in Ghana. *Journal of African Art Education*, 1(2), 21–43.
- Sharma, R. (2017). *Computer-assisted instruction: A new approach*. Pearson.
- Shyu, H. Y. (2000). The effects of computer-assisted instruction on high school visual arts students' learning outcomes. *Journal of Educational Technology Systems*, 28(3), 201–215.
- Silverman, L. K., & Casazza, M. E. (2000). *Learning styles and strategies for gifted learners*. Prufrock Press.

- Singh, R., & Rana, A. (2004). *Teaching methods and instructional strategies*. APH Publishing.
- Skinner, B. F. (1953). *Science and human behavior*. Macmillan.
- Skinner, B. F. (1968). *The technology of teaching*. Appleton-Century-Crofts.
- Smith, M. K., & Blake, J. (2005). *The learning organization*. The Encyclopedia of Informal Education.
- Smith, T. A., & Lowrey, K. A. (2017). Accessible technology in the arts classroom. *Art Education*, 70(3), 10–15.
- Stebbins, R. A. (2001). *Exploratory research in the social sciences*. Sage.
- Stuckey, H. L. (2015). The second step in data analysis: Coding qualitative research data. *Journal of Social Health and Diabetes*, 3(1), 7–10.
- Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What makes technology effective in schools? A meta-analysis of studies on instructional technology and student achievement. *Computers & Education*, 56(4), 1147–1153.
- Taylor, C., & Gibbs, G. R. (2010). *What is qualitative data analysis (QDA)?*
- Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education*, 59(1), 134–144.
- Trucano, M. (2016). *Smarter education systems: Realizing the promise of technology in schools*. World Bank.
- Tuckman, B. W. (1999). *Conducting educational research* (5th ed.). Harcourt Brace College Publishers.
- UNESCO. (2020). *Global education monitoring report: Gender report – A new generation: 25 years of efforts for gender equality in education*.
- Van Merriënboer, J. J. G., & Kester, L. (2014). The four-component instructional design model: Multimedia principles in environments for complex learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed., pp. 104–148). Cambridge University Press.

- Vanderpuye, I. (2013). *Qualitative data analysis in educational research* [Unpublished manuscript].
- Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education, 24*(1), 80–91.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Wang, F. (2011). Blended learning in art education: A case study. *Computers & Education, 56*(3), 637–645.
- Watling, J., & James, C. (2012). *Research methods in education: A practical guide*. Routledge.
- Watson, J. B. (1913). Psychology as the behaviorist views it. *Psychological Review, 20*(2), 158–177.
- Wiersma, W. (1995). *Research methods in education: An introduction* (6th ed.). Allyn & Bacon.
- World Bank. (2021). *Ghana accountability for learning outcomes project (GALOP)*. World Bank Group.
- Yin, R. K. (2016). *Qualitative research from start to finish* (2nd ed.). Guilford Press.
- Yusuf, M. O., & Balogun, M. R. (2011). Student-teachers' competence and attitude towards information and communication technology: A case study in a Nigerian university. *Contemporary Educational Technology, 2*(1), 18–36.

## APPENDIX A

### INTERVIEW QUESTIONS

#### COMPUTER-ASSISTED INSTRUCTION USAGE IN TEACHING GRAPHIC DESIGN IN SENIOR HIGH SCHOOLS IN THE EASTERN REGION

##### INTERVIEW GUIDE

##### Introduction Script:

"Good morning/afternoon. Thank you for making time to speak with me. I am conducting research on how Computer-Assisted Instruction is being used in teaching Graphic Design in our senior high schools. Your perspective as a practitioner is incredibly valuable. Our conversation will take about 30-45 minutes. With your permission, I will audio record our discussion to ensure I accurately capture your insights. All information will remain confidential, and your identity will be anonymized in any publications. You may choose to skip any question or stop the interview at any time. Are you comfortable proceeding?"

##### Theme 1: Technology Access and Availability

1. "Could you walk me through the specific digital tools and resources you have available for teaching Graphic Design here?"
  - *Probe: What about design-specific software like CorelDRAW or Adobe Suite? Projectors? Reliable internet?*
2. "How would you describe the functionality and accessibility of these technologies on a typical teaching day?"
  - *Probe: Are they readily available when you need them? Are there many technical issues?*
3. "Can you describe the process of accessing the computer lab or other digital resources for your Graphic Design lessons?"
4. "Beyond school-provided resources, do you use any personal devices or software for teaching? If so, what prompts this?"
5. "If you could instantly add one technological resource to your classroom, what would it be and why?"

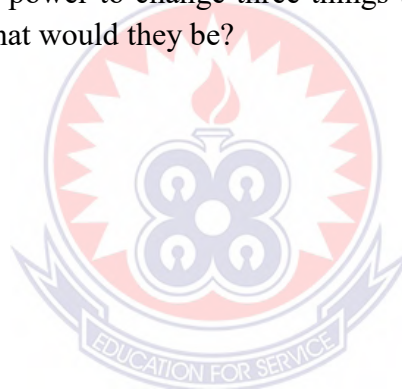
##### Theme 2: Teaching Practices and Integration

6. "Please describe a recent Graphic Design lesson where you successfully used computer technology. What did you and the students do?"
7. "How do you typically decide when and how to integrate digital tools into your lesson planning?"
  - *Probe: Are there specific topics or skills where CAI is most beneficial?*
8. "What teaching strategies do you find most effective when using CAI? For example, do you use demonstrations, project-based learning, or collaborative digital projects?"

9. "How has using CAI changed your role as a teacher in the Graphic Design classroom?"
10. "What kind of student learning outcomes have you observed when using CAI compared to traditional methods?"

### **Theme 3: Challenges and Support Systems**

11. "From your experience, what are the most significant challenges you face in using CAI for Graphic Design instruction?"
12. "What training or professional development have you received for using technology in teaching? What additional support would you find most helpful?"
13. "How supportive is the school administration and the general school environment for integrating technology into your lessons?"
  - *Probe: What about timetable structures and technical maintenance?*
14. "What are the main difficulties from a teaching perspective when using digital tools?"
  - *Probe: Curriculum alignment, assessment, large class sizes?*
15. "If you had the power to change three things to improve CAI use in Graphic Design here, what would they be?"



## APPENDIX B

### OBSERVATION CHECKLIST FOR CAI INTEGRATION IN GRAPHIC DESIGN CLASSROOMS

This observation checklist was developed to assess the extent to which Computer-Assisted Instruction (CAI) is integrated into Graphic Design lessons in selected Senior High Schools. The checklist focuses on infrastructural availability, instructional practices, teacher-student interactions, and the learning environment.

#### A. Infrastructure and Resources

1. Availability of functional computers in the classroom/laboratory.
2. Presence of CAI-related software (e.g., CorelDRAW, Photoshop).
3. Accessibility of projectors or other multimedia devices.
4. Availability of stable electricity supply.
5. Presence of internet connectivity.
6. Functionality of power outlets and extension boards.
7. Ratio of students to available computers.

#### B. Teacher Practices

8. Use of CAI tools (software, videos, digital images) during lesson delivery.
9. Teacher movement and interaction with students when using digital tools.
10. Use of personal devices (e.g., phones, laptops) for CAI demonstration.
11. Teacher familiarity with and confidence in using CAI.
12. Integration of CAI with traditional teaching methods.
13. Teacher support for student use of digital tools during class.

#### C. Student Engagement

14. Student participation during CAI-based activities.
15. Student attentiveness and enthusiasm during CAI sessions.
16. Student ability to independently operate digital tools.
17. Instances of student collaboration using CAI tools.
18. Student response to digital content compared to traditional instruction.

#### D. Learning Environment and Organization

19. Adequacy of classroom or lab space for CAI-based instruction.
20. Time lost transitioning between classrooms and ICT labs (if applicable).
21. Class timetable suitability for CAI integration.
22. Presence of technical support personnel or ICT coordinators (if any).

#### E. General Remarks

23. Observed challenges or disruptions during CAI use.
24. Notable best practices observed during lessons.
25. Suggestions for improving CAI implementation (researcher notes).

**Note.** Observations were conducted during scheduled Graphic Design lessons using a non-intrusive approach. Findings were recorded descriptively and used to complement data gathered from interviews.

## APPENDIX C

### SAMPLE LESSON PLAN: POSTER DESIGN FOR FORM 2 GRAPHIC DESIGN

**Table E1: Lesson without CAI**

*Two-Hour Lesson Plan on Poster Design*

**Topic:** Poster Design

**Class:** Form 2

**Class Size:** 43 students

**Duration:** 2 hours

**Objectives:** learners will be able to

1. Define poster
2. Design and make poster on a given theme

Time	Core Point	Teacher-Learner Activities	Resources	Evaluation
0–10 min	Introduction to Poster	Teacher greets students and introduces objectives. Learners share examples of posters.	Whiteboard, marker	Participation in discussion
10–25 min	Understanding Poster	Teacher explains poster components. Learners observe real samples and identify elements.	Poster samples, chalkboard	Q&A
25–45 min	Design Principles	Teacher reviews design principles. Learners analyze posters in groups.	Group worksheet, printed posters	Group worksheet submission
45–60 min	Planning Poster Concept	Teacher assigns theme. Learners brainstorm and sketch rough layouts.	Sketch paper, pencils, rulers	Review and approval of layout sketch
60–100 min	Poster Creation	Learners create posters using art materials. Teacher circulates and guides.	Poster paper, glue, markers, colored pencils	Observation and feedback
100–115 min	Gallery Walk	Learners display work and give peer comments.	Display space, masking tape, sticky notes	Peer feedback participation
115–120 min	Evaluation & Reflection	Teacher evaluates posters with rubric. Learners write reflections.	Rubric, writing materials	Poster collected and reflection reviewed

Note. This lesson plan was developed for classroom observation and instructional planning purposes. It was designed for a regular classroom setting using manual art tools and collaborative peer feedback strategies.

**Table E2: Lesson with CAI***Two-Hour Lesson Plan on Poster Design***Topic:** Poster Design**Class:** Form 2**Class Size:** 35 students**Duration:** 2 hours**Objectives:** Learners will be able to

3. Define poster
4. Design and make poster on a given theme

Time	Core Point	Teacher-Learner Activities	Resources	Evaluation
0–10 min	Introduction to Posters	Teacher facilitates a class discussion on what a poster is and its purpose. Learners share examples of posters they have seen.	Sample posters, projector	Oral responses, Q&A
10–25 min	Features of Effective Posters	Teacher presents visual elements (layout, typography, imagery). Learners analyze sample posters in small groups.	CorelDRAW poster samples, handouts	Group discussion summaries
25–45 min	Planning Poster Design	Learners brainstorm poster topics (e.g., school event, environmental awareness). Teacher demonstrates how to plan using thumbnail sketches.	Sketch paper, pencils	Individual thumbnails assessed informally
45–60 min	Introduction to CorelDRAW	Teacher introduces the	Computers, CorelDRAW	Q&A, navigation

	Interface	CorelDRAW workspace. Learners follow along with basic tools: text, shape, and color tools.	software	checklist
60–100 min	Designing Posters in CorelDRAW	Learners use CorelDRAW to create their posters. Teacher provides support and gives feedback as needed.	Computers, CorelDRAW	Ongoing feedback
100–115 min	Presentation and Peer Review	Learners present posters to peers in small groups and give constructive feedback.	Projector (optional)	Peer evaluation checklist
115–120 min	Wrap-up and Reflection	Class reflects on the design process. Teacher summarizes key learning points.	Whiteboard, markers	Exit ticket: What did you learn today?

Note. This lesson plan was developed for classroom observation and instructional planning purposes. It was designed for a regular classroom setting using CAI and collaborative peer feedback strategies.

## APPENDIX D

### ICT TOOLS USED IN GRAPHIC DESIGN TEACHING

**Figure D1**

*Projector used to display CorelDRAW interface during classroom instruction.*



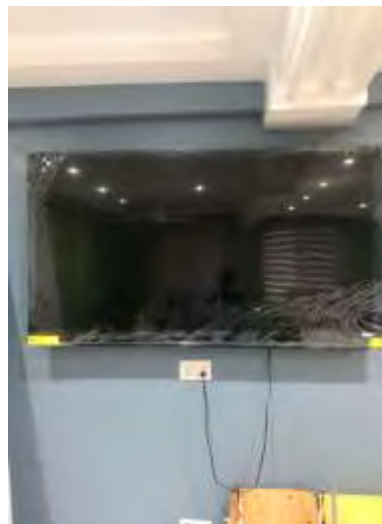
**Figure D2**

*Desktop computer lab where students practiced poster design.*



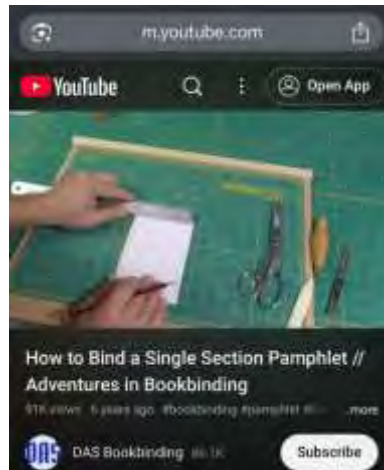
**Figure D3**

*Interactive Screen used for digital sketching and illustration.*



**Figure D4**

*Multimedia video during lesson delivery.*



*Note.* “How to bind single section book” [video] by Dash Bookbinding, 2019, December 15, 0:07:20.



## APPENDIX E

### SAMPLES OF POSTER DESIGNS (MANUAL AND DIGITAL)

This appendix contains selected samples of poster designs created by students as part of their Graphic Design coursework. The works are categorized into manual and digital formats. Manual designs were created using traditional art tools such as markers, pencils, and paper, while digital designs were produced using CorelDRAW. Manual Poster Designs

**Figure E1**

*Student Manual Poster Design 1*



**Figure E2**

*Student Manual Poster Design 2*



**Figure E3**  
*Student Manual Poster Design 3*



**Figure E4**  
*Student Manual Poster Design 4*



Digital Poster Designs (CorelDRAW)

**Figure E5**

*Student Digital Poster Design 1*



**Figure E6**

*Student Digital Poster Design 2*



**Figure E7**  
*Student Digital Poster Design 3*



## APPENDIX F

### IMAGES ILLUSTRATING BARRIERS TO IMPLEMENTING COMPUTER-ASSISTED INSTRUCTION (CAI)

This appendix provides visual evidence of some key challenges encountered in the implementation of CAI in Graphic Design education. These images were taken from selected classrooms and highlight both infrastructural and practical barriers faced by teachers and learners.

**Figure F1.**

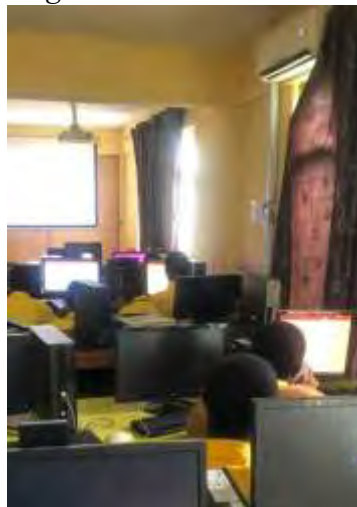
*Inadequate ICT Infrastructure in Visual Arts Classroom*



*NOTE:* This image shows a regular classroom setting where Graphic Design lessons are conducted without access to computers, projectors, or internet connectivity, limiting the potential of CAI integration. Photo taken at School A with permission

**Figure F2**

*Graphic Design Classroom with ICT integration*



*Note:* Photo of more than one student using one desktop computer. Photo taken with permission at School B