DEVELOPMENT OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) MODULAR FRAMEWORK FOR THE DEPARTMENT OF INDUSTRIAL ART (DIA), KNUST

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DECLARATION

I hereby declare that this submission is my own work towards the Doctor of Philosophy in Art Education and that, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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ABSTRACT

The study developed ICT Modular framework to provide a holistic ICT-based training of students at the Department of Industrial Art (DIA) of the Kwame Nkrumah University of Science and Technology, Kumasi. The framework was formulated on the basis that the current interdisciplinary computer-based modules in the Textiles, Metal Products Design and Ceramics programmes run by the Department lack the needed software and courseware application programmes in content, instruction, course structure and description. Also, the computer-based modular course lacks educational experience in scope and sequence. There is no coherent and comprehensive framework on ICT literacy to reflect the much talked about ICT-based education. The study employed a classical curriculum model design for the examination of the computer-based modules in the programmes of DIA curriculum, and the development and implementation of the ICT Modular Framework. The current modules were examined in view of scope, sequence and methodology of instruction. Interview guide was used to collect remote data from stakeholders in triangulation to questionnaire which was the main technique of data collection. Main findings of the examination of the current modules recommended the development of the ICT Modular Framework. This was pretested using the behavioural objective domains, true-experimental design and checklist for purpose of recommendations and integration. The study revealed two major findings. The first set of findings revealed that the current interdisciplinary computer-based modules should be reviewed to meet prevailing conditions. The second set of findings established that the proposed framework upon pre-test served as a constructive model for teaching and learning of ICT at the Department of Industrial Art, KNUST. The framework provides mastery learning approach to teaching and learning of ICT. This conscientiously focuses on

consistency, sequence and subject relevance. The framework is highly significant to other Visual Arts Disciplines at the tertiary level, as it serves as a multi-modal approach to teaching and learning of ICT. It also serves as a vehicle to encourage creativity and creative thinking of learners, using ICT tools.

TABLE OF CONTENTS

CHAPTER THREE

EXAMINATION OF THE EXISTING ICT MODULES IN THE PROGRAMMES OF THE DEPARTMENT OF INDUSTRIAL ART (DIA), KNUST

CHAPTER FOUR

METHODOLOGY

CHAPTER FIVE

DISCUSSION OF FINDINGS

CHAPTER SIX

PROPOSED ICT MODULAR FRAMEWORK FOR THE DEPARTMENT OF INDUSTRIAL ART, KNUST

CHAPTER SEVEN

PRETEST OF THE PROPOSED ICT MODULAR FRAMEWORK (IMF) FOR THE DEPARTMENT OF INDUSTRIAL ART (DIA), KNUST

CHAPTER EIGHT

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

LIST OF TABLES

Page

LIST OF FIGURES

LIST OF PLATES

Page

LIST OF APPENDICES

Page

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

With respect to recent globalization, economies, educational and business institutions are growing steadily in all their endeavours. These are believed to have stemmed from the integration of Information and Communication Technology (ICT) in their operations. In 2002, a Committee on Review of Education Reforms in Ghana was tasked to evaluate the entire educational system in the country in order to make it more responsive to current challenges, taking into consideration recent globalization which is still unfolding. The Committee reviewed the constrained access to ICT, Distance Education, Library and Information Services, Science and Technology, in addition to other cross-cutting issues concerning the delivery of education in Ghana (WPER, 2002).

In the light of these constraints, Ghana could only be projected into the 21st century through the integration of ICT into all spheres of national development effort. The Committee in its review attached value to ICT education among other recommendations which were laudable to the Government. Some action towards the incorporation of ICT in various spheres of government machinery and education has been initiated. It was against this backdrop that the Kofi Annan Centre of Excellence in Information Technology (IT) was established to promote IT education and usage in the country's development efforts.

Besides, there have been numerous efforts in the education sector by the Kwame Nkrumah University Science and Technology (KNUST) to produce high-level manpower with special skills in Science and Technology to act as vehicle for the

technological development of the country. In the KNUST's Corporate Strategic Plan-PLAN2K14 (2005) and ICT Policy (ICT4KD, 2006), a number of plans have been put in place to beef-up the use and application of ICT in education and administration of the university. These plans however could not see the light of day as a result of difficulty in raising funds to resolve the inadequacy in infrastructure. Consequently, in the university's plan matrix, strategies have been instituted to expand the IT infrastructure and institutionalize its application in the business of the university; integrate the use of IT in teaching and learning; establish computer laboratories in the colleges, halls and hostels where students can readily put to use their ICT skills. These efforts are geared towards the advancement of knowledge in Science and Technology for sustainable development in Africa by the year 2014 (KNUST-PLAN2K14, 2005).

The ability of our country to compete and face the challenges of the 21st century, undoubtedly, depends on the quality of tertiary education. In an increasingly scientific and technological world, no country can afford to ignore the importance of quality and technology-based education. The ICT revolution has had a tremendous impact on the rapid development of world economies and making national economies more interdependent than they were some years ago. With the trends of recent Reform efforts, ICT fits into the scheme of revolutionizing education in Ghana.

Therefore, it is imperative that students at the tertiary level should be given technology-based education. In addition, there should be the requisite knowledge, skills and competence in ICT applications, to meet the high-level manpower required for national development. Significantly, the current computer-based modules run by the Department of Industrial Art (DIA) of KNUST are woefully inadequate and lack the needed computer application programmes and instructions required for their operation. There are discrepancies between the DIA's mission to produce properly

trained graduates with the requisite knowledge and skills for today's technology-based industries (VCR, 2006), with that of the interdisciplinary courses taken in Computer Literacy from other departments. These necessitated the development of an ICT Modular Framework for the Department of Industrial Art, KNUST.

1.2 Statement of the Problem

The Department of Industrial Art is responsible for the training and production of high-level manpower in the respective disciplines (Textiles, Metal Products Design, and Ceramics) for the Ghanaian economy. The mission of the Department is to produce properly trained graduates with the requisite knowledge and skills for today's technology-based industries. But as far as the current curricula structures, content and instruction are concerned, achieving the ICT missions and goals of the university remains a mirage.

It is common knowledge now that the ICT aspect (interdisciplinary computer-based modular course) of the department's curricula has been almost neglected for a long time; leading to inadequate assessment and learning outcomes in the ICT related courses. This undoubtedly defeats the very essence of a culture of excellence, leadership in innovation and technology, which the university seeks to espouse. Besides, there is no comprehensive framework on ICT leading to misdirected priorities in the educational experience of students. A specific case in point bothers on the Computer-Aided Manufacturing (CAM) aspect of the curricula; where students are expected to be taught Computer-Aided Design (CAD) and CAM processes. A casual investigation will attest to the fact that these modules have been neglected and in most cases not taught at all. The current modules lack the needed application programmes (software) in content, course outline and description for the three Visual

Arts programmes. Above all, the modules are not flexible, dynamic and adaptable enough to meet the ICT literacy needs of students and to reflect the modern day technology-based education.

In view of these, it is expedient to review the interdisciplinary computer-based modular course in line with the university's wider vision of advancing knowledge in science and technology for sustainable development in Africa, to develop a holistic Information and Communication Technology Modular framework for the Department.

1.3 Objectives of the Study

- To examine the existing computer-based modules in the programmes of the Department of Industrial Art, KNUST.
- To design a comprehensive and coherent ICT Modular Framework for the Department of Industrial Art, KNUST.
- To pretest the proposed ICT Modular Framework developed for the Department of Industrial Art.

1.4 Hypothesis

The development of the ICT Modular Framework for the DIA, KNUST will provide a holistic ICT-based training of students for today's technology-based industry, institution, society and the knowledge-based economy.

1.5 Delimitation

The scope of this research is limited to the Department of Industrial Art, KNUST-Kumasi. The department has three constituent Sections which offer Textiles, Metal Products Design and Ceramics. The development of the ICT Modular

Framework covers Textiles, Fashion Design and Clothing, Metal Products Design and Ceramics.

1.6 Limitation

The most noticeable limitation of the data collected in this study has been the concern that the researcher served as a subject teacher and pretested the framework at DIA all alone, this could result in bias of findings.

1.7 Definition of Terms

Information Technology - Processing and distribution of data using computer hardware and software, telecommunications, and digital electronics.

Information and Communication Technology (ICT) - Is defined to cover any product that will store, retrieve, manipulate, transmits or receives information electronically in a digital form.

Curriculum - Curriculum (plural curricula) is the set of courses and their content offered by an institution such as a school or university.

Modular Course - A modular course is defined as a part of the main course that can stand alone. The topics are related and when combined with all other parts, become the entire course.

Computer Literacy - Knowledge and understanding of computers combined with the ability to use them effectively.

Department of Industrial Art - Consists of Textiles, Metal Products Design, and Ceramics Sections.

Curriculum Development - Is the term used to describe the construction of a curriculum.

E-Learning – Is any virtual act or process used to acquire data, information, skills or knowledge, to enable learning.

1.8 Abbreviations

CAD	Computer-Aided Design
CAM	Computer-Aided Manufacturing

CAL	Computer-Assisted Learning
CBE	Computer-Based education
CBL	Computer-Based Learning
CBT	Computer-Based Training
DCD	Department of Communication Design
DIA	Department of Industrial Art
ICT	Information and Communication Technology
IMF	ICT Modular Framework
IT	Information Technology
MS	Microsoft
PBL	Problem-Based Learning
MPD	Metal Products Design
FDC	Fashion Design and Clothing
UEW	University of Education, Winniba

1.9 Importance of the Study

The significance of this study can be seen in the following:

1. Upon completing the framework, graduates should teach ICT at the second cycle institutions without any further ICT education qualification.
2. Integrating ICT tools into the curricula of Visual Arts Education, the proposed IMF in the curricula of the department will help produce the high-level manpower required for today's technology-based industries and institutions.
3. The research will contribute immensely to the Visual Arts education in the country with respect to the ICT knowledge and skills required by today's technology-based education.
4. Students who go through this programme should be able to exhibit proficiency in using their ICT skills to increase their productivity both on campus and as lifelong learners.

5. The study will serve as a resource to ICT educators, professionals and curriculum developers.

1.10 Arrangement of the Rest of the Text

Following the Chapter One, the Chapter Two discusses Review of Related Literature; Chapter Three examines the existing computer-based modules in the programmes run by DIA, KNUST. Chapter Four also discusses the Methodology which considers the research design, library research, population for the study, sampling, instrumentations, and validation and administration of instruments. Chapter Five covers analysis and discussion of data, and the main findings.

Chapter Six outlines the proposed IMF for DIA, KNUST. Chapter Seven discusses the pretest of the proposed IMF. Finally, Chapter Eight lays bare the summary of findings, conclusions and recommendations.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Overview

The scope of the Review of Related Literature is discrete in the following categories:

i. The Philosophical and Psychological foundations of ICT education in Ghana
ii. National philosophy and Policy on Education
iii. Philosophies and Theories of Education
iv. Some Curriculum Theories, Models and Development Processes
v. Computer-based Teaching and Learning Theories
vi. ICT Modules in Some Art-based Programmes
vii. Importance of ICT in Visual Arts Education (VAE) in Ghana
viii. Evaluation and Methods of Evaluating ICT Programme.

2.1 The Philosophical and Psychological Foundations of ICT Education in Ghana

2.1.1 Education Reforms

Over the past fifty years or so, there have been many attempts to reform the education system in a bid to improve access, quality and relevance. A number of commissions and review committees on education have made recommendations on how to improve the education system to make it more responsive to the needs of the labour market, to the promotion of culture and good citizenship, and generally to achieve national development goals. Some of these interventions include the Accelerated Development Plan of Education engineered by Dr. Kwame Nkrumah in 1951. In Post-Independence Educational Development, the Education Act of 1961 was enacted, the Kwapong Review Committee of 1966, and the Dzobo Review

Committee of 1974. The result of the work of the Dzobo Committee was the implementation of the Junior Secondary School concept of education and the logical extension to the Senior Secondary School (SSS) system which began in 1987.

However, in January 2002, the Government of Ghana appointed yet another education reform committee to review the 1987 reforms. The rationale was that the 1987 reforms have failed to meet the expectations of access, equity, quality and economic utility required of the education system. The 2002 Education Reform Review Committee was tasked to review the entire educational system to make it more responsive to national development needs. The review was also expected to address the current challenges of ICT education, among others. The Education Reform Review Committee completed its work in October 2002 and the Government had decided that the implementation of the new structure of education should begin in the 2007-2008 academic year (Afeti, 2006).

Moreover, President Kufuor noted that the reform was designed, among other things, to prepare the appropriate human resource in the form of skilled, technologically-advanced and disciplined workforce with the right ethics to service the growing economy (NERL, 2008). The Reform also acknowledged the mastery of ICT as a priority and that skills in ICT had become crucial for the survival of the global world, government would extend the national broadband backbone connectivity throughout the country to facilitate the development of ICT infrastructure in schools.

To this end, teaching and learning of ICT and its integration in other sectors of the education system must be embraced by all, because the rudiments of knowledge, training and skill are the manifestation of school education. The labour force of any economy is the product of school. Philosophically, the foundation for the nation's

involvement in the Information Age or the technological revolution has been established by government in its Education Reforms 2007 and the National ICT policy. Allotey (2000) argued that the nation has no excuse to boycott the technological revolution in the 21st century, because the indicators are glaring for any economic implementation. In a speech, he said:

> We paid the price of not taking part in the Industrial Revolution, because we did not have the opportunity to see what was taking place in Europe. Now we see that information and communication technology has become an indispensable tool. This time we should not miss out on this technological revolution.

In order not to miss out on the Information Age too, educational institutions have a fundamental role of making this concept achievable. With this, the conceptual framework of reconstruction of knowledge geared towards ICT in scope and sequence is needed right from the lower primary through to the tertiary institutions. Thanks to the Education Reforms 2007 for making ICT education compulsory in the primary, junior and secondary high schools.

Psychologically, policies have been instituted by the government for smooth implementation of ICT policies in all sectors of the economy. In education, a clearly thought-out and well implemented policy on the use of ICT in the education sector can help to prioritise school products of international standard; it also opens up possibilities for international collaboration of information sharing and research.

2.1.2 National ICT Policy

According to the National ICT Policy (2007), the Government of Ghana is committed to pursuing an ICT for Accelerated Development (ICT4AD) Vision, aimed at improving the quality of life of the people of Ghana by significantly enriching their

social, economic and cultural well-being through the rapid development and modernization of the economy and society using Information and Communication Technologies (ICTs) as the main engine for accelerated and sustainable economic and social development.

In achieving this vision, a number of frameworks have been instituted in the form of missions to fulfil the Ghana ICT4AD Vision. Notably among them, to transform Ghana into an information-rich, knowledge-based and technology-driven high-income economy and society; and to transform the educational system to provide the requisite educational and training services and environment capable of producing the right types of skills and human resources required for developing and driving Ghana's information and knowledge-based economy and society.

In this context, the Government acknowledges the key role that ICTs can play in educational delivery and training and the need for ICT training and education in Schools, Colleges and Universities. The Government further acknowledges the role that ICTs can play in education and need to improve the educational system as a whole (National ICT Policy, 2007).

In one of the consultative meetings prior to the policy formation, it was noted that there is the need to publish and make available the necessary textbooks to aid children and teachers in their learning and teaching sessions. It is important to train people to produce educational and training modules suitable for school children. Ghana's National ICT Policy offers us a useful model for accelerated development in economic and social resources. It is therefore vital that a national policy strategy should encourage the use of ICT to produce content that can support the economical and social activities of the nation. In the changing educational landscape, there is the need for ICT-based teaching and learning to be intensified at higher level of education

so that products from these institutions in their circles can promote ICT literacy in the educational setting. There is therefore the need to have a comprehensive ICT literacy framework to meet the ICT policy vision which this dissertation seeks to achieve.

2.2 National Philosophy and Policy on Education

Microsoft Encarta Dictionary (2008) expounds the meaning of philosophy in the following shades of opinion: is a set of basic principles or concepts underlying a particular sphere of knowledge; or a precept, or set of precepts, beliefs, principles, or aims, underlying somebody's practice or conduct. In addition, philosophy is the branch of knowledge or academic study devoted to the systematic examination of basic concepts such as truth, existence, reality, causality, and freedom. Philosophy (Lewis, 2007) is a belief (or system of beliefs) accepted as authoritative by some group or school or any personal belief about how to live or how to deal with a situation. Policy on the other hand, is a plan of action adopted by an individual or social group; or a line of argument rationalizing the course of action of a government (Lewis, 2007).

Fundamentally, a thin line can be drawn between philosophy and policy which is, when a plan of action becomes a guiding principle or precept upon which tenets or beliefs are drawn then there is a transition from policy to philosophy. In this vein, Education Reform is a policy, a plan of action rationalizing the course of action of a government to review its education system to meet prevailing conditions. In such a policy, certain concepts or aims are set. And out of the policy, the philosophy of the reform is formed.

There has been a continuing aim to make education in Ghana more relevant to the world of work after school, to rural development and modernization of the

predominantly agriculture- and knowledge-based economy, the need to promote national and cultural identity and citizenship. With time, policies on education have evolved in order to making it more relevant to current phenomena (White Paper on Education Reforms, 2002).

2.2.1 Education Reform 2007

It is believed that attaining excellence in our socio-economic activities as a country lies in both our human resource management and in appreciation of global phenomena. In this regard, making the educational system as an engine of growth for the economy necessarily required some proactive measures by stakeholders to make the education system reflect current challenges such as ICT education. Therefore, frameworks are required to serve as a policy direction in achieving these challenges. It is in this view that this research was carried out.

In the 2002 review committee report on the new Education Reform 2007, the committee proposed a new philosophy of education for the country. The committee is of the view that the philosophy underlying the education system in Ghana, "creation of well-balanced (intellectually, spiritually, emotionally and physically) individuals with the requisite knowledge, skills, values and aptitudes for self-actualisation and for the socio-economic and political transformation of the nation". Ideally, this philosophy of education holistically looks at human development from mental, physical and spiritual points of view. However, moving away from the culture of self-reliance which emanated from Dr. Nkrumah's days to a system of self-actualisation, puts Ghanaians on the edge of being not only self-reliant but becoming pacesetter for other nations. Indeed, this philosophy is responsive to current challenges.

Furthermore, the economies of the world are increasingly being shaped by scientific and technological advances, which have resulted in the emergence of what is now known as the knowledge-based economy. A large amount of human capital in all professions is needed to promulgate our socio-economic developmental agenda. Thus, the teaching and learning of ICT to complement the collective effort of other subjects of study are required in achieving the knowledge-based economy. As a result, there is the need to develop a holistic ICT modality in subject areas to produce the requisite human capital required by the 21st century's economies.

2.2.2 National ICT Policy on Education

According to the National ICT Policy (2007), the Government of Ghana is committed to pursuing an ICT for Accelerated Development (ICT4AD) Vision, aimed at improving the quality of life of the people of Ghana by significantly enriching their social, economic and cultural well-being through the rapid development and modernization of the economy and society using Information and Communication Technologies (ICTs) as the main engine for accelerated and sustainable economic and social development. This however serves as a standard and a policy direction to use ICTs as a tool in transforming the socio-economic activities of the people of Ghana. There is the need to produce human resource to meet the demands of the industry and society. This calls for reviews and restructuring of teaching and learning to reflect this policy direction.

In the policy statement, the government of Ghana has acknowledged the key role of ICT in educational delivery and in training and learning. To effectively harness the power of the new ICTs to improve learning, the following essential conditions must be met:

1. High quality, meaningful, and culturally responsive digital content must be available for teachers and learners.
2. Teachers must have the knowledge and skills to use the new digital tools and resources to help all students achieve high academic standards (National ICT Policy, 2007).

In meeting these essential conditions, this dissertation seeks to develop a comprehensive ICT modular framework for some Visual Art Disciplines which is also applicable to all Visual Art programmes at the tertiary level. Magda (2002), in his assessment of Ghana's readiness for ICT, explained that two out of five public universities in Ghana currently run programmes in ICT-related subjects. The university runs a combined Computer Science programme (that is, Computer Science with Mathematics, Computer Science with Psychology, among others) because of the lack of human resources available to teach. Interestingly, each university graduates approximately 50 - 60 students a year (Magda, 2002), this is woefully inadequate for the job market. Moreover, other universities that also provide degrees in computer science are Valley View University, Central University and Ashesi University all in Accra, with minimum outputs as compared to the public universities.

More to the point, the human capital needed by today's institutions, organisations and industries is far less than required. In the sense, ICT teachers are needed at primary, junior and senior high schools and some institutions such as Training Colleges, and Technical/Vocational institutions, among others, to teach ICT which is believed to be an engine of growth in any economy. To meet the government's policy of providing ICT education to every Ghanaian, remains a vision until enough human capital is injected into the economy by educational institutions to teach or introduce individuals to this new discipline. As a result, there is the need to

produce these professionals in all disciplines of study so that ICT education can be applied in all disciplines. With this, it is prudent to propose that the ICT aspect of every discipline should be revised in order to produce teachers or graduates who can handle courses or disciplines at the lower levels.

2.2.3 Other Policies

In providing a holistic education to enhance learning, socializing and communications skills, the government has embarked on 'global information sharing system' since 1994 to provide internet services (Dankwa, 2007). With these developments, it is becoming increasingly clearer that all sectors of the economy could benefit from this idea of networking. Ghana can make gains both in education and in socio-economic activities.

Following the examples of other countries, especially the industrialized countries, it is clear that the education sector can have a big boost when schools are networked. It creates the enabling environment for information sharing which intend enhances teaching and learning, administration of school system and socializing among individuals and institutions.

In making education more accessible to all, the government in one of its policies waived the duty on instructional materials such as computers that are meant for educational purposes. As a result, there has been an influx of computers into the country which gradually helps to foster computer-mediated communication (Dankwa, 2007). This facilitates the delivery of ICT-based education, as computer and software constitute the main instructional material in this context.

2.3 Philosophies and Theories of Education

Philosophy considers the fundamental assumption of other branches of knowledge. When philosophy turns its attention to science, then it is philosophy of science, when it examines the basic concepts of the law, it is philosophy of law; when it deals with education, and then it is philosophy of education or educational philosophy (Kneller, 1971).

Kneller (1971) forwarded a more complete picture of relevance demystifying philosophy into modes. Nonetheless, he said that nothing illuminating can be said about philosophy with a single definition. Kneller therefore thinks of philosophy as an activity in three modes or styles that is, the speculative, the prescriptive and the analytic.

Speculative Philosophy is a way of thinking systematically about everything that exists. It is a search for order and wholeness, applied not to particular items or experience but to all knowledge and all experience. In brief, speculative philosophy is the attempts to find coherence in the whole realm of thought and experience.

Prescriptive Philosophy seeks to establish standard for assessing values, judging conduct and appraising art. It examines what one means by good and bad, right and wrong, beautiful and ugly. It seeks to discover and to recommend principles for deciding what actions and qualities are most worthwhile and why they should be so.

Analytic Philosophy focuses on words and meaning. The analytic philosopher examines such notions as ‘cause’, ‘mind’, ‘academic freedom’ and ‘equality of opportunity’ in order to assess the different meanings they carry in different contexts. Analytic philosopher tends to be sceptical, cautious, and disinclined to build systems of thought.

In line with these three modes of philosophy, acquiring knowledge from an educational experience has to be fully thought through in order to justify the kind of knowledge and for what purpose. In brief, developing a framework for knowledge acquisition speculatively must look at the shades of concepts and experience as a whole. The underlying principles for deciding what actions and qualities to establish standards are most worthwhile. This coupled with the analytic philosophy looks at such concepts as cause, mind, equality of opportunity among others, in order to assess the different semantics they carry in different contexts.

The task of educational philosophy is to bring students, teachers, school administrators, and curriculum specialists into face-to-face contact with the large questions underlying the meaning and purpose of life and education. To understand these questions, the student must wrestle with such issues as the nature of realty, the meaning and sources of knowledge and the structure of values. These bring students into a position from which they can intelligently evaluate alternative ends, relate their aims to desired ends and select pedagogical methods that harmonises with their aims.

Meanwhile, the philosophy behind ICT gives the students and beneficiaries the meaning and source of knowledge in which the world and its contents for that matter can be virtualised or simulated and projected into the future. ICT has made it clear that intelligence, knowledge and values which are scattered across the surface of the earth, can be restructured in the proximity of all people (the internet), thereby putting the world and its contents under one umbrella – global village.

2.3.1 Philosophy of Outdoor Education

Philosophy of Outdoor Education is also known as natural learning. According to Philosophy of Outdoor Education (2006), several researchers stated that the

elements of a philosophical basis for outdoor education can be found in the doctrines of Comenius, Rousseau, and Pestalozzi. In today's information age, philosophy of outdoor education harnesses the potentials of ICT by using the internet among others, to facilitate teaching and learning.

John Amos Comenius (1592-1670) was a strong advocate of sensory learning who believed that the learner should experience the actual object of study before reading about it. He thought the use of the senses - seeing, hearing, tasting, and touching, were the avenues through which learners come in contact with the natural world (*ibid*, 2006). Upon his theory, teaching and learning of ICT or eLearning can be efficiently and effectively taught and assimilated by learners, in that, eLearning is not theoretically oriented but more of praxis, requiring hands-on application for acquaintance.

Jean-Jacques Rousseau (1712-1778), though he paid his respects to Plato's philosophy, rejected it as impractical due to the decayed state of society. Rousseau had a different theory of human development - where Plato held that people are born with skills appropriate to different castes. Rousseau held that there was one developmental process common to all humans. This was an intrinsic, natural process, of which the primary behavioural manifestation was curiosity. He carried out the ideas of Comenius by educating the learner, according to principles found in nature. He believed that physical activity was very important in the education of a learner. Rousseau deems that learners are curious and this curiosity should be utilized to the fullest. And is upon this basis or curiosity that teaching and learning of ICT strives in a more effective and efficient manner. He asserted that education should be more sensory and rational; less literary and linguistic. Rather than learning indirectly from books, learners should learn through direct experience. However, He said that, "Our

first teachers are our feet, our hands and our eyes. To substitute books for all these, is but to teach us to use the reasons of others." This paradigm reiterates Comenius's theory of hands-on application for knowledge acquisition (Philosophy of Outdoor Education, 2006).

Johann Henrick Pestalozzi (1746-1827) emphasized the use of direct, first-hand experiences and real objects, also. In addition to "reading, writing, and arithmetic," students should be taught the practical skills such as farming, housekeeping, spinning and weaving. His methodology was based on the belief that the learner would use these beginning experiences at a later time to formulate principles and generalizations on his own. Pestalozzi, a follower of Rousseau believed that the learner should be taught by nature rather than by the teacher. In the sense, the individual will listen better, and the sense of freedom will give him more strength to overcome difficulties (Philosophy of Outdoor Education, 2006).

Other philosophers who embraced the cause of "learning by doing" ranged from Johann Frederick Herbart (1776-1841) and Herbert Spencer (1820-1903) in the 19th Century. In the 20th Century, philosopher-educators like John Dewey (1859-1952), Alfred North Whitehead (1861-1947), William Heard Kilpatrick (1871-1965), William James (1842-1910) and Rudolf Steiner (1861-1925) were precursors to modern theories of education aside legends such as Plato, Aristotle and the like (Philosophy of Outdoor Education, 2006).

2.3.2 Summary of Some Philosophers of Education

Plato is the earliest important educational thinker. Education is, of course, a relatively minor part of his overall philosophical vision, but it is an important one. He saw education as the key to creating and sustaining his Republic. He advocated

extreme methods that is, removing children from their mothers' care and raising them as wards of the state, with great care being taken to differentiate children suitable to the various castes, the highest receiving the most education so that they could act as guardians of the city and care for the less able (Philosophy of Education, 2008). The autocratic nature of Plato's philosophy should serve as a model approach to give ICT-based education to learners at all levels of education because of its relevance.

Aristotle wrote a treatise on education. He considered nature, habit and reason to be three equally important forces to be cultivated in education. For example, he considered repetition to be a key tool to develop good habits. The teacher was to lead the student systematically. Aristotle placed great emphasis on balancing the theoretical and practical aspects of subjects taught. He also mentioned the importance of play upon which most writers of ICT literature believed that ICT education strives on (Philosophy of Education, 2008).

Dewey John (1859–1952) was an American philosopher, psychologist, educational reformer and pragmatist, whose thoughts and ideas have been greatly influential in the United States and around the world. Dewey's ideal was espoused as a result of synthesis, critic, and expansion upon the democratic educational philosophies of Rousseau and Plato. He saw Rousseau's philosophy as overemphasizing the individual and Plato's philosophy as overemphasizing the society in which the individual lived.

For Dewey, it was vitally important that education should not be the teaching of mere dead fact, but that the skills and knowledge which students learn should be integrated fully into their lives as persons, citizens and human beings. This practical element "learning by doing" sprang from his subscription to the philosophical school of Pragmatism. Dewey criticized focusing on the outcome of learning at the expense

of the process, describing a strict emphasis on standards as an undesirable extreme. The central concept of Dewey's view of education was that greater emphasis should be placed on the broadening of intellect and development of problem solving and critical thinking skills, rather than simply on the memorization of lessons (Dewey, 2007).

2.3.3 Some Philosophies of Education

Kurtus (2001) argued that there is a philosophy behind every school system, based on the views and values of the educators, as well as the society that is sponsoring the education. The philosophy starts with the view of reality and definitions of truth and goodness. From this, the mission of the school and the emphasis of the instruction are established.

Educational philosophy seeks to comprehend education in its entirety, interpreting its concepts and relevance. Students construct knowledge when they are given the opportunity to discover and practice skills in authentic situations for themselves. For example, providing students access to hands-on activities and allowing adequate time and space to use materials that reinforce the lesson being studied, creates an opportunity for individual discovery and construction of knowledge to occur in this Information Age. The following are some ICT education related philosophies: Experimentalism, Essentialism and Progressivism.

2.3.3.1 Experimentalism

Experimentalism believes that things are constantly changing. It is based on the view that reality is what one experiences. It believes that truth is what works right now and that goodness comes from group decisions. As a result, schools exist to

discover and expand the society we live in. Students study social experiences and solve problems.

2.3.3.2 Progressivism

Progressivism has a respect for individuality. It is believed that people are social animals who learn well through active interplay with others and that an individual learning increases when he is engaged in activities that have meaning for him. In a progressivist classroom, teachers plan lessons to arouse curiosity and push the student to a higher level of knowledge. The students are encouraged to learn by doing and to interact with one another. This develops social virtues such as cooperation and tolerance for different points of view. In addition, students solve problems in the classroom similar to those they will encounter outside school, which provides them with the tools needed to become flexible problem solvers in preparation for adult lives. Progressivists believe that this approach to education is a perpetually enriching process of on-going growth (Shaw, 2008).

2.3.3.3 Essentialism

The term essentialism was popularized in the 1930s by the American educator William Bagley (1874-1946). In an essentialist classroom, Bagley urged that the most essential or basic academic skills and knowledge be taught to all students. Traditional disciplines such as Mathematics, Natural Science, History, Foreign Language, and Literature form the foundation of the essentialist curriculum. Essentialists frown upon Vocational, lift-adjustment, or other courses with "watered down" academic content. Even while learning Art and Music, subjects most often associated with the development of creativity, the students are required to master a body of information

and basic techniques, gradually moving from less to more complex skills and detailed knowledge.

Moreover, essentialists maintain that classrooms should be oriented around the teacher, who ideally serves as an intellectual and moral role model for the students. The teachers or administrators decide what is most important for the students to learn and place little emphasis on students' interests, particularly when they divert time and attention from the academic curriculum (Shaw, 2008). Reflecting upon the essentialist emphasis on subjects' integration for course mastering, in the 21st century, ICT-based Education has been considered essential and structured into the Ghanaian national curriculum.

In addition, these philosophies are based on a view of society and what is important, as well as other determinants such as politics. A combination of several of these philosophies may be the best route to take when developing a curriculum. But the philosophy of education in the 21st century must go beyond any educational tradition due to the presence of ICT-based education. The educational system is changing so fast that ICT-based education is required in all disciplines. ICT-based education fosters curriculum development around students' interest and cultivates intrinsic motivation and stimulates the passion to learn.

The three philosophies of education discussed correspond to the researcher's philosophy to train Visual Arts students with requisite ICT knowledge and skills in the attainment of the university's philosophy of culture of excellence and the National Policy on ICT for accelerated development. These three philosophies culminate the birth of a new order, where education has to move from the ordinary concept and context to a more evolved state that fashions itself to dispensations in retrospect. This new order brought the quest for information and knowledge at a click of a button. The

world flourishes in a pool of information, thereby making it a global village through the use of the Internet. In the light of this, a curriculum based on these philosophies will serve as a catalyst to produce the high-level manpower with requisite knowledge and skills required by today's technology-based industries and institutions.

2.4 Some Curriculum Theories, Models and Development Process

2.4.1 Curriculum Concepts

The idea of curriculum is hardly new but the way one understands and theorizes it has altered over the years and there remains considerable dispute as to meaning. Curriculum has its origins in the running/chariot tracks of Greece. It was, literally, a course. In Latin, curriculum was a racing chariot; 'currere' was to run. Educators use the term in variety of ways (Mednick, 2007).

Mednick (2007) defines curriculum as all the learning which is planned and guided by the school, whether it is carried out in groups or individually, inside or outside the school. In line with that, other schools of thought expound curriculum as the planned and guided learning experiences and intended learning outcomes, formulated through the systematic reconstruction of knowledge and experiences, under the auspices of the school, for the learners' continuous and wilful growth in personal social competence (Tanner, 1980, as cited in Madeus, and Stufflebeam, 1989). Besides, curriculum is a programme of activities (by teachers and pupils) designed so that pupils will attain as far as possible certain educational and other schooling ends or objectives (Grundy, 1987).

Nevertheless, one has the understanding that before an individual is taken through a learning experience - curriculum. The goals and the needs of the learner and the society are well thought out that is planned and guided with the learner and the society in focus. A Curriculum Model based on the work of Tyler (2007), a web

article buttressed and explained the needs of the learner as cognitive development, linguistic development, psycho-social development, moral/affective development and vocational focus. The needs of society are literacy, vocational skills, social order and morality; interpersonal skills, transmission of values and culture; creativity and innovation. The learner is then taken through a sequential or systematic reconstruction of knowledge and experiences, based on the curriculum structure of the school, to achieve the intended learning outcomes.

Dunn (1995), explained the word curriculum as "What schools teach; the combined experiences children undergo during schooling; a planned, sequenced series of experiences leading to ends that are sometimes known in advance and obtained with a maximum of teaching efficiency." Posner (1992) delineates six common concepts of curriculum in a succinctly organised manner:

1. Scope and sequence – the depiction of curriculum as a matrix of objectives assigned to successive grade levels (that is sequence) and grouped according to topic, theme or dimension (that is scope).
2. Syllabus – a plan for an entire course, typically including rationale, topics, resources and evaluation.
3. Content outline – a list of topics covered, organized in outline form.
4. Textbook – instructional materials used as the guide for classroom instruction.
5. Course of study – a series of courses that the student must complete.
6. Planned experiences – all the experiences that are planned by the school for students such experiences include academic, athletic, emotional, or social dimensions.

However, the definitions of curriculum amid the discussions point to the fact that curriculum definition is incomplete without the concomitance of planned teaching

and learning processes, with intended learning outcomes – goal and aims. Therefore, curriculum is the planned phenomena of teaching and learning students' experience, with learning outcomes such as the needs of the individual and the society, under the patronage of a school. Development of ICT Modules Framework for educational institutions like the university should encompass the following; teaching and learning of philosophy and psychology behind ICT, socio-economic impact; coupled with the needs of the learner and the society, thereby building a cognitive, moral and vocational personality of the learner for global integration and survival.

2.4.2 Types of Curriculum

The overt (rational) and the covert (hidden) are two types of curriculum often discussed in curriculum argument (Yakubu, 2000).

2.4.2.1 The Overt (Rational) Curriculum

Yakubu (2000) further postulates that the overt or rational curriculum is that which is explicitly and rationally designed. The designing of the overt curriculum is done by a body of competent stakeholders, which also involves the learners and the society. The learner is taken through a body of knowledge and skills which are formulated systematically to replace an empty mind with an open one. Its content includes subject such as Mathematics, Science, History, Language, ICT, Arts, among others. This type of curriculum uses curriculum design models such as Tyler's model, Traditional model, Classical model and System model. An overt curriculum, therefore states what the learning outcomes of the education process should be.

2.4.2.2 The Covert (Hidden) Curriculum

The covert or hidden curriculum is a set of attitudes, values and practices which a school places high premium on and tries to promote. Such attitude, values and practices are not written down but understood or taken for granted (Yakubu, 2000). In a different view, The World Book Encyclopaedia (2001) explains it as the total of experiences, attitudes, values and behaviours a student learns in school. The hidden curriculum may or may not be intentionally taught by teachers. Yakuba further contends that this is similar to the conventions of the constitution of a country which are not written down but are understood. One of the functions of the overt (rational) curriculum is to serve as a vehicle for the hidden curriculum. Examples of the constituents of a hidden curriculum are honesty, justice, humility, punctuality, hard work among others. Nevertheless, ICT apparently follows basic principles or rules of engagement as in any system approach model.

2.4.3 Curriculum as Content

Nacino-Brown, Festus and Brown (1982) described the meaning of content as the subject matter, ideas, skills or substance or what is taught. Content is presented to students as in instruction or teaching (method). Curriculum content refers to the nature of instruction and knowledge given to students at a particular time. It varies from stage to stage, from one year level to other. Curriculum content has scope and sequence which determines the flow of knowledge from the less difficult to most difficult level (The World Book Encyclopaedia, 2001). This however shapes the chronology of subject matter in terms of scope and sequence.

2.4.4 Curriculum Design Models

Yakubu (2000), construed curriculum design models to mean a body of theories. In that a theory is a rational formulation or a pattern to explain reality. Besides, Psychology Dictionary (2004) explained theory as a "general principle proposed to explain how a number of separate facts are related." The term curriculum model refers to an educational system that combines theory with practice. A curriculum model has a theory and knowledge base that reflects a philosophical orientation and is supported, in varying degrees, by educational evaluation. The practical application of a curriculum model includes guidelines on how to set up the physical environment for teaching and learning, structure the activities, interact with the learners and their families, and support staff members.

A Curriculum Model Based on the Work of Ralph Tyler (2007), explained that curriculum models should be based on the following ideals:

1. On a body of theory about teaching and learning.
2. Are targeted to needs and characteristics of a particular group of learners.
3. Outline approaches, methods and procedures for implementation.

In addition, Tyler postulates four imperative and fundamental questions which need to be answered before a worthwhile curriculum can be constructed. In this regard, Tyler's Model hangs on the following questions: What educational purposes should the school seek to attain? What educational experiences can be provided that are likely to attain these purposes? How can these educational experiences be effectively organized? Lastly, how can we determine whether and to what extent these purposes are being attained? These rubrics are important in the organisation of the

objectives, contents, scope and sequence and the pretest of the proposed IMF. The four questions are transformed into four principles as follows:

1. Aims and Objectives
2. Content
3. Organization
4. Evaluation

Figure 2.1: Tyler's Model of constructing a Curriculum

(Yakubu, 2000)

These principles are interrelated to form a linear model. Tyler (1949) believed that a curriculum design process ought to follow this linear progression. But some educationist like Denis Lawton (as cited in Yakubu, 2000) disagrees with this assertion of linear model for curriculum development. He stated that the model is linear and rather too simple, and evaluation is left until the end of the course, among others.

Notwithstanding, to further expound these concepts of curriculum design model, Tyler (1949) opines three important concepts underlying educational experiences need to be considered before developing a curriculum. These are the nature and structure of knowledge, the needs of the society, and the needs of the learner. With the nature and structure of knowledge - selection of subject matter, organization of subject matter or discipline and theoretical basis of methods and approaches must be considered. The needs of the learner on the other hand are cognitive development, linguistic development, psycho-social development,

moral/affective development and vocational focus. Parallel to that, the needs of society include literacy, vocational skills, social order and morality, interpersonal skills, transmission of values and culture, creativity and innovation. In what follows are some curriculum design models like Traditional, Hallowell, System and Classical models.

Traditional Model

The traditional model (Figure 2.2) represents curriculum as a content and method. The teacher, student and content do not interact which means that it is linear and there is always an imposition of concepts on the learner. That is traditional method is teacher-centred.

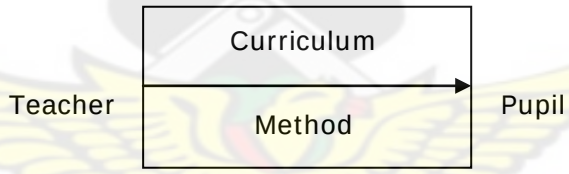


Figure 2.2: The Traditional Model of constructing a Curriculum
(Lawton, 1973 as cited in Yakubu, 2000)

This negates the theory proposed by Tyler which explained that the needs of the learner should be considered. This model portrays education as a static activity (Yakubu, 2000). This model does not demonstrate the dynamism of a curriculum, in that it shows no cybernetic interactions between the teacher and the learner in all stages of the curriculum construction. The idea of cross-checking to ensure that one is on the right path is not portrayed. The objectives of using this model to develop ICT-based modular course are not likely to be achieved to a greater extent because evaluation is done only at the end of the process.

Lawton (as cited in Yakubu, 2000) proposed an improved traditional design model (Figure 2.3) where the teacher, pupil and content should interact in an

educational process. The teacher should understand the needs of the pupil and then set the climate in which the pupil's learning of the content is facilitated. The pupils' difficulties and questions should serve as a cybernetic system between the teacher and curriculum, to modify and reorganize the learning of the content to become more relevant and interesting to the pupil. He added that such a theory should be derived from philosophical, sociological and psychological principles.

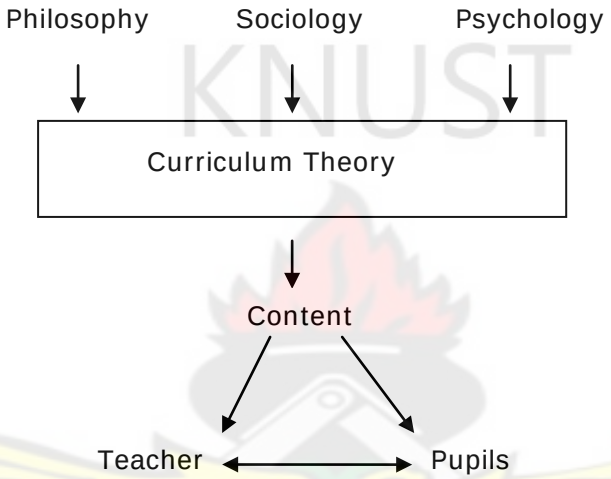


Figure 2.3: Improved version of the Traditional Curriculum Design Model
(Lawton 1973, as cited in Yakubu, 2000)

Hallowell's Model

Hallowell's model (illustrated in Figure 2.4) is another variation of Tyler's model. In this model, the ideas of interaction and cross-checking are represented. This model seems to be more pragmatic because it includes what should be done in the classroom. It is the achievement of the child that is important. Another ideal is the introduction of an in-built feedback mechanism so that methods, objectives and assessments can be adjusted.

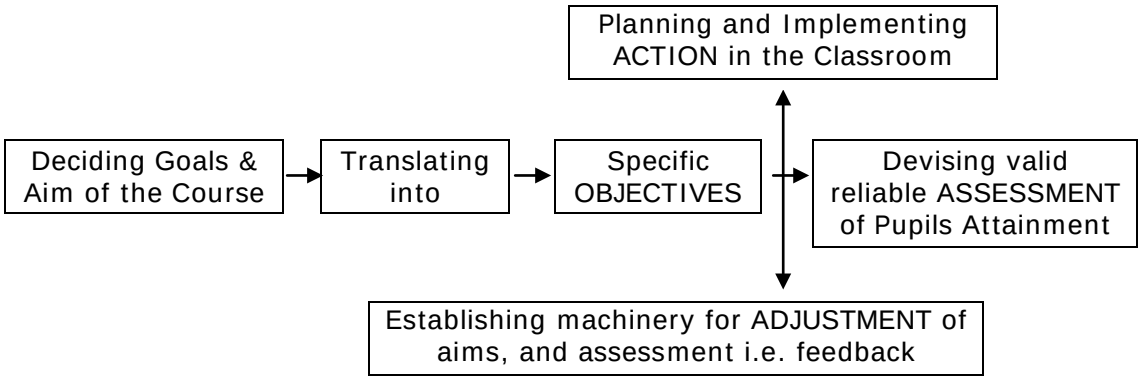


Figure 2.4: Hallowell's Model of constructing a Curriculum (Yakubu, 2000)

System Model

A system is defined as a set of interconnected elements which have been identified as worthy of isolation for consideration. It means that curriculum can be isolated as an entity for consideration. A system has the basic structure shown in Figure 2.5. The "INPUT" is the collection of "problems" needed to be transformed through the process of interaction to form an "OUTPUT" which is the "PRODUCT" or the educational experience or learning outcome.

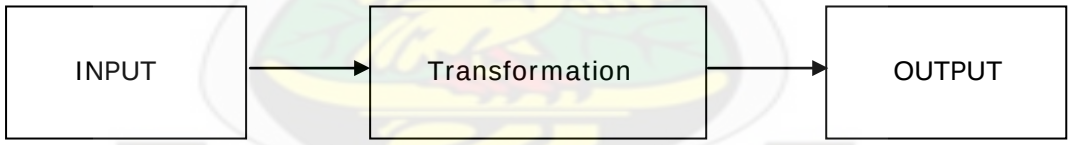


Figure 2.5: The Basic Structure of a System (Yakubu, 2000)

The system model or Baez model looks linear but in reality, it is not. The transformation area has a central portion which is linear but has checks and balances which interact to keep the process in the right direction. The system model is also a problem-solving one because it normally starts with a problem. This problem is subjected to a series of processes before a solution emerges. This model implies that curriculum construction should be problematized and should help in solving existential problems (Yakubu, 2000).

Classical Model

The classical model of constructing a curriculum is described as classical because it is used by many curriculum workers. The classical model (illustrated in Figure 2.6) seems to be practical. The entire society is considered and the teacher and pupils have significant roles to play through the comments they make. In other words, they participate in the curriculum design. Here again, there is a feedback mechanism to cross-check the process of the curriculum construction. This model is best used when a curriculum is under reconstruction as in the case of the researcher.

Figure 2.6: Linear Model of Classical Curriculum Model (Yakubu, 2000)

Besides these Models, there are others such as Montessori Method which is a curriculum model for children of preschool age and Reggio Emilia method emphasizes the involvement of children, staff, and parents in the learning experience. These models among others focus on child development involving a pedagogy

paradigm. The few selected curriculum design models discussed and illustrated give the idea that every model has its own views about what things are important in education. However, out of the models discussed, in this research, the researcher deems it necessary to use the Classical Curriculum Model for the development of the ICT modular framework because it meets the research objectives to evaluate, develop and pretest.

2.4.5 Curriculum Theories

Curriculum theory is a way of describing the philosophy of certain approaches to the development and enactment of curriculum. It is both a historical analysis of curriculum and a way of viewing current educational curriculum and policy decisions. There are many different views of curriculum theory including those of Kliebard, Schiro, Dewey, among others (Wikipedia 2007). The following is a synopsis of the curriculum theory perspective of Kliebard, which organized curriculum into four groups: Mental Disciplinarians, Social Meliorists, Social Efficiency Educators, and Developmentalists.

Mental Disciplinarians like Humanists believe in all students' abilities to develop mental reasoning and that education was not intended for social reform in itself but for the systematic development of reasoning power. Good reasoning power would lead to the betterment of society (Kliebard, 2004).

Social Meliorists believe that education is a tool to reform society and create change for the better. This socialization goal was based on the power of the individual's intelligence, and the ability to improve on intelligence through education (Kliebard, 2004). Some critics are of the view that Social Meliorists has goals that are difficult to measure and a product that has slow results.

Social Efficiency Educators (Theorists Ross, Bobbitt, Gilbreth, Taylor, and Thorndike) were aiming to design a curriculum that would optimize the "social utility" of each individual in a society. By using education as an efficiency tool, these theorists believed that society could be controlled.

Developmentalists focus attention to the development of children's emotional and behavioural qualities. Some critics claim this model is at the expense of other relevant factors. In orientation, the natural order of development in the child was most significant and scientifically defensible basis for determining what should be taught. The curriculum of the Developmentalists sought a curriculum in harmony with the child's 'real' interests, needs and learning patterns, thereby, using the characteristics of children and youth as the source of the curriculum (Mednick, 2007).

The researcher is of the view that the development of ICT-based modular framework for curriculum integration must be based on the Social Meliorists and Mental Disciplinarians theories. It is believed that education is a tool to reform society and the abilities to develop mental reasoning is the key to social reform. ICT-based education is an ever transforming tool in education and in the socio-economic activities of the 21st century man and thus, teaching and learning of ICT is paramount in the education system.

2.4.6 Curriculum as Syllabus to be Transmitted

Many people still equate a curriculum with a syllabus. Where people equate curriculum with a syllabus, they are likely to limit their planning to a consideration of the content or the body of knowledge that they wish to transmit, Kelly (1985) claimed. Syllabus, basically, means a concise statement or table of the heads of a discourse, or the subjects of a series of lectures. In another view, Microsoft Encarta

Dictionary (2008) defines syllabus as a summary or list of the main topics of a course of study, text, or lecture.

A syllabus will not generally indicate the relative importance of its topics or the order in which they are to be studied. In some cases as Curzon (1985) points out, those who compile a syllabus tend to follow the traditional textbook approach of an 'order of contents', or a pattern prescribed by a 'logical' approach to the subject. However, curriculum is a body of knowledge-content or subjects. The process by which these are transmitted or 'delivered' to students by the most effective methods is called education (Blenkin, 1992).

2.4.7 Curriculum as Product

The dominant modes of describing and managing education are today couched in the productive form. Education is most often seen as a technical exercise, a system approach to solving a problem. Objectives are set, a plan drawn up, and then applied, and the outcomes (products) measured. This shows the abilities, attitudes, habits, appreciations and forms of knowledge that men need. Tacitly, it forms the objectives of the curriculum.

More to the point, this approach to curriculum involves detailed attention to what people needed to know in order to work, live their lives and so on. In other words, the curriculum was not to be the result of 'armchair speculation' but the product of systematic study (Smith, 2000). In the university, curriculum as a product seeks to address two major objectives: firstly, to enable students to experience "deep" learning; and secondly, to facilitate the development of transferable skills. However, Tyler (1949) argued that the real purpose of education is not to have the instructor to perform certain activities but to bring about significant changes in the students' pattern of behaviour. It becomes important to recognize that any statements of

objectives of the school should be a statement of changes to take place in the students.

2.4.8 Curriculum Development Process

There are two models of curriculum development process that is central dissemination model and the periphery model. These models show how teachers and curriculum committee are predisposed to a curriculum process.

2.4.8.1 The Central Dissemination Model

In this model, a group of specialists form a central staff to prepare materials. The materials are sent to the schools and then returned to the central staff after a given period for assessment or evaluation. The teachers have to be trained to be able to use these materials. Orientation courses are organized for the classroom teachers and as matter of fact it is a time-consuming process. This renders this model somewhat ineffective.

The Central Dissemination Model seems to be common in most developing countries where the educational system is centralized. For instance, in Ghana, the Curriculum Research and Development Division (CRDD) of the Ministry of Education produces most of the curriculum materials for the first and second-cycle schools. Even though CRDD collaborates with teachers on syllabus and textbook writing, the initiative invariably starts with it rather that with the classroom teacher. When the initiative starts from somewhere outside the classroom then it is Central Dissemination Model. But when it is started by the classroom teachers on their initiative, then it is Periphery Dissemination Model (Yakubu, 2000).

2.4.8.2 Periphery Dissemination Model

In the Periphery Dissemination Model, teachers form small teams in their schools, and write the curriculum materials. The project staff act as consultants and edit the materials and send them back to the teachers. Moreover, in this strategy, in-service training is not necessary because the action starts with the teachers unlike the Central Dissemination Model. The work is broken down into units and each team concentrates on a unit. The periphery model is common in countries like Britain, among others, where the educational system is decentralized and teachers enjoy a measure of freedom in planning their own courses.

Since one of the problems of teachers in Ghana with regard to attending courses is that of transportation and travelling, this method looks recommendable (Yakubu, 2000). In this view, the researcher believes that this method is useful at the tertiary level to be specific the university, where departments design their own curricula and proposition made to the Academic Board of the University for approval. With this, the researcher intends to use the Periphery Dissemination Model of curriculum development and implementation to develop ICT integration modules for DIA, whose mission is to produce properly trained graduates (high-level manpower) with the requisite knowledge and skills for today's technology-based industries.

O'Hanlon (2007) presented brief descriptions of the management, systematic and open-access curriculum development models. These descriptions identified the decision-making bases, operational processes, evaluation requirement and curriculum control methods of each model.

2.4.9 Implementation of a New Curriculum

Designing a curriculum is the most exciting and creative part of curriculum development. However, the ultimate goal is not to design the best and ideal curriculum, but to implement it successfully. There are many conditions and requirements for successful implementation of a curriculum, which include the promotion of faculty members' ownership of the process of curriculum implementation and the allocation of adequate resources. Unequivocal support from the highest academic authority must be secured before starting to put a new curriculum into operation. Following the first phase of implementation of the new programme, a formal assessment must be carried out in order to adjust the process and to establish a link between institutional goals, courses and curriculum (Mednick, 2007). This phenomenon precedes the objective three of the study in that the IMF can be assessed upon implementation.

2.4.10 Curriculum Evaluation

Although evaluation of curriculum is the last step in this practical approach (curriculum development and implementation), it is not necessarily the final action. The evaluation of data collected must serve as criteria for adjusting the curriculum to meet the goals of the programme or the mission of a faculty or department. The most important message here is that a curriculum must be evaluated, corrected and go through repeated levels of innovation because it is not a static system. Feedback from teachers, stakeholders and students must continuously be taken into consideration so as to enhance the learning outcomes for the students. In this sense curriculum development is cyclic nature.

O'Hanlon (2007) explained that curriculum goals are generally stated in terms of what the school will do for the student. And evaluation is done by weighing this standard (Goals of the curriculum) against the evaluation data collected from teachers, students and society (graduates). Evaluation focuses in part on determining whether the curriculum that has been developed is being accepted by the teachers, citizens, and students of the school community. Evidence of the strength of the curriculum is sought through such means as comparing standardized test scores with national norms, following up graduates now in tertiary or in the industries. Imperatively, O'Hanlon added that evaluation evidence is not a prerequisite to the making of curriculum changes, that is, changes can be made without data showing the need for. When the curriculum development process itself is evaluated, it is usually for the purpose of determining its efficiency of operation. These discussions provide theoretical implications for this research.

2.5 Computer-Based Teaching and Learning Theories

Although human beings have survived and evolved as species partly because of capacity to share knowledge, teaching as a profession did not emerge until recently. The societies of the ancient world made substantial advances in knowledge and its governance, however, were those in which specially designated people assumed responsibility for educating the young ones (Ryan, 2006).

Nacino-Brown, Festus and Desmond (1982) concurred that human society functions by its members performing certain roles in the community. The skills needed to perform these functions or roles do not come naturally but have to be taught and acquired through teaching and learning. In effect, teaching and learning go together or are like the opposite sides of a coin. In traditional society, the task of

directing formal education of the young ones was the responsibility of the elders. But as technological and industrial developments began to influence and change the nature and value of rural and urban communities, the role of teaching was passed on to professional teachers.

2.5.1 Concepts of Teaching

Teaching is the act, process, or art of imparting knowledge and skills through education, instruction, pedagogy, andragogy, schooling, training, tuition, tutelage, and tutoring (Teaching, 2007). Ryan (2006) also argued that teaching is a systematic presentation of facts, ideas, skills, and techniques to students. In congruence, the first definition encompasses wider spectrum to the meaning which involves all sought of instructions leading to knowledge impartation, regardless of where one finds himself/herself, in school, organisation and vocational centres. Knowledge acquisition does not only occur in or is the preserved of school milieu but rather, teaching is an ever on-going process in the lives of every living thing. For example, all over the world progenies are taught by their parents through day-to-day phenomenon of activities.

These however, form the rudimentary foundation for systematic presentation of knowledge and skills to the young ones which is expedient in the school settings. Besides, Ryan's definition depicts teaching in school environment in that teaching is an act or art but when it becomes a systematic principle then certain guiding principles come into play and this operates within a school setting.

Subsequently, Nacino-Brown, *et al.,* (1982) confirm that teaching has often been used loosely to give the impression of single unitary process to which a general theory could be applied. But that notwithstanding, to them, teaching embraces many

kinds of processes, behaviour and activities that no single theory can explain adequately. Teaching has been defined as an attempt to help someone acquire, or change, some skill, attitude, knowledge, idea or appreciation.

Teaching can be defined as the science (art, process, act) of transferring knowledge, skill, moral, and cognitive applications from one generation to another, under the auspices of designate environment such as school, organisation and domestic setting. Meanwhile, teaching itself occurs in all professional and in domestic settings, everyone is involved to some extent in teaching those around them. People preserve the achievement of their generation by passing on to their children the experience they have gained and thus enable the young to begin where they (the old) left off. Teaching serves as a link between these two phenomena of generations. Undoubtedly, without this each generation would be compelled to begin life all over again. There would be no continuity and growth from one generation to the next without the transfer of knowledge and expenses from one generation to another.

According to Teaching (2007), Germany introduced the first formal criteria for the education of teachers in the 18th century. In the 19th century, as societies became more industrialized, the concept of schooling became more universal. In Ghana, teacher-training institutions can be found in all regions to consolidate the ever growing technological phenomenon to produce skilled labour for the teaching profession. Likewise, the teaching of students to embrace the information age is imperative for the sustainability of our society and economy

In this discourse, the meaning of teaching is incomplete without making reference to learning, education, content and method. Learning is the acquisition of knowledge or developing the ability to perform new behaviours. It is common to think of learning as something that takes place in school, but much of human learning occur

outside the classroom, and people continue to learn throughout their lives (Mazur, 2006). Naturally, the teacher's task is to create desirable changes in behaviour of his students.

John Dewey (as cited in Nacino-Brown *et al.*, 1982) maintains that in order to say one has taught, some changes in student behaviour should have taken place, which means that there is always a concomitance. Further, the only valid criterion of successes in teaching is the degree to which the teacher has been able to achieve this learning in his students. Here, a dichotomy has been drawn between teaching and learning, in that it is necessary to have a learner in order to teach, and it is not necessary to have a teacher in order to learn. People often do learn many things on their own without the aid of a teacher.

However, Nacino-Brown *et al.*, (1982) indicate that education is the initiation into activities and modes of thought that are worthwhile. But they also believe that there are two sides to the meaning of education, at one end of the scale, is the older view which refers to just any process of bringing up or rearing. What is lacking in this concept is the developing of understanding and modes of thought in the learner which are desirable. Being initiated into family or cultural traditions which involves no critical thinking and analysis, but only memorising or copying cannot be called education. Moreover, the recent and more specific concept is the development of states of a person that involve knowledge and understanding in depth and breadth that they desire.

More to the point, education implies that a person has achieved or will achieve a state of mind characterised by a mastery of and a care of worthwhile things viewed in some kind of cognitive perspective. Content on the other hand, can be described as the subject matter or syllabus, idea, skills or substance of what is taught. It is a very

important part of curriculum development. Method is the manner in which the content is presented to the students. Content and method are integral part of the teaching process.

2.5.2 Teaching Methods

A teaching method is seldom used in a teaching process. In a typical classroom lesson, an effective instructor normally uses more than one method. For example, a demonstration is usually accompanied by a thorough explanation, which is essentially accompanied by a lecture method. As a teacher, one will find it necessary to use different methods of teaching to suit varying situations. Succinct

The interaction which takes place between students and teachers, there are varied ways in which contrivance of learning is effected. Hence, one of the most paramount issues which readily come to the fore in any teaching-learning interaction is how to effect learning. The processes through which learning is effected are the methods used. Ideally, these should be called teaching-learning methods but the common parlance is teaching methods (Tamakloe, Amedahe & Atta, 2005).

However, in a teaching-learning interaction when one takes a look at the continuum of the processes which take place, one is tempted to opt for the first proposition “teaching-learning methods”. This results from the fact that there are teachers and students in this interaction phenomenon. In the interaction, there is interplay of teacher activity and student activity. These two types of activity can be placed along a continuum where at one end teacher activity is dominant (lecture method) through to the other end where student activity predominates (discussion method).

Besides these two methods, there are series of methods which are characterized by dominance of student activity. Some of these are the project method,

the Dalton Plan, the problem-solving method, the study trip and discovery method. All these are examples of teaching-learning methods (Tamakloe *et al.,* 2005). There are some methods of teaching (the lecture, discussion, demonstration, project and study trip) that have been used for many years and these, according to Nacino-Brown *et al.,* (1982) are called 'Traditional Time-Tested Methods' because they stood the test of time. To an extent, some of these methods will be discussed in the following sub-sections.

2.5.2.1 The Lecture Method

The lecture method is one of the oldest methods of teaching. Long before printing was invented, the lecture method was the "core of Scholastic instruction" (Broudy, 1963 as cited in Tamakloe *et al.,* 2005). The lecture method is the most widely used form of lesson presentation. It is very important in every instructor's professional life. Lectures are used for the introduction of new subjects, summarizing ideas, showing relationships between theory and practice, and re-emphasizing main points. The lecture method is adaptable to many different settings, including either small or large groups. It may be combined with other teaching methods to give added meaning and direction.

Teaching methods (2007), for example, noted that the lecture method of teaching needs to be very flexible since it may be used in different ways. For instance, there are several types of lectures such as the **illustrated talk** where the speaker relies heavily on visual aids to convey ideas to the listeners. With a **briefing**, the speaker presents a concise array of facts to the listeners who normally do not expect elaboration of supporting material. During a **formal lecture**, the speaker's purpose is to inform, to persuade, or to entertain with little or no verbal participation by the

students. When using a **teaching lecture**, the instructor plans and delivers an oral presentation in manners that allow some participation by the students and help direct them toward the desired learning outcomes.

In view of these, Lowman (1984) has isolated various forms of the lecture method such as the "formal oral essay" which is of the old order, "provocation lecture", "lecture-demonstration", "question-lecture", "lecture-discussion", "lecture-recitation" and the "lecture-laboratory". In the **provocative lecture**, the teacher raises issues regarding knowledge which students have already acquired, evaluates it and attempts to help the students get a higher order cognitive process of that knowledge.

In the **lecture-demonstration** (illustrated talk) the teacher makes increasing use of materials such as diagrams and charts to illustrate issues raised in the delivery. The teacher issues the illustrations to demonstrate how the issue could be conceptualized in a variety of frames. In that case, this form of lecture method is most appropriate for teaching students Computer-Based Training (CBT) programmes. CBT is the application of special training programmes on a computer relating to one's discipline. In the **lecture-question**, the teacher usually at the instance of the students allows questions to help students satisfy their curiosity and also to clarify points which may be baffling students.

Nevertheless, in the **lecture-discussion** method interaction between the teacher and students is brief and may be allowed only twice during the delivery. This ensures a smooth flow of the delivery and also to accomplish the task. The **lecture-recitation** variety is the one in which students are given the chance to expatiate on what they have been asked to read about and has been touched upon in the lecture. The last variation is the **lecture-laboratory** in which students are given the opportunity to do independent work, experiment and observe after a short lecture has

been given by the teacher as an introduction (Tamakloe *et al.,* 2005). Nacino-Brown *et al.,* (1982) however, concluded that the lecture method has no place in the primary school and is not frequently used in secondary schools, especially in the lower forms. But nowadays, the lecture method of teaching is being de-emphasised in universities, thereby making way for students' dominance in the teaching activities.

In merit, the lecture method has high inspirational and motivational valve. It is therefore an effective method for creating interest and appreciation. However, if the objective was to develop a skill then another method should be used. It supplements and enriches materials found in students' textbooks. On the contrary, it reduces students to passive recipients of ideas and does not encourage creative mind. It could at worst produce students who are mere listeners and not thinkers (Nacino-Brown *et al.,* 1982).

2.5.2.2 The Discussion Method

Broadly speaking, when two or more people interact with each other verbally, it means they are involved in a discussion. Like any other teaching method, during the discussion a number of pertinent issues are raised by the teacher for students to wrestle or ponder upon. In effect, it means that the teacher has taken into account the cognitive skills of the students' ability to cope with the issues at hand. It is believed that in this milieu of discussion, students make use of knowledge gained from previous learning experiences. More to the point, Tamakloe *et al.,* (2005) postulate that for an effective discussion to take place, the assumption is that the students have assimilated data from experience gained on a field trip, through experience from film and from a reading assignment.

Therefore, discussion method always dwells on a bulk of knowledge of the students in order to become effective. Based on students understanding and assimilation, a series of questions are asked to stimulate the discussion on the information acquired. This means that the students are given ample time to research and gather information prior to the discussion. According to Tamakloe, *et al.,* (2005) since the discussion method demands a great deal of reflective thinking on the part of students, invariably, the rate of transmission of information and achieving goals in the lesson can be very slow. And this obviously makes most teachers shy away from the discussion method. Hence, students of the lecture culture are prone to thinking that the discussion method is a time-wasting and show uninterested behaviour in the teaching-learning process.

However, the role of the teacher is paramount for effective discussion. The discussion method has little input when it comes to teaching-learning of computer-based education. Most of the issues that might have arisen during the use of software in class, apparently, had been tackled by the software producers and they constantly improve upon it in versions when notable future problems are foreseen and addressed. It should be emphasized that in the context of computer-based training, the lecture method is paramount but in the context of CBL the discussion method is appropriate.

Notwithstanding, the discussion as a method of teaching has these to offer; it tends to make students more tolerant as they become aware of different views which they may have to accommodate, and when individuals share ideas as a group, they are much more likely to correct deficiencies in evidence and reasoning than they could on their own. On the other hand, it does not easily lend itself to all types of subjects or topics. The choice of a suitable topic is the problem of the teacher. Also, it is difficult

to achieve maximum interaction when the group is large (Tamakloe *et al.*, 2005; Nacino-Brown *et al.,* 1982)

2.5.2.3 The Demonstration Method

Nacino-Brown *et al.*, (1982) defined demonstration as an audio-visual explanation, emphasising the important points of a product, a process or an idea. In effect, it is basically an activity which combines telling, showing and doing for the benefit of an audience, be it a person or a group of persons. It is used in relation to other approaches to teaching as a special technique. Thus in the discovery approach, the teacher initiates the process for example by introducing students to the tools in an application and allowing them to manipulate and explore more potential skills in their applications or usage. In the light of this students are able to discover and formulate concepts which aid experiential learning. Because demonstration combines telling, showing and doing which is the most appropriate teaching method in a Computer-Based Learning (CBL) concept and context.

CBL refers to the use of computers as a key component of the educational environment. Broadly, it refers to a structured environment in which computers are used for teaching-learning purposes. Nacino-Brown *et al*., (1982) iterate that although the emphasis in demonstration is learning by observing, it is often followed by doing. The demonstration can be applied in subjects involving skill learning such as computer-based learning, technical and vocational education, and the sciences. Appropriately, demonstration method is necessary when teaching a skill, when materials and equipment are insufficient or when experimenting with dangerous chemicals or solutions in the case of sciences. It trains students to be good observers. Further, it is very effective as an introduction to skill learning. On the contrary, it

provides less opportunity for children to discover things or solve problems on their own. Also, when classes are big, problem of audibility and visibility may arise.

In effect, a combination of lecture, discussion and demonstration methods is deemed important for the purpose of this research. Teaching students with this blend of methods preferably does not only instruct but brings together telling, showing and doing.

2.5.3 Learning

Learning (2007) states that learning is the acquisition and development of memories and behaviours, including skills, knowledge, understanding, values, and wisdom. It is the goal of education, and the product of experience. In another view, Learning Theory (2007) also argued that learning is a lasting change in behaviours or beliefs that results from experience. The ability to learn provides every living organism with the ability to adapt to a changing environment. It concurred that learning is an inevitable consequence of living – 'if we could not learn, we would die'.

In view of these, learning can be defined as an act of acquiring knowledge to perform new behaviours or the act, process, or experience of gaining knowledge or skill. Because learning continues throughout one's life and affects almost everything one does, the study of learning is important in many different fields. Teachers need to understand the best ways to educate their students.

Nonetheless, there are different concepts and varied understandings to the meaning and definition of learning but as a matter of fact, learning can be cannoned into various concepts. In the Physiology of learning (thought), it is generally recognized that memory is more easily retained when multiple parts of the brain are

stimulated, such as through combinations of hearing, seeing, smelling, motor skills, touch sense, and logical thinking. However, repeating thoughts and actions are an essential part of learning. Thinking about a specific idea will make it easy to recall. This is the reason why reviews are such an integral part of education (Learning, 2007).

In scope, learning has no boundaries. Learners can learn at home or at school. Learning has become an on-going process that does not end in the classroom. Interesting enough, it has no borders because everyday situations pose opportunities to experience learning. Advancement in technology offer greater opportunities for lifelong learning experiences and educators must take advantage of it to train learners to become lifelong learners.

2.5.4 Learning Theories

Different theories of learning helped educational psychologists to understand, predict, and control human behaviour. It is the premise educators consider when designing a curriculum and applying them to instruction. A curriculum determines what and how the learning material should be taught. There are various ways of looking at learning theories. However, at the heart of every learning theory and its practical application is the student. Experiential learning is one way students learn through their active interaction with environment (that is through experiences gained).

Experiential learning (Experiential education): It is both a philosophy and methodology in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, and clarify values (AEE, n.d.). The outcome of student participation and involvement facilitates personal growth and "transfers learning" (Sachse, 2002). Students and

teachers engage in the learning process at the same time. The fact that students and teachers collaborate on learning, has a strong impact on both. This exchange of information encourages students to model the teacher for continued lifelong learning. Teachers play an important role in the students' learning. Imperatively, teaching of ICT (Computer-Based Learning) using experiential learning methodology puts the learner at an excellent position of knowledge acquisition. In effect, the learner has a hands-on learning ability, and this encourages individual participation in the learning procedure.

Moreover, Carl Rogers' theory of learning is based on the idea of lifelong learning. He discusses two kinds of learning: cognitive and experiential. The key distinction is that experiential learning addresses the needs and wants of the learner (Kearsley, 2004). Learning becomes meaningful and significant when the subject matter is related to the student's interests and needs. The culture and environment of the learner in concomitance has effect on the behavioural learning pattern of the student.

Behaviourism: The term behaviourism was first used by John B. Watson in the early 1910s. Later, B. F. Skinner expanded and popularized the behavioural approach. The essential characteristic of the behavioural approach to learning is that events in the environment are understood to predict a person’s behaviour, not thoughts, feelings, or other events that take place inside the person. Strict behaviourists believe that it is dangerous and unscientific to treat thoughts and feelings as the causes of a person’s behaviour, because no one can see another person’s thoughts or feelings. Behaviourists maintain that human learning can be explained by examining the stimuli, reinforces, and punishments that a person experiences. According to behaviourists, reinforcement and punishment, along with

other basic principles such as generalization and discrimination, can explain even the most advanced types of human learning, such as learning to read or to solve complex problems (Mazur, 2006).

Computational Learning Theory: Computational Learning Theory (2007) defined it in theoretical computer science, as a mathematical field related to the analysis of machine learning algorithms. It is traditionally referred to as the grammatical inference problem. In addition, computational learning theorists study the time complexity and feasibility of learning. In computational learning theory, a computation is considered feasible if it can be done in polynomial time. There are two kinds of time complexity results: Positive results - showing that a certain class of functions is learnable in polynomial time and Negative results - showing that certain classes cannot be learned in polynomial time.

However, the computer has been used as a metaphor for the human brain and its functioning. It uses a set of instructions preset by the computer programmer in consultation with other stakeholders and with the user or learner in view to facilitate teaching and learning. In recent times, this algorithm of teaching replaces the teacher in the classroom. Students are allowed to follow a set of organised computer instructions in the teaching learning process. Importantly, computers can be programmed to judge student input and to tailor lessons to each individual's level of mastery. This device is called teaching machines (Tiemann and Meyer, 2006). It is a mechanical device employed to present systematically programmed sequence of instruction to students.

Constructivist Learning Theory: This theory was put forward by Bruner (1960). Here, learning is an active process where learners construct new ideas through the use of their knowledge and understanding. The theory of knowledge must begin

with a consideration of the development of knowledge as an adaptive human response to environmental conditions aimed at an active restructuring of these conditions. Unlike traditional approaches in the theory of knowledge, this thought is seen as subjective and primitive out of which knowledge was composed (Bruner, 1960). Some teachers are adopting the constructivist approach because it is more learner-centred and provides a basis for CBL; in fact the paradigm shift in pedagogy now, which favours this approach.

Conversation Model of Learning: Laurillard (1993) argues that dialogue between teacher and student should be advocated, following from the Socratic method of question and answer. In theory, conversation theory was developed from the cybernetics framework by Pask (1975), and explains learning in living beings and machines. Its central tenet is that learning takes place from conversations, which operate at different levels such as natural language, object language and metalanguage.

Andragogy: Knowles (1984) defined andragogy as 'the science and art of helping adults to learn'. Andragogy (2007) on the other hand defines andragogy as the process of engaging adult learners in the structure of the learning experience. However, Knowles held the view that andragogy (from the Greek words meaning "adult-leading") should be distinguished from the more commonly used pedagogy (Greek: "child-leading"). Pedagogy is a theory of learning which focuses more consistently upon the learning of children. Andragogy approach is a form of experiential learning. Andragogy model of learning is practice at the tertiary level.

Instructionally, this family of theories relates to training. Gagne (1985), for example, argues that there are different levels of learning that require different types of instruction. He presents different types of learning including: verbal information,

intellectual skills, cognitive strategies, motor skills and attitudes. Moreover, learning theories serve as a theory for the curriculum developer whose plan is to structure learning experience for students. This paradigm guides them as to which learning theory best suits the content of knowledge to conjugate that the desired learning outcome expected will materialise. Learning theory simulates and conceptualise the activities in the classroom environment which intend benefits the students who are the consumers of these experiences. In effect, this phenomenon pays more attention to the behavioural changes expected in the students after successfully going through a programme.

2.5.5 Types of Learning

Habituation: In psychology, habituation is an example of non-associative learning in which there is a progressive diminution of behavioural response probability with repetition of a stimulus (Learning, 2007). It is another form of integration. An individual first responds to a stimulus, but if it is neither rewarding nor harmful the individual reduces subsequent responses. An example of this can be seen when a rural African child is first introduced to a concept such as computer application, because this phenomenon is not common in where he lives. Initially, he will react to it as though it was a predator. Soon he reacts less, showing habituation. So after series of lessons the child's reaction to it normalises and sees it as a user-friendly system.

Imprinting: Imprinting is the term used in psychology and ethnology to describe any kind of phase-sensitive learning, that is learning occurring at a particular age or a particular life stage (Learning, 2007). Encyclopaedia Britannica Online (2007) for example explains imprint as a form of learning in which a very young

animal fixes its attention on the first object with which it has visual, auditory, or tactile experience and thereafter follows that object.

It is well known that under certain conditions, newly hatched goslings and ducklings will follow and become socially bonded to the first moving object they encounter. Lorenz (as cited in Howard, 2003) employed the term "Imprinting" to describe the process by which the social bond was formed. Imprinting occurs in many species including man; it helps one to better understand a number of otherwise puzzling issues with respect to how individuals deal with each other and with children in terms of disposition.

Observational Learning: This occurs as a function of observing, retaining and replicating behaviour observed in others (Observational learning, 2007 November). Although observational learning can take place at any stage in life, it is thought to be particularly important during childhood. Observational Learning (2007, December) also expounds the meaning of observational learning as an observer's behaviour changes after viewing the behaviour of a model. An observer's behaviour can be affected by the positive or negative consequences - called vicarious reinforcement or vicarious punishment.

It further iterates that the observer will react to the way the model is treated and mimic the model's behaviour. When the model's behaviour is rewarded, the observer is more likely to reproduce the rewarded behaviour. When the model is punished, the observer is less likely to reproduce the same behaviour. Learning by observation involves four separate processes:

Attention - observers cannot learn unless they pay attention to what is happening around them,

Retention - observers must not only recognize the observed behaviour but also remember it at some later time,

Production - observers must be physically and intellectually capable of producing the act, and

Motivation - observers will perform the act only if they have some motivation or reason to do so.

Attention and retention account for acquisition or learning of a model's behaviour; production and motivation control the performance (Observational Learning, 2007, December). In curriculum, observational learning has the propensity to give students a chance to observe and model the behaviour that leads to a positive reinforcement. And in instruction, it encourages collaborative learning, since much learning happens within social and environmental contexts.

2.5.6 Approaches to Learning

Informal Learning: This occurs through the experience of day-to-day situations (Observational learning, 2007 November). In addition to that Smith (1999) explained informal learning as that which takes place outside a dedicated learning environment and which arises from the activities and interests of individuals and groups, but which may not be recognised as learning.

According to Conner (2007), informal learning accounts for over 75% of the learning taking place in organizations today. Moreover, informal learning is non course-based learning activities which might include discussion, talks or presentations, information, advice and guidance. Informal learning should no longer be regarded as an inferior form of learning whose main purpose is to act as the

precursor of formal learning. It needs to be seen as fundamental, necessary and valuable in its own right, at times directly relevant in all situations of learning.

Formal Learning: Conner (2007) views formal learning as the hierarchically structured school system that runs from primary school through to the university. And Observational learning (2007, November) on the other hand, defines formal learning as learning that takes place within a teacher-student relationship, such as in a school system.

Therefore, formal learning is a planned learning activity within a structured learning setting, attending lectures, preparing coursework, engaging in seminar or tutorial discussions. In formal learning milieu, there is always an attestation of participation in the form of certificate when one had successfully gone through a structured programme. These certificates have bearing on other human establishments such as work or further study.

As an addendum to approaches in learning, Conner (2007) expounds further two additional approaches that is intentional and accidental learning. Intentional learning is the process whereby an individual aims to learn something and goes about achieving that objective. Accidental learning happens when in everyday activities an individual learns something that he or she had not intended or expected.

Flexible Learning: Is a learning activity where the learner's choice is of primary importance. It relates to distance learning and applies to all kinds of learning. As well, students' comfort, ability and capabilities are paramount in this context (Collis and Moonen, 2001). This kind of learning is augmented as a result of technological advancement toward education in recent times. In that case, technology has made distance learning easier and affordable.

Problem-Based Learning (PBL): Is an active learning approach that involves students in solving problems similar to those they may find in life. In a PBL environment, teachers act as facilitators and coaches, enabling students to take responsibility for learning and developing higher order thinking skills (Teaching and Learning Resource, 2007).

Action Learning: This approach to learning was developed by Reg Revans (as cited in Boshyk, 2000). It focuses not upon what one knows but what one does not know. Within a set or group often work-based problems are discussed and reframed in a learning context, through sharing experiences and advice action is suggested and solutions discussed. In this manner learning from shared experience provides often creative solutions for institutions, faculties engage in interdisciplinary courses and organisations.

2.5.7 Learning Styles

Fleming and Mills (1992) categorised learning styles into four groups to reflect the experiences of students. Visual, Aural/Auditory, Read/write and Kinaesthetic (VARK) models of learning are the four basic learning styles. The models in this family may use different terms to describe same or similar learning styles. These models often describe four basic learning styles:

Visual Learning (learn by seeing): This preference includes the depiction of information in charts, graphs, flow charts, and all the symbolic arrows, circles, hierarchies and other devices that instructors use to represent what could have been presented in words.

Auditory Learning (learn by hearing): This perceptual mode describes a preference for information that is "heard." Students with this modality report that they

learn best from lectures, tutorials, tapes, group discussion, speaking, web chat, talking things through.

Reading/Writing (learn by processing text): This preference is for information displayed as words. Not surprisingly, many academics have a strong preference for this modality. This preference emphasizes text-based input and output — reading and writing in all its forms.

Kinaesthetic Learning or Practical (learn by doing): By definition, this modality refers to the perceptual preference related to the use of experience and practice (simulated or real). Although such an experience may invoke other modalities, the key is that the student is connected to reality, either through experience, example, practice or simulation. In application, the term multi-modal describes people who have more than one strong learning style.

With these, information presented above has been largely theoretical, emphasizing concepts and principles pertinent to the teaching and learning processes, human behaviour and effective communication in education and training programs. This knowledge, if properly used, will enable the researcher, instructors, curriculum developers and planners to be more confident, efficient, and successful in planning lessons, course modules and in selection of instructional materials for teaching and learning. Moreover, ICT-based education invariably employs instructional and learning methods such as lecture, discussion and demonstration methods among other learning theories and approaches in the teaching and learning of subject matter.

In effect, the appropriate teaching learning theory for ICT-based education is experiential education, which purposefully engages teachers and learners in direct experience or hands-on and focused reflection in order to increase knowledge, develop skills, and clarifies values. With this, the outcome of student participation is

developing keen interest and involvement which facilitates personal growth and transfer of knowledge. Experiential education naturally involves VARK learning styles.

2.6 ICT Modules in Some Art-based Programmes

The issue of ICT curriculum implementation in schools and colleges is not limited to the boundaries of Ghana alone but rather, to the continent of Africa and beyond. There are serious concerns in Africa regarding the shortage of locally developed, contextually relevant course content for both teachers and learners in ICT (SchoolNet Africa, 2004). It was maintained that more emphasis should be placed on developing contextually relevant African digitised content so that African teachers and students can realise the full potential of ICT to transform their teaching and learning practice.

Several African countries have developed national ICT policies, and several more are in the process of finalising their ICT policies. But on the contrary, the prospects of these contextually relevant initiatives look bleak in that, there is lack of coherence among individual government policies with respect to developing teacher's and student's ICT capabilities in Africa. However, national ICT policies with respect to teacher and student training remain fragmented, under-funded and inadequate in some African countries (SchoolNet Africa, 2004), especially in Ghana. But thanks to the new Education Reforms of 2007, where ICT has become the substratum of philosophy across the national curriculum.

Though ICT has an immense impact on modern life with excellent job prospects, the field is rigorous, intellectually vibrant, and multi-faceted. Tucker and Bowdoin (2003) concurred that ICT education is in perpetual danger of disappearing

from schools. In that, only a little had been heard about other experiences so as to understand and advocate for computer-based learning in schools. As an essential component of a well-rounded education, a key factor in ensuring that our students have the skills needed, not just to survive but to thrive in this increasingly technological and global economy.

Furthermore, Eischen (2000) explained that approaching ICT from process, product and industry viewpoints creates a much richer methodology for understanding the impact of ICT on economic and social processes. Arguably, it is also the only way to capture both the technical and social aspects of ICT simultaneously. However, in the 1970s, the basic paradigm to take technology into the classrooms began to unfold. Some hardware manufacturers considered the education market as a serious possibility and produced software for it.

In terms of learning outcomes which is an end to a curriculum, ICT-based education provides the individual ability to work independently or with others, to use tools, resources, processes, and systems responsibly to access and evaluate information in any medium; as well use that information to solve problems, communicate clearly, make informed decisions, and construct new knowledge products or systems (Benson, 1998).

2.6.1 The Purpose of ICT in Education

ICT Curriculum prepares students to become citizens of the global community. Quite recently, educationists in Ghana identified ICT literacy as foundation skills to be developed across the curriculum from Kindergarten to higher education. Although students in the past have focused on developing literacy skills such as reading, writing and numeracy, 21st-century students must develop multiple-

literacy (using ICT) to allow them respond to changing ideas, attitudes, and technologies. Webster (2007), fully endorsed the coming of technological revolution and expounded its economic and political benefits for all members of society. This is summed up succinctly below:

> One of the most striking characteristics of the present age is the extraordinary progress which it has witnessed of popular knowledge. A new movement towards higher attainments, in science and arts, has been communicated to the whole mass of society. A powerful impulse, far exceeding in degree anything experienced before, has come to act on the whole social system. Everyone beholds a great change, begun, and going on, in what is around him; in morals, in politics, in science, in art, and in literature.

In view of Daniel's commentary, the 21st century students and professionals have exceeding and abundant information more than ever to improve their existence and above all, add to what is currently there for subsequent generations. He believes that modern man is swimming in 'a pool of knowledge and education' as a result of ICT expedience. This is described by Boyer (1997) as 'information overload.'

2.7 Importance of ICT in Visual Arts Education (VAE) in Ghana

In tune with globalization, technology as a foundation skill in education must be the priority of any well intended country such as Ghana, in order to rub shoulders with her counterparts. In achieving this, ICT education should be integrated into the entire national curriculum framework, especially in VAE which intend prepares students to become citizens of the global community. Although students in the past have focused on developing literacy and creative skills, however, the 21st-century students must develop multiple knowledge acquisition skills through Visual, Aural/Auditory, Read/write and Kinesthetic (VARK). This will allow them to respond

to changing ideas, attitudes, and technologies as their communities and world evolve (LIAC, 2006).

Historically, before the major policy change and reforms in Ghana in 1987, Visual Art was perceived as Art and Craft, the two dimensional works being the Art and the three dimensional being the Craft. Art and Craft was limited to drawing and painting, dyed and printed textiles and gourd work. In the 1987 Education Reform programme, Visual Art was introduced under the Vocational Education programme and since then, it has been given more attention than ever (AEPOG, 2001). One reason is that Visual Art is perceived as an important subject through which creativity can be fostered.

Ghana needs creative citizens to solve national problems. In this regard, proactive measures such as the use of ICT in teaching and learning of Visual Art must be encouraged across the national Visual Arts curriculum. This in turn will produce the requisite manpower work force for the 21st century industries. Therefore, there is the need to develop strategic ICT programmes or curricula for Visual Art disciplines, not only at the higher institutions level but right from the kindergarten through to the higher level. In order that art students of this age can be part of global revolution through ICT.

In Ghana, Visual Art has been an integral part of the school curriculum from pre-primary through to pre-tertiary level for many years. At the tertiary level only few institutions such as KNUST, UEW, Takoradi, Kumasi and Accra Polytechnics offer some visual arts related courses. However, it naturally follows that to achieve the information and knowledge-based economy vision being propagated through the spectrum of National ICT Policy that is, the Information and Communication Technology for Accelerated Development (ICT4AD) Policy. Visual Arts Education at

the tertiary level requires a proper integration of ICT in its curriculum across the entire Visual Arts Disciplines. In light of this, properly mainstreaming of ICT into VAE will not only increase the quality product and human resource, but will optimize processes in terms of course delivery or methodology for efficiency and effective attainments instructional and learning goals/objectives.

Technology has been defined as the processes, tools and techniques that alter human activity (IEAICT, 2007). In a broader context, being a modern parlance it involves information and communications. Often, much attention is paid to such tools as computers, productivity software and peripheral devices, when one speaks of technology. There is the need to focus on the processes that provide us with the conceptual tools to live our lives and to do our work more efficiently and effectively. The use of ICT will help all students to solve problems, improve their personal performance, and gain the critical and abstract thinking skills necessary to become lifelong learners and productive members of their communities.

ICT has had a great effect on the evolution of education. It has allowed for more advanced home teaching, made teaching in remote areas easier in Ghana. Now that it is taught from an early age according to the Education Reform 2007, it makes life easier in a continuum of developmental stages of teaching-learning and in its daily applications. Also schools, colleges and universities can now share information, which can lead to higher standards in education and resources.

In education, teaching and learning to the visually impaired can be improved with ICT. Computer can be used as an intelligent interface between the visually impaired and the sighted. For years, the visually impaired have been able to command the user interfaces of computers using screen readers, speech synthesis, Braille displays, screen magnification systems and text-to-speech engines. With these,

opportunities are created to impart any form of knowledge, training or skills to the visually impaired. Visual Arts education however can be passed-on onto the visually impaired and even the physically challenged through the consolidation of ICT (Lars, 2002).

The technologies that were used in the past to deliver distance education courses were the printing press and the post office. Higher institutions of learning did not, at the time, provide distance-learning courses. Now, for very good reasons, many universities throughout the world especially Africa Virtual University (AVU) which can be found on a number of campuses, are offering distance education courses. They are doing that with ICT. In distance education, ICT can be used in preparing and presenting lectures. A distance education provider can create and use ICT as a portal to provide technical and methodological help for academic staff, developing ICT-based courses and provide video conferencing facility to exhibit arts works for the distance learners undertaking Visual Arts courses. As far as VAE is concerned, ICT has a great continuum from Graphical User Interface (GUI) through to the use of Artificial Intelligence (AI). ICT is the most appropriate technology of the day to foster a whole learning experience to the Visual Art student.

Moreover, in a speech delivered by the Honourable Minister of Education at the Information and Communications Technology in education policy makers' workshop on the 27th May, 2002, he stated that the inability of the country's public universities to admit about 60 per cent of qualified applicants each year was due to inadequate infrastructure and teaching personnel. An efficient use of ICT in education would be an important asset for the promotion of distance education in all educational institutions. In effect, the use of ICT can increase students' enrolment in universities thereby augmenting the high level man-power skills required by the state for a better

placement in the Information Age. In this fashion, VAE has the propensity of being taught out the classroom, and its courses studied from anywhere.

Admittedly, ICT is not extensively used in Visual Arts Education in Ghana now. There is, however, a lot of optimism about the potential of technology-enhanced VAE. Therefore, there is the need for colleges, faculties and departments in the universities to develop appropriate and the state-of-the-art ICT modules or curricula to supplement the deficit of ICT education in the country. The challenge to "everyday people" to keep up with this phenomenon, can only be met through the development of a framework for ICT Literacy. This when done, makes the Ghanaian student globally competitive and capable of taking up any challenge in life.

In addition, little has been said about the challenges of ICT-driven education. Perhaps the benefits are seen to outweigh the disadvantages. It is often very easy to think that because of the perceived potential of ICT, there will be no serious challenges in its implementation in educational programmes. It has been argued that countries that have paid relatively scarce attention to the area of ICT are lagging behind in the field of spreading education using the latest technology (Serim, 2002). There is evidence to suggest that Ghana, as a country, recognizes the importance of ICT in its socio-economic developments. That is why the ICT4AD policy has been implemented and also integrated in the National Curriculum.

2.8 Evaluation and Methods of Evaluating ICT Programmes

Before an evaluation of a programme can be carried out, there should be a said target called standards. According to Lewis (2007), standard is a basis for comparison; a reference point against which other things can be evaluated, or the ideal in terms of which something can be judged. Cronbach (as cited in Yakubu, 2000)

identifies evaluation in the context of education as the collection and use of information to make decisions about an educational programme. Besides, Microsoft Encarta Dictionary (2008) defines evaluation as an assessment of value, the act of considering or examining something in order to judge its value, quality, importance, extent, or condition. It naturally follows then that evaluation is the act of assessing or examining something or a system against a reference point, such as standard. Therefore, standards form the bases upon which an evaluation is conducted. These are principles laid down either by the university or the department to serve as means and ends upon which the institution is constituted.

Nacino-Brown, *et al.*, (1982) are also of the view that evaluation in the context of education is a process used to obtain information from testing, from direct observation of behaviour, from essays and from other devices to assess a student's overall progress towards some predetermined goals or objectives. Consequently, they asserted that it involves a value of judgement of overall student behaviour, and delineate a dichotomy between evaluation and measurement. When assessment is done based on student's knowledge and understanding in a subject by means of an objective or essay type test, that is measurement. On the other hand, if a teacher puts a value on the student's work, talents, attitudes, and other characteristics of behaviour that is evaluation.

2.8.1 Purposes and Roles of Evaluation

In analysing a curriculum from an evaluation point of view, the first thing to clarify is the purpose of evaluation. However, an evaluation is conducted to determine the value of something. Posner (1992) explained that the following questions should be weighed against purpose of the evaluation: why determine its value? What would

one do with this information? According to him and every other evaluator, the main reason to conduct an evaluation of any kind, in the context of curriculum is to provide information for making decisions about either individuals or the curriculum. Figure 2.7 depicts the distinction between these two kinds of decisions and summarises the following discussion.

2.8.2 Decision about Individuals

Decisions about individuals are necessary for six purposes: diagnosis, instructional feedback, placement, promotion, credentialing and selection. With **diagnosis**, information about strengths and weaknesses are required in determination of areas that need special instructional attention.

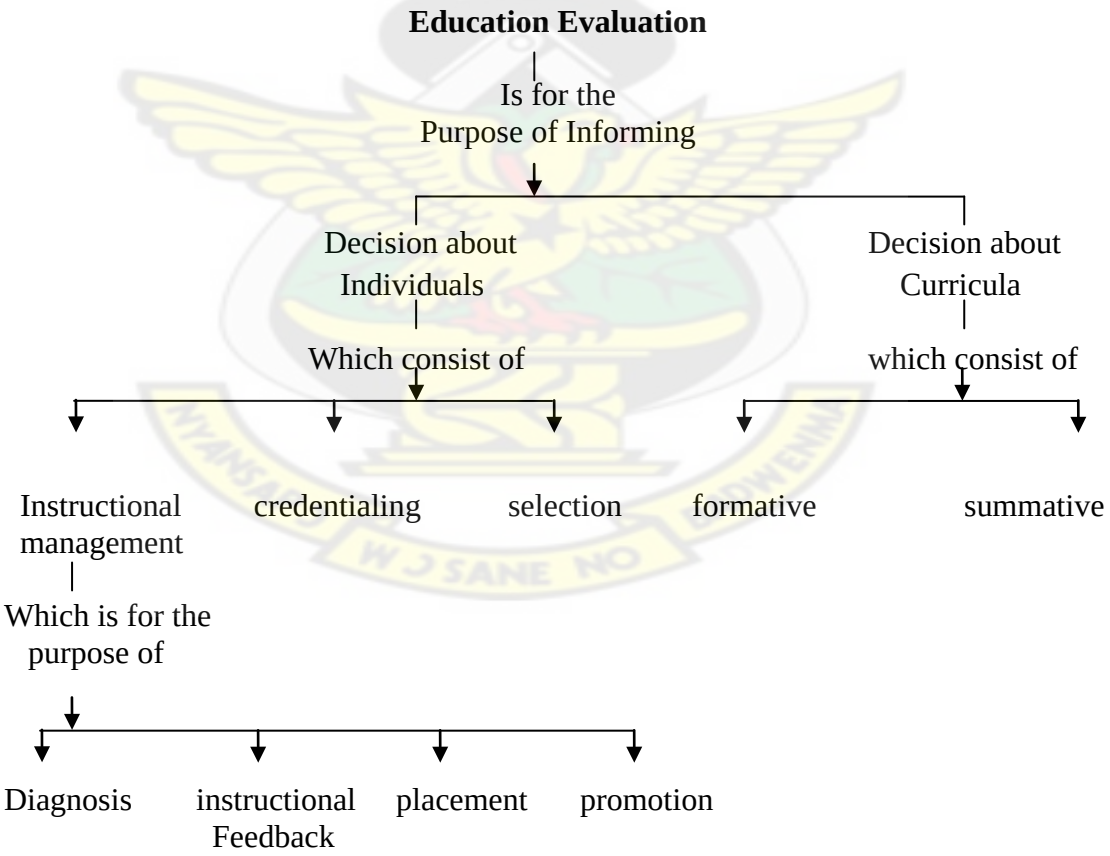


Figure 2.7: Purposes and Roles of Evaluation

Posner (1992:232)

For example, observations of student performance; attitude, interest and behavioural scales; and standardised achievement and aptitude tests with subscores. **Instructional feedback**, decisions concern adjustments students might need to make in their approach to studying a subject based in their knowledge of the progress they are making.

To make **placement** decisions, information about the level of proficiency of the students in particular skills is required, in order to place them in groups that are relatively homogeneous. Similarly, decisions about **promotion** or its opposite, retention, are based on information about the proficiency and maturity of students, information necessary in order to decide whether or not to promote to the next class. Standard tests or continuous assessments, seminars, and teacher recommendations based on in-class observations are typically used methods for these types of decision (Posner, 1992). In a similar view, Nacino-Brown, *et al.*, looked at the purposes of evaluation in a broader spectrum and outlined eight major purposes:

1. As a basis for school marks or grades by teachers,
2. As a means of informing parents,
3. Evaluation for promotion to a higher class,
4. Evaluation for students motivation,
5. For the purposes of guidance and counselling,
6. To assess the effectiveness of the teaching strategy
7. Evaluation for employment purposes
8. Evaluation for university and college entrance.

Moreover, **credentialing** decisions have to do with certification, licensure and otherwise attesting to the competence of a programmes graduate. Typically, these decisions require attaining a predetermined passing level on a test designed by the

credentialing body, typically the Accreditation Board (Posner, 1992). **Selection** decisions, such as those made by Ghana Education Service using Computerized School Selection and Placement System (CSSPS) or the University Admission Office, typically uses existing data about students' academic achievements like SSSCE or equivalent to make admission decisions.

2.8.3 Curriculum Decisions

Evaluation for the purpose of informing decisions about a curriculum is aptly termed "curriculum evaluation." Since the definition of curriculum varies, one should expect evaluation to mean many things to many people, depending upon what they think a curriculum is. If curriculum refers to a document such as a content outline, scope and sequence, or syllabus, then curriculum evaluation might mean a judgement regarding the value or worth of such a document. Posner (1992), however, delineates the following queries: is the document complete, internally consistent and well written? Does the document represent a curriculum that has sufficient depth and breadth and is well organised, rigorous and up to date? How can it be made so?

On the other hand, if a curriculum refers to the experiences of the students, then curriculum evaluation might mean a judgement about the value of the educational experiences afforded to the students. Notwithstanding, this evaluation is necessitated by the following questions: Are the experiences educational, challenging, and engaging? Are they appropriate, wholesome, and safe for learners of this particular age? Are student of different backgrounds treated equitably? How can the educational experience be improved?

Curriculum evaluation decisions are of two types: Posner (1992) explained that decisions as to how to improve the curriculum require a **formative evaluation**,

whereas, a decision as to whether to continue to use the curriculum requires a **summative evaluation**. Evaluation plays a formative role when it occurs during the ongoing curriculum development process. Questions of the following sort are typical: Are students getting the point? Are teachers well equipped to handle the new demands that the curriculum places on them? Is the time required to teach the curriculum realistic?

Evaluation plays a summative role when it enables administrators to decide whether or not a curriculum is good enough to warrant institutional support. Decisions on whether a school system should formally adopt a curriculum, or whether an external funding agency should continue to support a curriculum, are the kinds of decision that can be informed by an evaluation serving a summative role.

The important difference between evaluations serving formative and summative roles is the location of the decision maker and the evaluation. In formative evaluation, the decision maker is part of the curriculum development effort and thus the evaluation is an internal process. In summative evaluation, the decision maker is external to this effort and so, therefore, is the evaluation. In effect, formative curriculum evaluation will be used by the researcher to first critique the existing curricula run by DIA in order to make a proposition based on the findings. Also, both formative and summative evaluations will be used to pretest the proposed ICT Modular Framework and subject-integration for DIA, to see whether it should be adopted as a curriculum within a curriculum.

2.8.4 Methods of Evaluating Individuals and Curricula

As might be expected, whether an evaluation decision is about individuals or curricula significantly affects the methods used. Methods such as questionnaires,

interviews with teachers, content analysis of curriculum materials, comparisons of achievement test data for groups using different curricula, follow-up interviews of course graduates, and case studies of classrooms are typical of those in evaluations focused on curriculum decisions. Methods such as norm and criterion-reference test data, clinical interviews, and family or professional conferences to identify an individual's strengths, weaknesses, problems, and concerns are typical of evaluation methods used to inform decisions about individuals. The reason for the common confusion of these two purposes is that they provide same information, student test data, can be used for the both kinds of decisions: about individuals and about the curricula. However, failure to make this distinction can result in collecting costly but unnecessary information.

2.8.5 Evaluation Information provided by a Curriculum

The first step in analysing a curriculum from an evaluation point of view is to try to identify any evaluation data (test scores), suggestions (questions), or instruments (scales) provided by the curriculum material or in the research literature. If one can find any data, suggestions, or instruments specifically associated with the curriculum, then determine supposes and roles that evaluation information is intended to serve. Is it supposed to provide information for decisions about individual students, and if so, for what kinds of decisions? Is it supposed to provide information for decisions about the curriculum, and if so, are the decisions supposed to serve a formative or a summative role? (Posner, 1992). In an ideal situation, information collected for individual and curriculum decisions serve as feedbacks for reviewing curriculum contents which is inextricable part of the standards of a school.

2.8.6 Criteria for Evaluating ICT Instructional Materials

Evaluating and selecting the appropriate software is a very important component of success in using multimedia systems in both educational and corporate settings. Computer-mediated multimedia (CMM) is the integration of two or more communication media, controlled or manipulated by the user via a computer, to present information. CMM can be combinations of text, images, animation, sound, colour, and video in a single, computer-controlled presentation. The evaluation and selection of CMM systems may be different from computer-mediated instruction (CMI) systems. CMI is the integration of instructional software or courseware in education to facilitate teaching and learning processes. Issues considered for evaluating courseware for Visual Arts include: content, instructional design, user interface, and documentation. With examples based on current and confirmed research to support the teaching and learning of ICT in Visual Arts. The following were considered:

1. Opportunities must be created for students to increase their knowledge of the Visual Arts through the study of the historical development of IT and concepts on technology innovations, computers, and effects of industrial revolution on information age in relation to Visual Arts.
2. Content presented in interesting and engaging ways to students using modern technologies, to meet students' diverse learning styles and abilities according to current and confirmed research.
3. Terms and academic vocabulary appropriately used and accurately defined.
4. Clear procedures and explanations of underlying concepts, principles, and theories integral to and supportive of the teaching and learning of art forms so that performance skills are learned in the context of ICT education.

5. Guidelines for formal and informal presentations of student work and other artworks using present technology, focused on demonstrating the artistic elements and principles in the content area, thereby aiding meaningful learning.
6. Graphics (pictures, maps, charts) that are accurate, are well annotated or labelled, and enhance students' focus and understanding of the content. Make use of electronic resources (internet) that add richness and depth of understanding to the subjects being taught.

However, the criteria for evaluation will provide a useful framework to help educators and trainers select quality instructional software for their instructional purposes. This research seeks to explore the issues surrounding the evaluation of instructional software currently run by DIA and to present comprehensive criteria for evaluating and selecting courseware for effective instruction.

2.8.7 Assessment

Instructional materials should contain multiple measures to assess what students know and can do in the Visual Arts using ICT. The measures should reveal students' knowledge of the concepts, principles, theories, and skills related to those arts and students' ability to apply that knowledge to understanding advanced versions of those concepts, principles, and theories. Assessment tools that are part of the instructional material should provide evidence of students' progress in meeting the content standards and useful information for planning and modifying instruction to help all students meet or exceed those standards. Also, programmes must conform to the policies of the university and other applicable guidelines or standards constituted by the department.

2.8.7.1 Computer-Based Assessment (CBA)

Computer-Based Assessment (CBA) is gaining popularity in institutions of higher learning, replacing traditional written tests with computerized versions. Some reasons that have encouraged instructors to develop and adopt CBA include the increased number of students and the corresponding increase in time spent by instructors on assessment; technological inclination, wanting to optimize and augment processes. The primary objective of CBA is to save the instructor's time by leaving the computer software to mark and give feedback on the test (Manjit, 2008).

As ICT has become ever more important for teaching and learning, so computers have become an established means of student assessment. Manjit (2008) added that CBA is not just an alternative method for delivering tests; it represents an important qualitative shift away from traditional methods such as paper-based tests (multiple-choice questions). Computers are now regularly used to deliver, mark, and analyze student assessments in developed countries. However, computer-based assessment is used in many different contexts, to perform different functions, to test knowledge and problem-solving skills which are inextricable from the administration and curriculum implementation of DIA. It has a tendency of increasing student enrolment both physically and virtually, evaluating student outcomes or experiences and informing curriculum decisions.

There are generally two basic types of assessment, that is, formative and summative assessments (Manjit, 2008) as briefly described in the following. Formative assessment is designed to help students to gain understanding and to develop their good learning habits. Typically, this type of assessment is represented by activities integrated into the course and may include: feedback within study materials; self-assessments tests or quizzes; feedback from assignments; and dialogue

with peers or colleagues. In contrast, summative assessment attempts to measure the extent and quality of the students learning through: examinations; course work, assignments or mini projects; and practical demonstrations or oral presentation.

2.8.8 Software Evaluation

Studnicki (2008) explained that evaluating software is an important component in the process of choosing technology for learning and instruction. Whether it is for student learning or administrative management, the key to finding the right software is to know exactly why it is needed and how it is going to be used. For example, selecting courseware for university students to learn its applications in their discipline requires an understanding of how students can process information, augment coursework and learning standards, physically manipulate computer keyboards and a mouse to fetch imperative information.

Further, a teacher should know if students will work independently or in groups and how long will they have to work during any one session. Will their work be saved? If students will work cooperatively, software should be chosen that is designed to engage all the students sitting around the computer. These are a few considerations that teachers should use when they initially review software.

However, there is one basic rule for software selection that is, 'the 15-minute rule'. It basically means, if a person cannot understand software in the first 15 minutes of using it then give it no more precious time and move on to an alternative one. Not only should the software be intuitive but also the installation should be easy and quick. Software should impact the curriculum and be a part of its delivery. Here are some quick and easy guidelines to use for the selection process:

- Make it a curricula decision and not just a software decision.

- Involve as many people as possible, especially the curriculum and technology directors or supervisor, teachers, students, and the technician.
- Specifically identify the outcomes for the software. Know exactly what skills or concepts the student should experience that need to be improved or automated.
- Have consensus on these outcomes prior to previewing and purchase. It is always a good idea to put it in the hands of students first and get their reaction!
- Budget for upgrades and write it into the curriculum for ongoing use and review throughout the upcoming years.
- Collect data to determine success and future plan of actions.
- Do not write the title of software into an individual education plan (IEP), because of the evolving nature of technology. This will help manage software compulsion as the student progresses through year levels (Studnicki, 2008).

However, if the software truly impacts on student-learning, just load the trial software on the computers and let teachers and students play with it for a month. Collect the "checklists" identifying key uses and concepts and talk with the participants at the end of the month and the decision will be made.

The following are some simple questions to ask the student and the teacher, after trying the beta software. Student Review: Was it easy to use? Did it keep your attention? Was it challenging? Would you like to use it again? Did it help you learn something? Teacher Review: Was the student engaged? Did the software provide student feedback and were they easy to access? Did the use of the software integrate with the curriculum lesson? Can the software be managed in the classroom or do the students need the teacher's help? What is the student goal? (Studnicki, 2008).

In effect, evaluation is the act of considering or examining something in order to judge its value, quality, importance, worth, extent, or condition. The researcher is of view that evaluation plays a primary role in the implementation and continuity of curriculum. Therefore, evaluation will be used to review the existing computer-based modules in the curriculum of DIA and also used to pretest the proposed ICT Modular Framework for DIA in anticipation of its efficacy for implementation. The next chapter critiques the existing computer-based modules in the programmes of the Department of Industrial Art, KNUST.

CHAPTER THREE

EXAMINATION OF THE EXISTING COMPUTER-BASED MODULES IN THE PROGRAMMES OF THE DEPARTMENT OF INDUSTRIAL ART (DIA), KNUST

Overview

This chapter looks at the University and the National philosophy and policies on ICT education, and the role of ICT in Visual Arts Education in relation to the contents of the existing computer-based modules of DIA; Discussion of DIA computer-based modules structure and description; and its methodology, teaching and learning; Also, covered in this chapter is a reconnaissance in view of the study, analysis and discussion of the findings and recommendations.

3.1 The University Philosophy and Policies on ICT Education

In its policy document, the university has identified ICT as an efficient tool for achieving its strategic objectives. The increasing role of ICT as a vehicle for teaching, learning and research, and also as an important key skill for everyday life, has led to ICT moving towards the core of the University curriculum and also responding to vision, mission and strategic priorities of the University. The university has the vision of advancing knowledge in science and technology for sustainable development in Africa.

Philosophically, the central focus of the University ICT policy and the development plan is to meet the national expectations standards in ICT (ICT4KD, 2006). That is, using ICT as the main engine for accelerated and sustainable economic and social development; in improving the quality of life of the people of Ghana by

significantly enriching their social, economic and cultural well-being, through the rapid development and modernization of the economy and society.

Due to the rapidly changing nature of technology, the university anticipates that necessary periodic review on its ICT4KD policy will be made after every three years in relation to its key elements to meet new changing developmental objectives. With eLearning policy, the University will use eLearning where appropriate to advance the realisation of its goals in providing *learner-centred learning experiences* that are flexible, responsive and effective to meet the needs of all its learners and stakeholders. E-Learning will be used to innovate teaching and learning to promote effective and efficient use of resources (ICT4KD, 2006).

With E-Research Policy, the university will explore initiatives which support e-research and information management using new technologies which emphasize interoperability and flexibility. E-Research refers to large-scale, distributed, information-intensive forms of inquiry conducted collaboratively between institutions, and intra- and inter-nationally. In addition, Adarkwa (2008) in his 'State of the University Address' asserted that a pilot eLearning module is being developed by the ICT Unit to aid teaching and learning. This would aid the interaction of staff and students during lecture and non lecture periods. The project would extend the physical boundary of the lecture room making it possible to enroll distance education students.

The Department of Industrial Art is responsible for the training and production of high-level manpower in the respective disciplines (Textiles, Metal Products Design, and Ceramics) for the Ghanaian economy. Its foremost mission is to produce properly trained graduates with the requisite knowledge and skills for today's technology-based industries. Also, to develop high level human resource capacity required by the University to fulfil her mission, the university has identified ICT as a

vital tool to facilitate and implement its objectives. In this regard, faculties and departments owe it a duty to integrate ICT developmental approaches to transform education in the university.

3.2 National Philosophy on ICT Education

In order to produce the required human capital with relevant knowledge and skills in the 21st century, the Government of Ghana is committed to pursuing an ICT for Accelerated Development (**ICT4AD**) vision. This is aimed at using ICT as the main engine for accelerated and sustainable economic and social development, to improve the quality of life of the people of Ghana by significantly enriching their social, economic and cultural well-being through the rapid development and modernization of the economy and society. However, in achieving this vision, the Government upon consultations through fora decided to transform the educational system to provide the requisite educational and training services, and environment capable of producing the right types of skills and human resources required for developing and driving Ghana's information and knowledge-based economy and society. The Government has acknowledged the key role of ICT and has effectively harnessed the power of ICTs in order to improve educational delivery and in training and learning.

Furthermore, the policy aimed at transforming Ghana into an information-rich, knowledge-based, technology-driven and high-income economy. This is the philosophical concept underpinning Ghana's ICT Policy. The onus is on the faculties and departments in higher institutions to develop a comprehensive and integrating ICT curriculum to augment this initiative. In the end, this dissertation would have contributed to the course of transforming Ghana into an information-rich, knowledge-

based and technology-driven high-income economy through the educational experiences given to students.

However, the government's policy of providing ICT education to every Ghanaian remains a vision until enough human capital is injected into the system by educational institutions. There is therefore a need to produce these professionals in all disciplines of study so that ICT education can be applied in all disciplines. It is prudent to say that the ICT aspect of every discipline should be revised with a view to produce teachers or graduates who can handle those disciplines at the lower levels. And this is what this dissertation seeks to achieve.

3.3 The Role of ICT in Visual Arts Education

Ferdi (2002) defined ICT literacy as "using digital technology, communications tools or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society." ICT plays a larger role in society overall, developing a holistic, up-to-date system, which is particularly critical in higher education. Because, it offers new avenues to explore academically, socially and recreationally, it is becoming increasingly important in the pedagogy of VAE in at least three distinct areas:

3.3.1 Pedagogy

Volume of data - The amount of information or resources available online through Internet search-engines and portals enable users to search through large amounts of materials from library databases around the world. Therefore, time can be spent more productively analysing and synthesizing data rather than just digging for and retrieving it from books. When ICT is properly mainstreamed into the VAE, it develops students' technical, creative and cognitive skills, and knowledge through

Visual, Aural/Auditory, Read/write and Kinaesthetic (VARK) to become responsive to changing ideas, attitudes, and technologies as they evolve.

Immediacy and collaboration - Technology-enabled pedagogy allows lecturers and students to interact together in real-time with rapidly changing information. For example, a textile lecturer can use online news resources to discuss the latest innovations in the textile technology which is too recent to be included in a textbook. This facilitates students' performance to solve problems, gain the critical and abstract thinking skills to become lifelong learners and productive members of their societies and nation.

Interactive multimedia - Students and Lecturers can access a vast array of online and offline resources in a dynamic multimedia application by viewing DVD's, CD-ROM or online content. Besides, ICT-based education offers a wide range of possibilities to the blind and partially sighted. It makes life easier in a continuum of developmental stages of teaching learning and in students' project works. In distance education, ICT can be used in preparing and presenting lectures, providing video conferencing to exhibit art works for the distance learners undertaking Visual Arts courses.

3.3.2 Administrative Purposes

At the faculty or department level for administrative purposes, students information (financial data, names, addresses, grades, class schedules, and the likes) are readily available in a centralized database system. This system provides students with around-the-clock secure access to their personal information such as results, registration and courseware materials.

Having discussed the philosophies and policies of the university, department and the nation, coupled with the role of ICTs in Art Education, the premise is set to examine the existing computer-based modules run by the department on one divide and the philosophies of the university, department and the national policy on ICT on another divide. The objectives, philosophies and policies serve as standards and guiding principles upon which the existing computer-based modules structure is examined.

3.4 The Structure and Description of the Existing Computer-based Modules of DIA, KNUST

DIA falls under the Faculty of Industrial Art in the College of Art and Social Sciences, KNUST. It produces the requisite high level human capital needed to man educational institutions, organizations and the respective industries under its disciplines. Imperatively, DIA has the objective to train students in the theoretical and practical aspects in the following Visual Art Disciplines: Textiles, Metal Products Design and Ceramics. DIA has the aim of producing graduates with the requisite knowledge and skills to take up positions in the following areas: manufacturing, commerce, teaching, research and development.

The existing computer-based modules run by DIA, KNUST, are interdisciplinary subjects that students take from the Department of Communication Design (DCD). DCD runs modular courses in computer application design and is the only department in the then College of Art that made a preponderance use of computer. The mainstreaming of computer application courses from DCD into the DIA curricula was because of limited use of the computer in DIA in the past. Since the use of computer is burgeoning in all disciplines, particularly in VAE, it is

academically important to restructure the curricula to meet current trends and challenges. Therefore, the researcher seeks to review the computer-based modular course structure on the basis of abundance ICTs – emphasis on subject relevance and to produce ICT-based Industrial Art graduates for the industry.

The critique of the course structure and description of the computer-based modules was considered along the three Visual Arts disciplines run by the department. The course code and title of each course and description were lifted from the DCD course structure, which manifests its methodology of instruction. This denies DIA students' the purpose of subject relevance which has repelling effect on their learning outcomes. Below is the structure and description of the computer-based modules of DIA. In the course structure, **T** - theory time, **P** – practical and **C** – credit hours, describing the number of hours apportioned to each course. The expository structure and description of the computer-based modules was sourced from the DIA curriculum.

Course Structure

Year One students take common first year courses

Year One Semester One		**T**	**P**	**C**
DAD 157	Computer Application in Design I	1	2	2
	Total	**1**	**2**	**2**

Year One Semester Two		**T**	**P**	**C**
DAD 158	Computer Application in Design II	1	2	2
	Total	**1**	**2**	**2**

Textiles - Course Structure

Year Two: Semester One		**T**	**P**	**C**
DAD 269	Computer Application in Design III	1	2	2
	Total	**1**	**2**	**2**

Year Two: Semester Two			T	P	C
DAD	270	Computer Application in Design IV	1	2	2
		Total	**1**	**2**	**2**

Year Three: Semester One			T	P	C
DAD	359	Advanced Computer Application I	1	2	2
		Total	**1**	**2**	**2**

Year Three: Semester Two			T	P	C
DAD	360	Advanced Computer Application II	1	2	2
		Total	**1**	**2**	**2**

Course Description

Year One: Semester One

DAD 157: Computer Application in Design I (1,2,2)

History and development of computers, computer hard and software, Windows platform and word processing.

Year One: Semester Two

DAD 158: Computer Application in Design II (1,2,2)

This course is designed to address broad issues concerning the fundamentals of computer application in design. It offers a focus on computer graphic application and aims at equipping students with the skills and knowledge in some selected application software. Prerequisite: Computer Application in Design I.

Year Two: Semester One

DAD 269: Computer Application in Design III (1,2,2)

This is a development class in new media, students work on special projects designed to push the boundaries of digital technologies and explore the limits of current and future media.

Prerequisite: DAD 157, 158: Computer Application in Design I & II

Year Two: Semester Two

DAD 270: Computer Application in Design III (1,2,2)

Continuation of the previous semesters' programmes with further exploration in paint and image manipulation software as applied to Textile design to complete two-term project. Prerequisite: DAD 269

Year Three: Semester One

DAD 359: Advanced Computer Application I (1,2,2)

An extensive introduction to photographic imaging through digital technology. Course material covers a variety of tools and techniques used in image scanning, manipulation, and output. Complex assignments familiarize students with a wide variety of range of aesthetic, technical, and ethical issues relevant to working in an electronic image-making environment. Prerequisite: Computer Application in Design I & II

Year Three: Semester Two

DAD 360: Advanced Computer Application II (1,2,2)

An extensive introduction to photographic imaging through digital technology. Course material covers a variety of tools and techniques used in image scanning, manipulation, and output. Complex assignments familiarize with a wide variety of range of aesthetic, technical, and ethical issues relevant to working in an electronic image-making environment. Prerequisite: Computer Application in Design I & II

Metal Products Design - Course Structure

There are no stipulated computer-based courses for Metal Products Design

Ceramics - Course Structure

Year Two Semester One				**T**	**P**	**C**
IAC	263	Information Technology I		2	1	2
			Total	**2**	**1**	**2**

Year Two: Semester Two				**T**	**P**	**C**
IAC	264	Information Technology II		2	1	2
			Total	**2**	**1**	**2**

Course Description

Year Two: Semester One

IAC 263: Information Technology I (2,1,2)

Introduction to Computers. Drawing packages – CorelDraw and 3D modelling.

Year Two Semester Two

IAC 264: Information Technology II (2,1,2)

Use computer to assemble possible projections. Simulation of designs in 2D. Transfer of design in 3D and production.

3.5 Discussion of DIA Computer-based Modules

In the year one course structure, there is no rudimentary concept of learning as far as the first semester course (DAD 157 Computer Application in Design I) is concerned. The teaching-learning process does not capture the basic concept of course introduction, such as introduction to desktop computers. There is a disparity between the course title and its description. In that, the course captions Computer Application in Design which means that the students should in one way or the other learn to apply a computer application programme to either design or in subject area. But the course description indicates 'History and development of computers, computer hard and software, Windows platform and word processing' which does not designate the title contents. Further, the description for DAD 158 Computer Application in Design II does not synchronize with the methodological sequence in ICT education in which students are first introduced to computers, followed by desktop publications, among others; to administratively learn computer to present documents and make presentations.

The university has identified ICT as an efficient tool for attaining its objectives and also for effective teaching and learning. For that reason, the department

should tremendously make a holistic integration of ICT in its curriculum structures and descriptions. With this, the nation would have produced the requisite manpower to transform Ghana into an information-rich, knowledge-based, technology-driven and high-income economy.

It is worth noting that all year one students in the department are offered the same course modules and in the subsequent year, major in one of these preferences (Textiles, Metal Products Design and Ceramics). In the Textiles course structure, the year two module has no bearing on Textiles because, it does not specifically describe what and how the computer should be applied in Textiles. The course structure of year three Textiles, both first and second semester descriptions are the same, which indicate no continuity in students' learning experience. Consequently, curriculum sequencing had not been followed, although the subjects are designated Roman numeral I & II, showing continuity in teaching and learning. In the final year, students are not offered any module, though much of data management and manufacturing aspects of ICT has not been explored.

In the case of Metal Products Design, the Section does not offer any ICT modules. It shows that there is no equitable application of ICT in all the Sections of the Department. This incapacitates the learners academically in several ways. ICT-led education provides students an efficient and effective leverage to collect and filter data from a variety of sources like the internet or encyclopaedic database on DVDs, analyse them with software such as MS Excel or SPSS for meaningful discussions. Also, ICT if comprehensively integrated in teaching and learning process serves as a powerful tool in all spheres, from basic idea development of designs to advance simulation of artefacts and manufacturing concepts. The absence of this has adverse effects such as blurring the vision and policy of the university and nation to use ICT

to accelerate development. Non-integration into the curriculum does not help to produce the prerequisite calibre of graduates required by today's industries, institutions, information and knowledge economy.

With the Ceramics structure, only year two offers the computer courses, with vague course title and mismatched course descriptions. The course title designates Information Technology, and IT has a broad concept with varied ramifications. And for that reason it is difficult to ascertain which aspects of IT are taught; is it introduction to IT or application of IT to the subject area? Secondly, the descriptions of the said courses are inappropriate because introduction to computers can stretch over a semester and the same applies to the teaching of CorelDraw or any other graphics application. As a result, all of these had been lumped into a semester's course description. Lastly, there is no scope and sequence to those courses which intends affect the teaching and learning processes and also denies students the privilege of applying ICT in their study. In view of these, one would admit that there is the need for structural adjustment in order to reflect current phenomena of using ICT-led education to produce high-level manpower required by the industries and the knowledge-based economy. Accordingly, this dissertation is in pursuant to reviewing the computer-based modules in DIA curriculum.

3.6 Teaching and Learning of the Existing Computer-Based Modules

The teaching approach being used by the service lecturers from Department of Communication Design (DCD) are not indicative of the methodology of instruction in the context of the Industrial Art disciplines. Computer application programmes are designed with an array of end users or professionals in mind. These programmes have expedient methods through which professional jobs are done; depending on the nature of your work, there are certain techniques and procedures one must follow. For

instance, although Adobe Photoshop is a graphic application programme used heavily for image editing, it also serves a powerful facility for fabric design. However, if an instructor has no knowledge to this effect, instructing students would be based on his/her bulk of knowledge without any relevance to the subject of study.

Students are taught with limited programmes such as CorelDraw and Adobe Illustrator which are vector programmes at the expense of other programmes for image editing and also 3-Dimensional applications. Indicatively, students are taught computer application programmes based on the service lecturer's ability in such applications. Students are not taught the required applications, for example, a Metal Products Design or Ceramics student by the end his study should properly produce products design with any 3-D application programme. But this not the case with the existing teaching and learning methods employed by the service lecturers (DCD). Students are only introduced to CorelDraw or Adobe Illustrator application tools, commends, menus, among others to design letter heads, business cards, envelopes, posters or newspapers cover page.

The DIA students are taught as though they were pursuing Graphics Design. Students are not taught important elements of ICT such as introduction computer networking and internet technique application, data management application, artificial intelligence (CAD/CAM), among others. This does not give students comprehensive ICT learning experiences in many ways. In the first place, students do not have the leverage to effectively and efficiently use modern technology like the internet, software and courseware to solve problems. Secondly, students are limited in the use of ICT as tool to simulate, facilitate, construct, and in collaboration of knowledge in their subject of study. Thirdly, they become incapacitated to life outside school because ICT is striving tremendously in all sectors of the economy.

In terms of equipment and instructional materials, admittedly, the department does not adequately provide the needed logistics such as computers, software and other facilitating equipment like LCD projector for smooth teaching and learning process. But in another view, the inadequacy of resources is a confounding variable in this context in that whether there are well structured ICT modules or not, of course, without the requisite resources there would not be effective teaching and learning. However, it is worth noting that comprehensive ICT modules with limited resources have the propensity to impart on the learning experience of students than an unstructured one with the same resources.

As a result, students are taught by demonstration using LCD projector without any hands-on application. Textbooks are made available for students to study without praxis. Consequently, more often than not students are unable to apply these application programmes in any given situation. Ideally, for effective teaching of computer application programmes, after a short demonstration, the students must be instructed to try their hands at it in order for them to grasp certain inherit tenets in the use of those applications. ICT-led education provides the student a learner-centred learning experience.

In content, DIA runs art disciplines requiring corresponding ICT integration applications. For example, Textiles should use 2-dimensional application software, while Metal Products Design and Ceramics should also use both 2- and 3-dimensional application software. But then a study revealed that, students are only taught 2-dimensional application software leaving other equally important aspects such as the 3-dimensional application software, courseware, CAM and other emerging trends in technology. These account for the shortfalls in the content of the interdisciplinary modules. As indicated, students are introduced to CorelDraw, Adobe Illustrator

applications and introduction to computers. This modular course contents are limited in scope and sequence thereby cannot complement the main curriculum to produce requisite graduates who will use ICT as the main engine for accelerated and sustainable economic and social development; by significantly enriching their social, economic and cultural well-being, through the rapid development and modernization of the economy and society.

In assessment, because students are taken through limited scope and sequence of the computer-based modules and inadequate resources such as computers and application software, students are given take-home assignments or test without supervision. In addition, oftentimes end-of-semester examinations are written papers and this invariably defeats the experiential learning experience, where students have the opportunity to learn by doing. This however prevents students from learning by praxis and it becomes difficult for the students to apply them practically.

3.7 Survey in View of the Study

In the past few years, our nation has seen continued, sustained growth in the deployment of eLearning initiatives in large and small organizations of every type: corporate, higher education, government and military, and non-profits. Thus, there is the need to strengthen or upgrade our educational institutions to meet these challenges. The purpose of this reconnaissance is to present a series of snapshots that capture certain loopholes and the need for structural adjustment of the DIA computer-based modules.

As a descriptive survey, the quantitative data was analyzed by using simple forms of statistical tools such as percentage, frequency, and tables to provide a picturesque presentation of the data. Copies of answered questionnaire were coded,

and analysed by computer using the Statistical Package for Social Scientist software (SPSS 15.0 Version).

Demographic Information on Respondents

In total there were 95 respondents in the survey conducted. This survey was open to 90 students and 5 graduates of DIA. The respondents were randomly selected from year two and three of the three Section in the Department. For students, Table 3.1 gives a statistical description of students' distribution. The survey was carried out at the beginning of the 2006/07 academic year (August 2006) and therefore, excludes year one students because they have not had ICT learning experience in the Department. The copies of questionnaire are made up of both open- and close-ended questions, and were administered in person and via Email. All the copies of administered questionnaire were collected from the respondents. Moreover, the premise for this survey was to ascertain students' and graduates' views and impressions about the computer-based modular course the Department of Industrial Art offers.

Table 3.1: Statistical Description of Students' Distribution according Disciplines

	Responses	**Frequency**	**Percentage**	Valid Percentage	Cumulative Percentage
Valid	Textiles	**47**	**49.5**	49.5	49.5
	Metal Products Design	**32**	**33.7**	33.7	83.2
	Ceramics	**16**	**16.8**	16.8	100.0
	Total	**95**	**100.0**	100.0	

Source: Fieldwork, August 2006

Respondents were asked whether they have ever studied any computer application programme as part of their course of study. In aggregating the cases, 100% responded Yes, meaning that the respondents were qualified to answer the questionnaire. Corresponding to that, is the question stating if Yes, which of the

following computer application programme(s) have you studied? In the cases presented, it shows that students were not given a balanced learning experience; they learnt CorelDraw, Adobe Illustrator and Windows which were not taught sequentially and consistently. These inconsistencies demonstrate lack of comprehensive modular course contents and thus the need for a robust structural adjustment in order to introduce state-of-the-art courseware into DIA curriculum.

In a follow-up question (Table 3.2), the respondents were asked, 'have you undertaken a computer literacy course outside DIA programmes?' 10.5% answered Yes and 89.5% answered No. It means that predominance of DIA students heavily depend on the kind of ICT literacy DIA gives as part of the main learning experiences. Hence, the onus is on DIA to give a well-rounded education to students.

Table 3.2: Responses on Computer Literacy Courses taken outside DIA Programmes

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	**10**	**10.5**	10.5	10.5
	No	**85**	**89.5**	89.5	100.0
	Total	**95**	**100.0**	100.0	

Source: Fieldwork, August 2006

However, in table 3.3, 91.6% asserted Yes and 8.4% No, when the respondents were asked, 'do you think the current ICT courses run by the department lack certain computer application programmes?' When asked to state the computer programmes that are lacking, respondents identified applications such as 3D StudioMax, Maya, Internet Training, SPSS, Ms Office, Statistical Programmes, Adobe PhotoShop, Rhino, CAM, WeavePoint, Ms Office, Artificial Intelligence (CAM) and Poser. A whole new set of courseware were stated which is indicative of the fact that they are needed to enhance their learning experiences. Therefore, it is

important to consider this courseware when reviewing the ICT modular course of DIA.

Table 3.3: Respondents' Views on the Computer Application Software in DIA Curriculum

Responses		**Frequency**	**Percentage**	Valid Percentage	Cumulative Percentage
Valid	Yes	**87**	**91.6**	91.6	91.6
	No	**8**	**8.4**	8.4	100.0
	Total	**95**	**100.0**	100.0	

Source: Fieldwork, August 2006

In assessing students' impression about the computer application software they have studied, with emphasis on subject relevance, the respondents were asked 'what has been your impression about the computer application courses in relation to your course of study?' In table 3.4, 63.2% of the respondents chose average because naturally, students cannot deprecate their lecturers' efforts; 9.5% poor – it has no relevance to their subject area; 22.1% good, because they had established a link between the courses and their subject of study; and 5.1% very good with the reason that the introductory nature of computer applications courses should help them in any endeavour. Because DIA is responsible to producing high level manpower human capital, students' impression about their educational experience should be good, not average.

Table 3.4: Respondents' Impressions about the Computer Application Courses studied

Responses		**Frequency**	**Percentage**	Valid Percentage	Cumulative Percentage
Valid	Poor	**9**	**9.5**	9.5	9.5
	Average	**60**	**63.2**	63.2	72.6
	Good	**21**	**22.1**	22.1	94.7
	Very good	**5**	**5.3**	5.3	100.0
	Total	**95**	**100.0**	100.0	

Source: Fieldwork, August 2006

Subsequently, the respondents were asked 'in terms of content and assessment how you will rate the computer application courses studied?' Looking at the cases

presented (Table 3.5), 52.6% of the respondents responded average because they were able to apprehend, apply and evaluate at any given time what were taught; 15.8% poor in that they cannot relate the contents to their subject area; 20% good and very good 11.6% because they believed that the contents can be applied to any situation with some assistance. However, this defeats the culture of excellence being promulgated by the University, when 52.6% of the respondents chose average instead of good to reflect the university's tenet. Hence, this necessitates the restructuring of DIA computer-based modular structure and methodology of instruction to meet the vision of the University.

Table 3.5: Respondents' Impressions about the Computer Application Courses' Content and Assessment

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Poor	**15**	**15.8**	15.8	15.8
	Average	**50**	**52.6**	52.6	68.4
	Good	**19**	**20.0**	20.0	88.4
	Very good	**11**	**11.6**	11.6	100.0
	Total	**95**	**100.0**	100.0	

Source: Fieldwork, August 2006

In Table 3.6, when asked 'do you think the objectives of the programme have been met' which goes to confirm the disposition of this research. On the average, 21.1% the respondents intimated Yes since the computer application courses served as a lead to explore other concepts and 78.9% No because they could not properly explore the computer application courses to the benefit of their subject areas due to limited computer programmes and the teaching approach used.

Table 3.6: Responses of Respondents about the Objectives of the Computer Application Courses in relation to Subject of Study

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	**20**	**21.1**	21.1	21.1
	No	**75**	**78.9**	78.9	100.0
	Total	**95**	**100.0**	100.0	

Source: Fieldwork, August 2006

Moreover in table 3.7, 91.6% checked No whiles 8.4% Yes, when the respondents were asked whether the teaching periods allocated for computer application courses are adequate. This however goes to affirm that students are not given enough eLearning experience and there is need to review the ICT modular structure. The respondents believed that ample time should be apportioned for ICT literacy because it has become a powerful tool that they need to study in order to equip them for the job market.

Table 3.7: Responses to teaching periods allocated to the Computer-Based Courses

Responses		**Frequency**	**Percentage**	Valid Percentage	Cumulative Percentage
Valid	Yes	**8**	**8.4**	8.4	8.4
	No	**87**	**91.6**	91.6	100.0
	Total	**95**	**100.0**	100.0	

Source: Fieldwork, August 2006

Because the ICT modular course is an interdisciplinary course, it lacks subject relevance and thus, in table 3.8 when asked 'do you think your department should have its own ICT syllabi and instructors?'96.8% are in favour with the view that students will have optimum benefit because the modules will invariably be integrated in their subject areas. And only 3% indicated No with the reason that the existing computer-based modules and methodology of teaching are appropriate.

Table 3.8: Responses for the Department to have its own ICT Syllabi and Instructors

Responses		**Frequency**	**Percentage**	Valid Percentage	Cumulative Percentage
Valid	Yes	**92**	**96.8**	96.8	96.8
	No	**3**	**3.2**	3.2	100.0
	Total	**95**	**100.0**	100.0	

Source: Fieldwork, August 2006

Finally, the respondents were asked, 'what would you have suggested to the department when it is developing its own ICT Modules?' In an assertion (Table 3.9),

23.2% indicated, ‘make available instructional materials and equipment;’ 21.1% also stated ‘select and make the computer programme relevant to the course of study’ and lastly, 55.8% said the department should review and upgrade the current ICT modules with the reason that DIA runs an old system which is not current and also lacks certain modern software.

Table 3.9: Suggestions for the Department to develop its own ICT Modules

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Review and upgrade the current ICT modules	**53**	**55.8**	55.8	55.8
	Select computer application programmes relevant to the course of study.	**20**	**21.1**	21.1	76.8
	Make available instructional materials and equipment.	**22**	**23.2**	23.2	100.0
	Total	**95**	**100.0**	100.0	

Source: Fieldwork, August 2006

3.8 Findings

The University has identified the increasing role of ICT as a vehicle for teaching, learning and research, and also as an important key skill for everyday life. It is dependent on the department to use this opportunity to train students who will acquire ICT-based knowledge and skills in responding to vision, mission and strategic priorities of the University. From the discussion, it has become increasingly apparent that revision of the computer-based modules is needed and this is strongly confirmed by the students’ responses to the administered questionnaire. As a result, the scope and sequence of the existing computer-based modules should be revised. The following are some observations made in relation to the structure and description, methodology and assessments of the existing computer-based modules of DIA, KNUST:

1. In the course structure and description, the year one course titles have not captured the introductory concept expedient in teaching and learning processes. There is a disparity between the planned curriculum and the received curriculum of the computer-based modules.
2. All final year students in the respective Visual Arts disciplines are not offered any computer-based courses. Also, there is no ICT subject-integration in some mandatory course descriptions which involve courseware application in subject areas.
3. The computer-based modules in the DIA curriculum are limited in scope and sequence and woefully inadequate and deficient in some Industrial Art related courseware.
4. Students who go through the interdisciplinary computer-based modules are not adequately equipped for today's technology-based industries because of lack of consistency in the methodology of course contents.
5. The same computer application programmes are taught students in the various Visual Arts Disciplines run by DIA, hence, neglecting subject relevance.
6. The ICT aspect of the DIA curriculum needs to be reviewed because since its development, it has never been reviewed to meet current challenges. In addition, DIA should run its own ICT literacy programme to suit the respective programmes that it runs.

From the preliminary investigation, there is the evidence that ICT as a modular course had never been comprehensively taught in DIA. There had been several shortcomings including limited use of computer application programmes; inadequate teaching periods and contents for computer-based courses; and lastly, some computer-based courses are not relevant to the various subjects of study. In this

vein, an ICT Modular Framework should be developed to help to address these problems. These modules would include computer-based learning that is the rudimentary study of technology, computers, information and communications technologies, and the social and ethical context of computing; computer-based training that is software applications in a study area; Computer Aided Manufacturing (CAM), such as Artificial Intelligence (expert systems and robotics), simulation in real and virtual reality. The development of the framework is considered in chapter five of this dissertation.

CHAPTER FOUR

METHODOLOGY

Overview

This chapter delineates and discusses the procedures involved in the methodology. These procedures include: the Research design (descriptive survey research and experimental research); Libraries visited for relevant information; Description of the population for the study and sampling method used to collect the sample population. Also, the chapter contains development, vetting, validation and administration of research instrument to the sampled population.

4.1 Research Design

The Descriptive survey method of research was used for the study. This method was used extensively to collect, collate and interpret data. Descriptive research (Statistical research) provides data about the population or universe being studied (Davis, 2007). In another view, descriptive research is used to obtain information concerning the current status of the phenomena to describe "what exists" with respect to variables or conditions in a situation. But it can only describe the "who, what, when, where and how" of a situation, not what caused it. It provides the number of times something occurs, or frequency, lends itself to statistical calculations such as determining the average number of occurrences or central tendencies (Descriptive Research, 2008).

Therefore, descriptive survey was used when the objective is to provide a systematic description of the phenomenon that is as factual and accurate as possible. It was employed to observe the status quo of academic work in DIA in terms of ICT education. In effect, it examined the computer-based modular course structure in

conjecture of limited scope and sequence, assessment, teaching and learning. This was subsequently proved when a pre-course questionnaire was used as an evaluation studies to measure student characteristics and expectations of the existing computer-based modular course. Moreover, descriptive survey was also employed to solicit information to ascertain the tier of ICT awareness, implementation, use, integration, and education. As a result, descriptive statistics were represented in tables, analysed, discussed, findings and recommendations made.

Experimental research is a quantitative method which manipulates and control variables in order to establish cause-and-effect relationships (Davis, 2007; Leedy and Ormrod, 2005). True experimental design (posttest-only control design) was employed to establish the causal relationship between the framework and the learning outcomes of students. This design was also used to determine the internal validity of the study. Davis (2007) noted that in order for an experiment to follow a true-experimental design, the following criteria must be employed: Random selection of subjects; Use of control groups; Random assignments to control and experimental groups; and random assignment of groups to control and experimental conditions. He further explained that the true-experimental design has the advantages of greater internal validity and causal claims can be investigated. Contrarily, true experimental design has the disadvantages of less external validity and not very practical.

4.2 Library Research

Both the empirical and the theoretical reviews of literature were obtained from the following libraries aside information gathered from the internet and software databases:

1. KNUST Main and Associate Libraries

2. University of Education, Winneba (North and South Campus Libraries)
3. Cape Coast University Library
4. British Council Library (Kumasi Library)
5. Balme Library, Legon
6. Kumasi and Cape Coast Polytechnic Libraries

4.3 Population for the Study

The target population studied include students, graduates and lecturers of the Textiles, Metal Products Design, and Ceramics Sections in DIA, KNUST. Moreover, stakeholders such as professionals in ICT and ICT-education, and selected Industrial Art Industries in Ghana are also included to give authenticity to the research. The accessible population sampled for the study covered students, graduates and lecturers of DIA, and some stakeholders (Table 4A). In the end, the accessible population for the study is 280.

4.4 Sampling

Sampling is the process of selecting units, such as people, organizations, from a population of interest so that by studying the sample one may fairly generalize the results, because the entire population is difficult to work with. In this research, the accessible population for the study is heterogeneous in nature. The heterogeneity of the accessible population was treated under proportional stratified sampling using stratum to identify each of the strata which come in different representations. Consequently, each category in the population will be treated as a stratum. Leedy (1974) asserted that for quality research, at least 30% of the accessible population is a fair representation for acceptable results.

Table 4A: Accessible Population

Population for the study	Accessible Population
Industrial Art Foundation:	
Year 1	50
Textiles Section:	
Year 2	30
Year 3	30
Year 4	30
Metal Products Design Section:	
Year 2	20
Year 3	20
Year 4	20
Ceramics Section:	
Year 2	10
Year 3	10
Year 4	10
Graduates	**20**
Lecturers	**10**
ICT Professionals	**10**
Industries	**10**
Total Population	280

For a good representation of the population, 50% of the total population (accessible) for students was randomly sampled for the study. Table 4B shows the schematic diagram of the stratification of the accessible population into 13 strata. Out of the 280, 140 were randomly sampled for the study. The following (Figure 4.1) diagram illustrates a schematic overview of the proportional stratified and sampling procedure used to randomly sample 140 respondents for the study.

Table 4B: Stratification of Accessible Population

Strata	Population for the Study	Accessible Population
	Industrial Art Foundation	
ST - 1	Year 1	50
	Textiles Section	
ST – 2	Year 2	30
ST – 3	Year 3	30
ST – 4	Year 4	30
	Metal Products Design Section	
ST – 5	Year 2	20
ST – 6	Year 3	20
ST – 7	Year 4	20
	Ceramics Section	
ST – 8	Year 2	10
ST – 9	Year 3	10
ST - 10	Year 4	10
ST - 11	**Graduates**	20
ST - 12	**Lecturers**	10
ST - 13	**ICT Professionals/Industries**	20
	Total Population	**280**

Schematic Overview of the Proportional Stratified and Sampling Procedure

Population level	**Total Population 280**												
Proportional Stratification level	ST1 50	ST2 30	ST3 30	ST4 30	ST5 20	ST6 20	ST7 20	ST8 10	ST9 10	ST10 10	ST11 20	ST12 10	ST13 20
Randomisation Level (Sampling) 50%	25	15	15	15	10	10	10	5	5	5	10	5	10
Total Randomised Stratified Sample (Data Level)	**140**												

* ST – Stratum
All figures used in sample design are estimates

Figure 4.1: Schematic Diagram of the Proportional Stratified Sampling Design

Source: Leedy and Ormrod (2005)

4.5 Instrumentation

The primary data collection was carried out in two phases. Phase one comprised questionnaire and that of phase two, interview. The use of more than one method of data collection is called triangulation. There are two key reasons why triangulation was used in this context. Firstly, by using more than one method, the "researcher is able to address different aspects of the same research question, thereby extending the breadth of the project." Secondly, by "employing methods from different research paradigms, the researcher is able to compensate for inherent weaknesses in each approach" (Gorman & Clayton, 1997). With the use of triangulation, the researcher was able to draw on the unique strengths of each instrument (questionnaire or interview) – thus providing both macro-and micro-level perspectives in a single project.

In the first phase, questionnaire (see Appendix A1) was the main research instrument for collecting the primary data. Questionnaire was drawn on because, it has standardized answers that make it simple to compile data and also the respondents could read and write. Romiszowski and Mason (1996) stated that a survey questionnaire is one of the most commonly used techniques in ICT-based education evaluation studies. The questionnaire was divided into three sections: demographic information; concepts on IT/ICT; and general information on ICT implementation, education, use, and integration. Basically, the questionnaire centred on ascertaining the level of ICT education in Ghana, its implementation, use, integration, and instruction.

The second phase of the primary data collection consists of telephone interviews. In quantitative research studies, survey research, however, interviews are fairly structured (Leedy & Ormrod, 2005). Telephone interview was used to solicit

data from stakeholders in some industries in Ghana, to establish the calibre of school products the industry needs in terms of ICT knowledge and skills. Moreover, the key reason for using interview is that it allowed the researcher to clarify ambiguous answers and, when appropriate, seek follow-up information. Also, because of its remote nature access to virtually anyone who has a telephone and then also, the limited number of respondents. In this study semi-structured interview was used to solicit data. Interview guide was designed in this regard (see Appendix B). Leedy and Ormrod (2005) explained that in a semi-structured interview, the research may follow the standard questions (interview guide) with one or more individual tailored questions to get clarification or probe a person's reasoning.

4.6 Validation of Instruments

With the questionnaire, both closed-ended and opened-ended questions were structured and administered to elicit data for this study. The questionnaire targeted the following respondents such as students, graduates and lecturers of DIA and ICT professionals who are stakeholders in curriculum development process. Some industries in Ghana were also administered to both structured and unstructured interview.

In validation, pretest was conducted to enable the researcher draw feasible and valid questionnaire to solicit for relevant data from the sampled population; few copies of the questionnaire were distributed to students in DIA and Art Education of CASS, KNUST, ICT specialists and lecturers. In effect, the questionnaire was vetted by scrutiny, criticism and suggestions to avert ambiguity of words and syntax. Subsequently, the final questionnaire and the interview guide were validated by the researcher's supervisor in agreement with the researcher.

4.7 Administration of Instruments

Copies of questionnaire were administered to students, graduates and lecturers in-person. But that of the ICT specialists and graduates, a preponderance of them were administered via emails. Telephone interview was used to elicit information from some related industries in Ghana. This, however, was attained with a structured interview guide (see Appendix B).

4.8 Data Collection Procedures

Because of the imperative use of ICT in our daily activities, the respondents' responses were swift and 96.3% (in table 4C) of the copies of questionnaire administered were retrieved in-person and by email.

With the telephone interview, respondents were first informed through telephone conversation and subsequently served with the structured interview guide prior to the time of the interview. Respective interview time was scheduled with each one of them. Recording of the meeting times with the respondents was done via a mobile phone with a recording facility. Playback of the recordings helped to transcribe the data for analysis and discussion.

Table 4C: Distribution of administered copies of questionnaire and copies retrieved

No. of Administered Copies of Questionnaire	No. of Copies Retrieved	Percentage
135	130	96.3

4.9 Data Analysis Plan

The analysis of data collected from the questionnaire and interview are in facets. In the first part, copies of answered questionnaire were coded as variables and cases, and then analysed using the Statistical Package for Social Scientist software

(SPSS 15.0 Version). Basically, the technique of presentation of findings was descriptive statistics in which the findings are presented in tables. The analysis of findings was presented in three sections: demographic information of respondents; secondly, concepts on IT/ICT; and lastly, information on ICT education, in terms of implementation, use and integration. This survey was done to solicit information to ascertain the tier of ICT awareness, education, implementation, use, integration, and instruction. In effect, this would give a fair idea which will inform and impact on the development ICT Modular Framework for the Department of Industrial Art.

Besides, the second part discusses data collected from the telephone interview with some Industrial Art disciplines related industries in Ghana. The issue examined focused on ascertaining the calibre of school graduates the industry needs in terms of ICT knowledge and skills.

In the next chapter, discussion of findings from data collected with copies of questionnaire and through telephone interview was looked at extensively and summary of main findings made.

CHAPTER FIVE

DATA ANALYSIS AND RESULTS

In total there were 140 respondents in the surveys conducted. These surveys were open to students and graduates of DIA, ICT Professionals, lecturers and some Industrial Art related Industries. Further, out of the 140 respondents, 5 respondents from some industries were interviewed using telephone interview approach. Out of 135 respondents sampled for the study, 130 (96.3%) responded to the copies of administered questionnaire which are divided into demographic information; concepts on IT/ICT; and general information on ICT implementation, education, use, and integration. Therefore, data collection centred on these attributes.

5.1 Data collected through Questionnaire

Section A: Demographic Information on Respondents

Lewis (2007) defined demographic as a statistic characterizing human populations or segments of human populations broken down by age or sex or income, among others. However, issues discussed in Section A, included age, gender, region and status.

In the Table 5.1, age groups ranging from 15 and above are indicative of the age range found in tertiary institutions. Apart from the lecturers and ICT professionals, contemporarily, the age group of tertiary students range averagely between 18 to 25 years. This age group is not incapacitation of learners and users of ICT and thus are the appropriate respondents in this study.

Table 5.1: Age group of Respondents

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	15-20 years	**23**	**17.7**	17.7	17.7
	21-25 years	**78**	**60.0**	60.0	77.7
	26-30 years	**25**	**19.2**	19.2	96.9
	31-35 years	**1**	**.8**	.8	97.7
	36-40 years	**1**	**.8**	.8	98.5
	Above 41 years	**2**	**1.5**	1.5	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

Looking at the distribution in Table 5.2 between male 53.1% and female 46.9%, it indicates no bias in the administered questionnaire but only reflects male-female ratio in school enrolment and the use of ICT. This marginal difference however, shows gender equity in this study.

Table 5.2: Gender

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Male	**69**	**53.1**	53.1	53.1
	Female	**61**	**46.9**	46.9	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

In terms of regional frequency (Table 5.3), the cases of the respondents skewed towards Greater Accra - 40% and Ashanti region - 27.7% which in no doubt are the two major cities with regard to the use of ICT in the country.

Tyler, in one of his assertions recommended that curriculum planners identify general objectives by gathering data from three sources: the learners, contemporary life outside the school, and the subject matter (Oliva, 1992).

Table 5.3: Region

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Gt. Accra	**52**	**40.0**	40.0	40.0
	Brong-Ahafo	**5**	**3.8**	3.8	43.8
	Eastern	**12**	**9.2**	9.2	53.1
	Central	**12**	**9.2**	9.2	62.3
	Ashanti	**36**	**27.7**	27.7	90.0
	Northern	**2**	**1.5**	1.5	91.5
	Upper East	**2**	**1.5**	1.5	93.1
	Upper West	**2**	**1.5**	1.5	94.6
	Volta	**5**	**3.8**	3.8	98.5
	Western	**2**	**1.5**	1.5	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

Incidentally, a preponderance of the respondents were students forming 86.9% because, they are the learners and substantial beneficiaries of this study. And contemporarily, lecturers/demonstrators, graduates and ICT professionals as shown in Table 5.4 represent the society.

Table 5.4: Status

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Student	**113**	**86.9**	86.9	86.9
	Lecturer/Demonstrator	**5**	**3.8**	3.8	90.8
	Graduate	**10**	**7.7**	7.7	98.5
	ICT Professional	**2**	**1.5**	1.5	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

Subsequently, detailed description of the students' representations according to their subject areas is shown in Table 5.5. Respondents were selected from the three Visual Arts programmes and that of the foundation class, offered by the Department because they are subject matter under review. Moreover, Table 5.6 represents the year levels of students. Note, not applicable response means that some respondents are not to answer the question or variable.

Table 5.5: Programme of Study and School

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Textiles, KNUST	**45**	**34.6**	34.6	34.6
	Ceramics, KNUST	**15**	**11.5**	11.5	46.2
	Metal Products Design, KNUST	**30**	**23.1**	23.1	69.2
	Foundation, Industrial Art-KNUST	**23**	**17.7**	17.7	86.9
	Not applicable	**17**	**13.1**	13.1	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

Table 5.6: Year of Students' Respondents

	Year	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1st Year	**23**	**17.7**	17.7	17.7
	2nd Year	**30**	**23.1**	23.1	40.8
	3rd Year	**30**	**23.1**	23.1	63.8
	4th Year	**30**	**23.1**	23.1	86.9
	Not applicable	**17**	**13.1**	13.1	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

With the lecturers/demonstrators, they were selected based on their relevance to the study. Computer Literacy teachers both servicing lecturers and non-servicing lecturers to the Department were selected because of their expertise, and as ICT teachers. Table 5.7 shows subject distribution of lecturers/demonstrators.

Table 5.7: Subject taught by Lecturers/Demonstrators

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Computer Appl. in Design, Media Project,	**1**	**.8**	.8	.8
	Computer Literacy	**3**	**2.3**	2.3	3.1
	Fabric Structure, Weaving Calculation	**1**	**.8**	.8	3.8
	Not applicable	**125**	**96.2**	96.2	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

Further, ICT professionals were also harnessed in view of Tyler's claim that curriculum planners identify general objectives by gathering data from contemporary

life outside the school (Oliva, 1992). In Table 5.8, 1.5% of ICT professionals were Project Managers of ICT Centres in some tertiary institutions in the country.

Table 5.8: Occupation of the ICT Professionals

	Responses	**Frequency**	**Percentage**	Valid Percentage	Cumulative Percentage
Valid	Project Manager	**2**	**1.5**	1.5	1.5
	Not applicable	**128**	**98.5**	98.5	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

Section B: Concepts of IT and ICT

To ascertain respondents' knowledge level of the subject matter, whether they read/heard of the term Information Technology (IT) and/or Information and Communication Technology (ICT)? Table 5.9 and Table 5.10 respectively reported 93.8% answered in affirmative Yes and 6.2% No, and 92.3% answered Yes and 7.7% No. From the answers given, the researcher had every reason to explore this subject matter.

Although the focus is on ICTs, a distinction between IT and ICT was drawn because, this subject matter is an evolving one and perhaps, respondents' familiarities with any of the two concepts should be conceded. Often, the two concepts are encapsulated into one concept due to lack of understanding in their definitions. This evidence is seen in Table 5.16.

Table 5.9: Respondents' understanding of Information Technology (IT)

	Responses	**Frequency**	**Percentage**	Valid Percentage	Cumulative Percentage
Valid	Yes	**122**	**93.8**	93.8	93.8
	No	**8**	**6.2**	6.2	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

Table 5.10: Respondents' understanding of Information and Communication Technology (ICT)

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	**120**	**92.3**	92.3	92.3
	No	**10**	**7.7**	7.7	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

In a succeeding question for both IT and ICT concepts, the respondents were asked if Yes, through which medium/media did you get to know? Tables 5.11 and 5.12 for IT and ICT respectively, apart from the 4.7 and 7.7% which indicated not applicable, a dominance making 21.5% and 22.3% respectively chose television. This means that much have not been done in the area of ICT education. It is expected that respondents have had at least second cycle educational qualification and might have come across such terms in their study. Thus, this is indicative of the fact that much should be done in this regard.

Table 5.11: Respondents knew about IT through the following Media

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Television, Radio, Newspapers, Internet, Literature	**17**	**13.1**	13.1	13.1
	Television, Radio,	**11**	**8.5**	8.5	21.5
	Television, Radio, Newspapers	**9**	**6.9**	6.9	28.5
	Television, Radio, Newspapers, Internet	**4**	**3.1**	3.1	31.5
	Television	**28**	**21.5**	21.5	53.1
	Radio	**6**	**4.6**	4.6	57.7
	Newspapers	**4**	**3.1**	3.1	60.8
	Internet	**22**	**16.9**	16.9	77.7
	Literature	**19**	**14.6**	14.6	92.3
	Television, Newspapers, Internet	**1**	**.8**	.8	93.1
	Radio, Newspapers, Internet, Literature	**3**	**2.3**	2.3	95.4
	Not applicable	**6**	**4.6**	4.6	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

Table 5.12: Respondents knew about ICT through the following media

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Television, Radio, Newspapers, Internet, Literature	**15**	**11.5**	11.5	11.5
	Television, Radio,	**11**	**8.5**	8.5	20.0
	Television, Radio, Newspapers	**7**	**5.4**	5.4	25.4
	Television, Radio, Newspapers, Internet	**3**	**2.3**	2.3	27.7
	Television	**29**	**22.3**	22.3	50.0
	Radio	**5**	**3.8**	3.8	53.8
	Newspapers	**4**	**3.1**	3.1	56.9
	Internet	**23**	**17.7**	17.7	74.6
	Literature	**21**	**16.2**	16.2	90.8
	Television, Newspapers, Internet	**2**	**1.5**	1.5	92.3
	Not applicable	**10**	**7.7**	7.7	100.0
	Total	**130**	**100.0**	100.0	

Source: Fieldwork, August-October 2007

However, to explore the two concepts further the respondents were inquired of, which of them are you familiar with. Out of the cases presented in Table 5.13, 35.4% IT, 34.6% ICT and 21% chose both which means that respondents have close familiarity with the two terms.

In spite of the difference in the quotations for IT and ICT when the 34.6% (ICT) and 21% (IT/ICT) are subsumed, it sums up to 55% which gives a fair understanding of the subject matter. But much should be done especially in education for the ICT concept to be assimilated.

Table 5.13: Respondents' familiarities between IT and ICT

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	IT	**46**	**35.4**	36.8	36.8
	ICT	**45**	**34.6**	36.0	72.8
	IT & ICT	**28**	**21.5**	22.4	95.2
	None of them	**6**	**4.6**	4.8	100.0
	Total	**125**	**96.2**	100.0	
Missing	System	**5**	**3.8**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

Besides, when asked what do you understand by Information Technology? How one defines a term indicatively shows the sort of knowledge one has in that area. In Table 5.14, because 17.7% of the respondents do not know the meaning of IT, they were indifferent which indicated missing. However, out of the cases presented both 27.7% and 21.5% are limited in their definitions which also form a chunk when aggregated. It indicates that although the respondents have heard/read of IT, they do not have much understanding of it and thus calls for more education. The 2.3% defined it based on Encarta encyclopaedia definition that is "processing and distribution of data using computer hardware and software, telecommunications, and digital electronics."

But according to the Information Technology Association of America (Wikipedia, 2009) and Salaam (2009), which is more detailed, IT is "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware.

Table 5.14: Respondents' Concepts of IT

	Responses	**Frequency**	**Percentage**	Valid Percentage	Cumulative Percentage
Valid	Transmit and receive information using computer	**36**	**27.7**	33.6	33.6
	Linking of computers together to share information	**17**	**13.1**	15.9	49.5
	Surfing and retrieving of information from the internet	**19**	**14.6**	17.8	67.3
	The use of computer and its application	**28**	**21.5**	26.2	93.5
	Ways of communicating information using technology	**3**	**2.3**	2.8	96.3
	Processing and distribution of data using computer hardware and software, digital electronics, and telecommunications.	**3**	**2.3**	2.8	99.1
	Devices and media as related to computer	**1**	**.8**	.9	100.0
	Total	**107**	**82.3**	100.0	
Missing	System	**23**	**17.7**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

However, the question 'what do you understand by Information and Communication Technology (ICT)?' According to Table 5.15, respondents expressed different shades of opinion but only 3.1% were able to define but not detailed. Moreover, 20.8% did not put up any case, indicating missing. Although respondents are aware of ICT, they do not have the knowhow which tend to limit their accessibility and use and therefore require more ICT education even in subject areas.

Further, ICT in education according to the World Bank (ICT and Education, 2008) consist of the hardware, software, networks, and media for the collection, storage, processing, transmission and presentation of information (voice, data text, images), as well as related services. This clearly spelt out what ICT is and its attributes.

Table 5.15: Respondents' Concepts of ICT

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Is software application	**23**	**17.7**	22.3	22.3
	Means of communication using the internet	**42**	**32.3**	40.8	63.1
	Mainly deals with communication through technology	**34**	**26.2**	33.0	96.1
	is an umbrella term that includes all technologies for the communication of information	**4**	**3.1**	3.9	100.0
	Total	**103**	**79.2**	100.0	
Missing	System	**27**	**20.8**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

In Table 5.16, there are three categories of respondents. The first category (46.9%) sees IT and ICT to be the same, different terms but the same meaning. The second category (24.6%) differentiates between the two concepts in view that IT refers to the technologies used in communication and ICT refers to the use of these technologies to communicate information. It could be deduced that, IT can be defined as the technology used to manage information and ICT defined as the technology to

manage information and aid communication. In practice, the two terms are interchangeably used. The last category (28.5%) was indifferent because they could not differentiate between the two concepts.

In aggregating the responses, it is revealing that more people with various levels of education do not know the difference between the two and thus students should be taught comprehensively in subject areas.

Table 5.16: Respondents' Idea about IT and ICT

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	they are the same	**61**	**46.9**	65.6	65.6
	IT refers to the technologies used in communication & ICT refers to the use of these technologies to communicate information	**32**	**24.6**	34.4	100.0
	Total	**93**	**71.5**	100.0	
Missing	System	**37**	**28.5**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

In determining the advantages to which respondents have used IT/ICT, Table 5.17 enumerates some uses. Even though respondents have not encapsulated all the attributes of the two concepts, quite a number forming 20.8% have not realised the potentials of ICT in their everyday lives. This nevertheless indicates the limited use of ICT in our societies, education and professions.

Table 5.17: Respondents' use of IT/ICT

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	To communicate, learn, and retrieve information	**36**	**27.7**	35.0	35.0
	Used it in my studies	**33**	**25.4**	32.0	67.0
	For internet surfing	**34**	**26.2**	33.0	100.0
	Total	**103**	**79.2**	100.0	
Missing	System	**27**	**20.8**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

To probe further respondents' understanding of the subject matter, they were asked 'which devices, tools or machines do you term as ICT.' According to Table

5.18, although the focus is on computer, on the average it is not enough and thus, there is the need for more awareness creation in order to make the education system effective and efficient to meet social and individual needs.

Table 5.18: Devices, tools or machines termed as ICT by Respondents

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Computer	**50**	**38.5**	47.2	47.2
	Computer & internet	**13**	**10.0**	12.3	59.4
	Computer, phone & calculator	**21**	**16.2**	19.8	79.2
	Any device that uses chips and microprocessors	**22**	**16.9**	20.8	100.0
	Total	**106**	**81.5**	100.0	
Missing	System	**24**	**18.5**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

Section C*:* General Information on ICT implementation, Education, Use, and Integration.

In Table 5.19, it was observed that respondents gave varied opinions in their definitions of curriculum but is superficial when juxtaposed by Tyler's definition, among others.

Table 5.19: Concepts of Curriculum

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Introducing students to learning experiences	**22**	**16.9**	25.0	25.0
	A step by step order of educating students	**37**	**28.5**	42.0	67.0
	Is the number of activities or programmes one studies in an institution	**29**	**22.3**	33.0	100.0
	Total	**88**	**67.7**	100.0	
Missing	System	**42**	**32.3**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

Subsequently, the respondents were asked if they think Ghanaians need a national ICT curriculum to produce the requisite human capital required by the information age. In response in Table 5.20, 82.3% presenting preponderance chose

Yes. This indicates the growing need for contemporary initiatives to improve and make efficient teaching and learning in our educational institutions. It therefore calls for drastic measures to review our Education System to meet technological advances.

Table 5.20: Responses to the need of a National ICT curriculum

Responses		**Frequency**	**Percentage**	Valid Percentage	Cumulative Percentage
Valid	Yes	**107**	**82.3**	95.5	95.5
	No	**5**	**3.8**	4.5	100.0
	Total	**112**	**86.2**	100.0	
Missing	System	**18**	**13.8**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

A follow-up to the question was if Yes, why? In Table 5.21, 40% of the respondents believed that it will improve research works, 26.9% was of the view that it will enhance communication in the nation, and 13.1% answered to be inclined globally. Contextually, this variable was discussed against the backdrop of education and communication but there are numerous uses for ICTs. Proper restructuring of departments and institutions curricula, teaching and learning will help address some of these pitfalls.

Table 5.21: Reasons to the need of a National ICT curriculum

	Responses	**Frequency**	**Percentage**	Valid Percentage	Cumulative Percentage
Valid	To enhance communication in the nation	**35**	**26.9**	32.4	32.4
	To improve research works	**52**	**40.0**	48.1	80.6
	To be inclined globally	**17**	**13.1**	15.7	96.3
	Not applicable	**4**	**3.1**	3.7	100.0
	Total	**108**	**83.1**	100.0	
Missing	System	**22**	**16.9**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

To determine whether respondents are aware that there is a foundational policy underlying the use and integration of ICT into our education system and socio-economic activities; they were asked is there a National Policy on ICT Education? The quotations in Table 5.22, 41.5% Yes and 40% No, which indicate the average

nature of awareness, thereby culminating in the need for more education on ICT through curriculum reviews by the educational institutions.

Table 5.22: Responses of whether there is a National Policy on ICT Education

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	**54**	**41.5**	50.9	50.9
	No	**52**	**40.0**	49.1	100.0
	Total	**106**	**81.5**	100.0	
Missing	System	**24**	**18.5**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

In a succeeding question in Table 5.23, the respondents were asked if Yes, how did you get to know? Because a preponderance of the respondents were students, it is obvious that in the responses presented in Table 5.23, school (1.5%) should have dominated but rather the internet (18.5%). Due to the average manner of responses in Table 5.22, quite a number forming 39.2% chose Not Applicable. Besides, 18.5% chose nothing which indicates missing. In view of these, valid responses in Table 5.23 show the limited use and integration of ICT resources and thus, requiring contemporary ways of disseminating ICT resources and information through proper teaching and learning methods.

Table 5.23: Media through which respondents knew about the National Policy on ICT Education

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Television	**17**	**13.1**	16.0	16.0
	Internet	**24**	**18.5**	22.6	38.7
	Television & Radio	**10**	**7.7**	9.4	48.1
	New Education Reforms	**2**	**1.5**	1.9	50.0
	School	**2**	**1.5**	1.9	51.9
	Not applicable	**51**	**39.2**	48.1	100.0
	Total	**106**	**81.5**	100.0	
Missing	System	**24**	**18.5**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

Responses presented in Table 5.24 show that 64.6% answered No and on the contrary 33.1% answered Yes; when asked do you think much have been done in terms of ICT education, implementation and use? This defines the inefficiency, especially in the context of education. Through curriculum reforms, the university must produce ICT integrated subject professionals to man various sectors of the economy. Imperatively, universities among other institutions have been identified by ICT4AD Policy committee as the key implementation agencies. From the data presented, it can be deduced that not enough has been done to promote ICT in education.

Table 5.24: Respondents' View on the use, implementation and education of ICT

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	**43**	**33.1**	33.9	33.9
	No	**84**	**64.6**	66.1	100.0
	Total	**127**	**97.7**	100.0	
Missing	System	**3**	**2.3**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

Among the distributions in Table 5.25, prominence should be given to 50.8% which indicates average. Although Ghana is still at the integration stage of ICT development, more efforts in curriculum reviews and infrastructure development are required to catapult Ghana into the transformation stage.

Table 5.25: Impressions of the Respondents on the level of ICT Education in the Country

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Very poor	**25**	**19.2**	19.7	19.7
	Poor	**19**	**14.6**	15.0	34.6
	Average	**66**	**50.8**	52.0	86.6
	Good	**16**	**12.3**	12.6	99.2
	Very good	**1**	**.8**	.8	100.0
	Total	**127**	**97.7**	100.0	
Missing	System	**3**	**2.3**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

At this stage, there is a drastic takeover of ICT in our socio-economic activities, transforming every aspect of our daily lives.

In addressing this problem, respondents were asked what they would propose when it comes to developing an ICT curriculum for students. According to the responses in Table 5.26, 14.6% indicated that students should be introduced at a tender age, this had been mainstreamed in the Education Reforms 2007; 37.7% also stated that computers should be used in schools and institutions.

Moreover, 20.8% indicated that quality teachers must be employed, and lastly, 13.8% said that the curriculum should cover primary, secondary and tertiary institutions. In culminating these responses, ICT should be introduced in all spheres of school education with corresponding infrastructure and human capital.

Table 5.26: Respondents' suggestions about ICT curriculum Implementation

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	students should be introduced at a tender age	**19**	**14.6**	16.8	16.8
	Provide every school and institution with computers	**49**	**37.7**	43.4	60.2
	Qualify teacher must be employed	**27**	**20.8**	23.9	84.1
	The curriculum should cover primary, secondary & tertiary institution	**18**	**13.8**	15.9	100.0
	Total	**113**	**86.9**	100.0	
Missing	System	**17**	**13.1**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

To inquire whether respondents can identify some areas in the socio-economic activities where ICT is impacting tremendously, in Table 5.27, mention has been made of some sectors leaving out an important sector like the security. This shows the limited knowledge in the use of ICT. More education is required so that people will know and understand the potentials of ICT in their socio-economic development to improve living standard.

Table 5.27: Sectors of the Economy on which ICT impacts

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Education	**32**	**24.6**	28.1	28.1
	Health, Education & Agriculture	**20**	**15.4**	17.5	45.6
	Industry	**10**	**7.7**	8.8	54.4
	Agriculture, education & Business	**8**	**6.2**	7.0	61.4
	Agriculture	**5**	**3.8**	4.4	65.8
	Business	**26**	**20.0**	22.8	88.6
	Communication	**8**	**6.2**	7.0	95.6
	Entertainment	**1**	**.8**	.9	96.5
	All sectors	**4**	**3.1**	3.5	100.0
	Total	**114**	**87.7**	100.0	
Missing	System	**16**	**12.3**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

The respondents were asked 'do you think ICT is the answer to the problems of developing countries such as Ghana?' Reponses in Table 5.28, 69.2% Yes, clearly shows the realization and readiness of the respondents to use ICT in transforming their socio-economic activities. Significantly, they have identified ICT as a vehicle for fostering development in all sectors of the economy in this 21st century. Transforming the economy and socio-economic activities largely depends on a good educational foundation to train requisite human capital to man those sectors. In addition to Table 5.28, the respondents were asked to state what they think it can do.

Table 5.28: Respondents' views on if ICT is a panacea to Developing Countries' Problems

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	**90**	**69.2**	72.6	72.6
	No	**34**	**26.2**	27.4	100.0
	Total	**124**	**95.4**	100.0	
Missing	System	**6**	**4.6**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

In Table 5.29, 13.1% stated that it will augment learning, 40% were of the opinion that it makes things faster and easier, 26.9% stated it will create jobs, and

10.8% also noted that it can connect us to the global village. These explain the tremendous benefits derived from ICT integration, which makes human activities effective and efficient.

Table 5.29: Views on the Impact of ICT in National Development

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Augment learning	**17**	**13.1**	14.4	14.4
	It makes things faster and easier	**52**	**40.0**	44.1	58.5
	Create jobs	**35**	**26.9**	29.7	88.1
	Join us to the global village	**14**	**10.8**	11.9	100.0
	Total	**118**	**90.8**	100.0	
Missing	System	**12**	**9.2**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

The effective use of ICT is becoming the most critical factor for rapid economic growth and wealth creation, and for improving socio-economic well-being. When asked, do you think there are cultural barriers that impede the implementation, process and use of ICT? 59.2% stated Yes and 36.9% stated No. Responses in Table 5.30 show the level of understanding to use ICT to transform teaching learning, business and other socio-economic activities, without impeding with it conventional cultural practices. Although majority indicated No, the 36.9% delineates some cultural barriers in Table 5.31.

Table 5.30: Cultural barriers

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	**48**	**36.9**	38.4	38.4
	No	**77**	**59.2**	61.6	100.0
	Total	**125**	**96.2**	100.0	
Missing	System	**5**	**3.8**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

Moreover, those who responded Yes when asked to state the cultural barriers. Out of 48 respondents who stated Yes, 20.8% indicated that technology is a man's

job; 9.2% explained that children should not play with sophisticated gadgets; 0.8% stated that language systems and traditions and lastly, quite a number were indifferent (10.8%). Even though some of the responses are legitimate, measures in the form of education could help curtail these phenomena which impede the use and implementation of ICT policies in the country.

Table 5.31: Views on some Cultural Barriers that impede the Implementation, Process and Use of ICT

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Technology is a man's job.	**27**	**20.8**	23.3	23.3
	Children should not play with sophisticated gadgets	**12**	**9.2**	10.3	33.6
	Language systems and traditions	**1**	**.8**	.9	34.5
	Not applicable	**76**	**58.5**	65.5	100.0
	Total	**116**	**89.2**	100.0	
Missing	System	**14**	**10.8**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

When asked in terms of use, do you think Ghanaians are patronizing ICT effectively and efficiently? Responses in Table 5.32 indicate that Ghanaians have accepted to buy into contemporary technologies to optimize processes and improve their living standards. In the table, 54.6% indicated Yes and 40.8% indicated No, arguably, 54.6% though marginal in terms of the number of respondents. This means that policy implementations and education on ICT have contributed in this regard.

Table 5.32: Respondents' views on the level of ICT patronage among Ghanaians

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	**71**	**54.6**	57.3	57.3
	No	**53**	**40.8**	42.7	100.0
	Total	**124**	**95.4**	100.0	
Missing	System	**6**	**4.6**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

Subsequently, those who responded No, in Table 5.32 when asked whether they think Ghanaians are patronizing ICT, in Table 5.33, 13.8% explained that lack of education; 26.9% due to cost and accessibility and 53.1% indicated not applicable because they chose Yes. The two responses are in line with an assertion made in the ICT4AD Policy document, 2003. It explained that relatively high proportion of the population with no educational attainment; a high school drop-out rate and limited access to higher education by the vast majority of the population. Consequently, this study seeks to bridge this lacuna by training the requisite human capital resources for the information-rich and knowledge-based economy.

Table 5.33: Reasons why Ghanaians do not patronize ICT

	Responses	**Frequency**	**Percentage**	Valid Percentage	Cumulative Percentage
Valid	Lack of education	**18**	**13.8**	14.8	14.8
	Due to cost and accessibility	**35**	**26.9**	28.7	43.4
	Not applicable	**69**	**53.1**	56.6	100.0
	Total	**122**	**93.8**	100.0	
Missing	System	**8**	**6.2**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

The respondents were asked to list some difficulties faced by Ghanaians in the use of ICT. In Table 5.34, the responses stated are legitimate in that in the purview of the Ghana ICT4AD Policy 2003, the policy document identified these policy challenges among others - limited human resource capacity characterized by low professional, technical and managerial manpower base; under-developed physical infrastructure, and poor and limited communications and telecommunications infrastructure. These are some of the major problems faced by Ghanaians in the quest of using ICT to improve their communication and knowledge-based socio-economic activities.

Table 5.34: Some difficulties faced by Ghanaians in the use of ICT

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Access ICT education	**34**	**26.2**	28.6	28.6
	Lack of equipment and infrastructure	**44**	**33.8**	37.0	65.5
	Lack of expertise, accessibility and cost intensive	**41**	**31.5**	34.5	100.0
	Total	**119**	**91.5**	100.0	
Missing	System	**11**	**8.5**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

In finding out whether ICT is appropriately integrated into our socio-economic activities can help alleviate poverty. According to Table 5.35, 68.5% stated Yes and 27.7% indicated No. With the 68.5% indicating Yes, it is explicit that the respondents have realized the potentials of ICT in improving their socio-economic activities and developments. It has been acknowledged (The Ghana ICT4AD Policy, 2003) that for Ghana to move her industrially weak and subsistence agriculture-based economy towards an information and knowledge economy, she will need to develop and implement comprehensive integrated ICT-led socio-economic development policies, strategies and plans.

Table 5.35: Responses to if ICT integration can help alleviate Poverty

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	**89**	**68.5**	71.2	71.2
	No	**36**	**27.7**	28.8	100.0
	Total	**125**	**96.2**	100.0	
Missing	System	**5**	**3.8**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

In a follow-up question in Table 5.36, the respondents were asked if Yes, how and if No, why? In response, 26.2% stated Yes and stated that people would have easy access to information; 40% answered Yes and added that it will provide jobs; and lastly, 23.8% No, it would rather reduce it. In the light of the two responses (26.2%

and 40%), respondents have recognised the benefits of ICT in an ICT-led socio-economic activities. The onus is on the government and non-governmental organisations to intensify ICT pedagogy at all levels particularly at the tertiary level. Apparently, the respondents who stated No, misconstrued alleviate to mean bring to an end.

Table 5.36: Reasons for Yes and No Responses

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes, people will have easy access to information	**34**	**26.2**	29.1	29.1
	Yes, it will provide jobs	**52**	**40.0**	44.4	73.5
	No, It would rather reduce it	**31**	**23.8**	26.5	100.0
	Total	**117**	**90.0**	100.0	
Missing	System	**13**	**10.0**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

The researcher inquired whether respondents are aware of the importance of ICTs integration and used in subject areas. Responses in Table 5.37 indicate 100%, aside the missing value. This means that respondents are aware of the paradigm shift and the enormous potentials an individual can derive from ICT when used as a vehicle to facilitate and optimise socio-economic activities.

Table 5.37: Respondents' view on ICT integration and use in Disciplines

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	**125**	**96.2**	100.0	100.0
Missing	System	**5**	**3.8**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

The respondents were asked is there gender equity in the study and use of ICT? If there is gender inequity in the study and the use of ICTs, basically, no national/institutional policy on ICT will be achieved. Since its use and study will divide along gender, level and age. This however, defeats the objectives of such

policies in that, it does not bring everyone on deck. In one of the specific objectives of the policy of the Ghana ICT for Accelerated Development; is to accelerate the development of women and eliminate gender inequalities in education, employment, decision making through the deployment and exploitation of ICTs by building capacities and providing opportunities for girls and women.

Responses in Table 5.38 indeed indicate some level gender inequity, 48.5% Yes and 46.9% No, although both fall below 50% and the disparity between the two is very narrow. From this sample population, it can be asserted to some extent that there is no gender inequity as far school enrolment is concerned, because it is as a result of male-female ratio intake in schools.

Table 5.38: Gender equity in the study and use of ICT

Responses		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Yes	**63**	**48.5**	50.8	50.8
	No	**61**	**46.9**	49.2	100.0
	Total	**124**	**95.4**	100.0	
Missing	System	**6**	**4.6**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

When asked how does the future look like for Ghana after integrating ICTs into our socio-economic activities? According to Table 5.39, 77.7% of the respondents stated bright. From this result, it is to be believed that respondents are much aware of the returns of ICT integration in their socio-economic activities and therefore are optimistic that the country will benefit or likely to be successful. Fundamentally, this is achievable on the premise of proper educational system, where ICT serves as a catalyst.

The policy statement of ICT4AD defines Ghana's ICT-driven development agenda to accelerate socio-economic development process towards the realization of the vision to transform Ghana into a high income economy and society that is

predominantly information-rich and knowledge-based within the next two to three decades or less.

Table 5.39: The future of Ghana after integrating ICTs into its socio-economic activities

	Responses	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Bright	**54**	**41.5**	43.5	43.5
	Bleak	**6**	**4.6**	4.8	48.4
	Promising	**47**	**36.2**	37.9	86.3
	trailing behind our colonial masters	**5**	**3.8**	4.0	90.3
	developed country	**12**	**9.2**	9.7	100.0
	Total	**124**	**95.4**	100.0	
Missing	System	**6**	**4.6**		
Total		**130**	**100.0**		

Source: Fieldwork, August-October 2007

In concluding this section on ascertaining the tier of ICT awareness, education, implementation, use, integration, and instruction, it must be noted that ICTs are not being utilised effectively enough to transform pedagogy and socio-economic activities.

5.2 Data collected through Interview

The telephone interview was open to some Industrial Art related Industries in Ghana. In order to synchronize the department and the industry on the kind of graduates to train as resources, five industries were interviewed. An interview guide (see Appendix B) was tailored to ascertain the calibre of graduates the industry needs in terms of ICT knowledge and skills. Industries interviewed include three Textiles companies, one Metal company and one ceramic company.

With the first variable (Do you employ school products from the university into your departments?), the companies indicated Yes when asked whether they do employ graduates from the university into their departments. Subsequently, when asked what sort of ICT skills they require from these products, there was a

commonality of idea that is they need products with basic ICT skills. Moreover, specifics in terms of the use of designate software were indicated by the diverse companies. Textiles companies made mentioned of application programmes such as CorelDraw and Adobe PhotoShop and Illustrator and further explained that, they actually use custom-made software which is not on the open market for institutions to purchase. They wish graduates know and understand the aforementioned software before seeking employment.

Ceramics and Metals companies apparently shared the same idea and added that the students should be taught contemporary 3D software such Rhino, 3D StudioMax and Maya, among others, so that when they come, there will be less on-the-job training for them.

Collectively, the companies did not state any special computer application programmes apart from the readily available ones on the market, but rather stressed the need for students to study them before seeking employment. In suggestion, all the companies shared a common front by saying that there should be periodic reviews of syllabus to meet current trends of knowledge and also, constant interaction between departments and the industries so that graduates are obsolete before seeking employment.

5.3 Main Findings

The overall objective of Ghana ICT4AD Policy is to engineer an ICT-led socio-economic development process with the potential to transform Ghana into a middle income, information-rich, knowledge-based and technology-driven economy and society. With this policy direction, it has become imperative that revision of ICT

modular course framework across educational curricula is required. This is apparently confirmed by responses collected from the survey.

However, this survey was designed to solicit information to ascertain the tier of ICT awareness in terms of education, implementation, use, integration, and instruction.

The following are some main observations made:

1. Apparently, close to 90% of respondents were responsive to the word ICT but 75.4% do not know the ramifications of ICT concepts nor could they differentiate between IT and ICT. This explains their limited knowledge and skills in ICT.
2. Respondents' source of knowledge about ICT was through the use of television rather than school education, indicating the limited nature ICT education in our school system.
3. Close to 96% of the respondents could not define the term ICT which therefore calls for drastic curriculum reviews for ICT subject-integration across disciplines.
4. Lack of an effective, comprehensive and dynamic curriculum tends to limit education, accessibility and use of ICTs.
5. Respondents could not properly enumerate the advantages to which they use ICT. This nevertheless indicates the limited use of ICT in our societies, education and professions.
6. There are some cultural barriers that impede the use, implementation and integration of ICTs.

7. ICT when properly integrated in our education and socio-economic activities, it would foster a holistic training of students to perfectly fit into the agenda of information-rich and knowledge-based economy, industry and society.
8. There is limited human resource capacity characterized by low professional, technical and managerial manpower base in ICTs.

To some extent, the proposed IMF for DIA will aid Ghana's development process by contributing to addressing the nation's key developmental challenges in industry, society and the knowledge-based economy. In spite of the challenges emanating from the findings, the framework aims at providing a holistic ICT-based training of students to become an asset for development.

The survey was to solicit information in ascertaining the tier of ICT awareness, education, implementation, use and integration which will inform and impact on the development of IMF for DIA. The extensive data sets (responses) from the survey sorted in many different ways, analyzed and discussed to an exhaustive or conclusive dimension, offered a broader view of trends and patterns that borders on ICT awareness, education and use.

However, students, close to 88% forming a preponderance of respondents' population, exhibited limited knowledge and skills against the backdrop of enormous benefits ICT has to offer. In view of the findings, it can be acknowledged that there is the need to revise the ICT modular course structures to meet current challenges and take advantage of rapidly evolving technologies. This dissertation seeks to achieve this in the purview of developing ICT Modular Framework for DIA; to provide a holistic ICT-based training of students for today's technology-based industry, society and the knowledge-based economy, using ICT as a catalyst.

As explained by Tyler that curriculum planners identify general objectives by gathering data from three sources: the learners, contemporary life outside the school, and the subject matter. Contemporary life outside the school like the industry as a stakeholder was also surveyed. This, however, was done to know the expectations of the industry in the information age and also, because it forms part of curriculum development process. In the assertion of the sampled industries, it is appropriate if graduates during course of study are systematically given introduction, intermediate and advanced training in contemporary ICTs education as part of their subject area. This research seeks to provide a holistic ICT-based training of students for today's technology-based industry, institution, society and the knowledge-based economy.

CHAPTER SIX

PROPOSED ICT MODULAR FRAMEWORK FOR THE DEPARTMENT OF INDUSTRIAL ART, KNUST

6.1 Preamble

Information and Communication Technology (ICT) has become, within a very short time, one of the basic building blocks of modern society. Understanding ICT and mastering the basic skills and concepts are now regarded by many countries, including Ghana as part of the core of education alongside reading and writing. KNUST which trains students in various disciplines under science and technology is inextricable in this current phenomenon. Since 1964, the Department of Industrial Art (DIA) made up of Textiles, Metal Products Design and Ceramics, has undergone several curriculum structure adjustments. In the light of these adjustments, there has not been any major structural adjustment in view of proper ICT integration in DIA curriculum.

However, this proposal seeks to achieve the University's vision of advancing knowledge in science and technology for sustainable development in Africa. Primarily, this serves as a catalyst to the Department's mission of producing properly trained graduates with the requisite knowledge and skills for today's technology-based industries, society, and knowledge-based economy. The framework will offer students with a broad-based knowledge in every aspect of information and communications technologies in their course of study.

The proposed ICT modular framework is composed of Textiles, Metal Products Design, Ceramics and Fashion Design and Clothing. The ICT curriculum is not intended to stand alone, but it is designed as a module to be integrated into DIA, and KNUST curricula. However, the framework provides ICT modules and subject-

integration of computer-based courses in Textiles, Metal Products Design, Ceramics and Fashion Design and Clothing. The framework is represented in Figure 6.1 with the theme, ICT Integration for Accelerated Industrial Art Education ***(ICT+IAE)***. This illustrates the philosophy of using ICT to transform teaching and learning of Visual Arts with the aim to producing holistic graduates for today's knowledge and information-based economy.

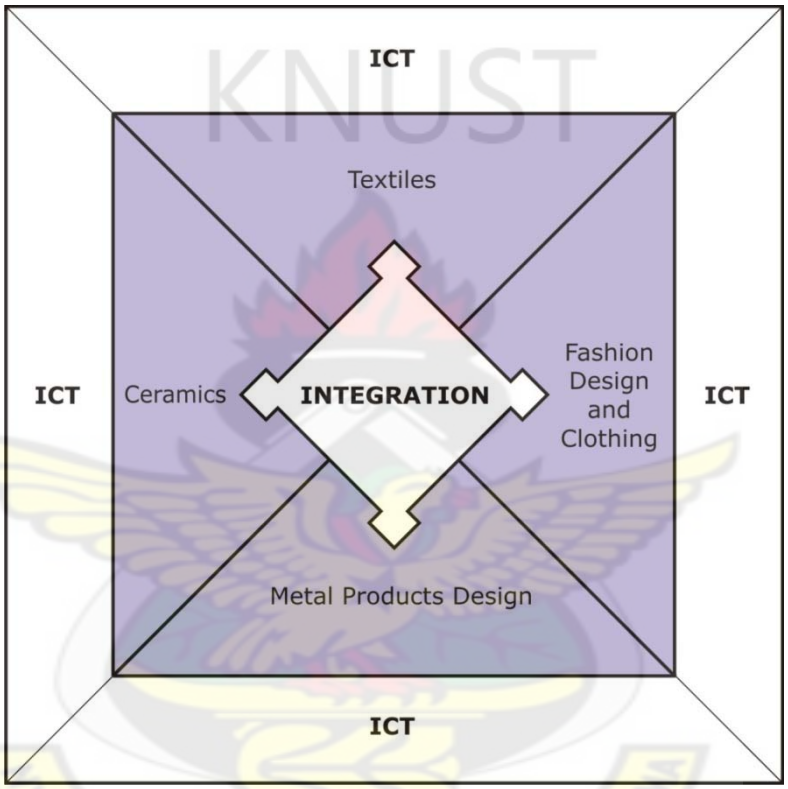


Figure 6.1: The Proposed ICT Module Integration Framework Model

6.2 Mode of Assessment

In line with DIA assessment policy, written examination papers, class tests, long essays, assignments, fieldwork reports in addition, practical examination and project works constitute the assessment for credentialing.

6.3 General Objectives

The general objectives of the ICT Modular Framework are to:

1. Train students in the theoretical and practical aspects of ICT in Textiles, Metal Products Design, Ceramics, and Fashion Design and Clothing.
2. Equip students with a coherent and broad understanding of the principles, methodologies, and applications of ICT in the modern world for them to become lifelong learners.
3. Train students to acquire ICT working knowledge and skills for today's technology-based industries and knowledge-based economy.
4. Serve as a multi-modal approach to other Visual Art Disciplines for the development of comprehensive ICT modular courses at the tertiary level.

6.4 Modular Course Structure

In the course structure, **T** - theory time, **P** – practical time and **C** – credit hours, describing the number of hours apportioned to each ICT course. ICT 151 is designated course code to identify each course. The course title, for example Introduction to Computers, gives an idea about the course contents and the learning experience students have to accomplish.

All year one students in Textiles, Metal Products Design (MPD), Ceramics and Fashion Design and Clothing (FDC) take the same foundation courses: ICT 151, 152, 153, 154.

6.4.1 Year One - Course Structure

Year One Semester One			**T**	**P**	**C**
ICT	151	Introduction to Computers	2	1	2
ICT	153	Introduction to Computer Skills	1	2	2
		Total	**3**	**3**	**4**

Year One Semester Two			T	P	C
ICT	152	Desktop Publications I	1	2	2
ICT	154	Intro. to Computer Networking & Internet Technique Application	1	2	2
		Total	**2**	**4**	**4**

6.4.2 Textiles - Course Structure

Year Two: Semester One			T	P	C
ICT	251	ICT Application in Textiles I	1	2	2
ICT	253	Desktop Publications II	1	2	2
		Total	**2**	**4**	**4**

Year Two: Semester Two			T	P	C
ICT	252	Computer Aided Design (CAD) I	1	2	2
ICT	254	ICT Application in Textiles II	1	2	2
		Total	**2**	**4**	**4**

Year Three: Semester One			T	P	C
ICT	351	Computer Aided Design (CAD) II	1	2	2
ICT	353	Data Management Application	1	2	2
		Total	**2**	**4**	**4**

Year Three: Semester Two			T	P	C
ICT	352	Industrial Computer Applications	0	4	2
		Total	**0**	**4**	**2**

Year Four: Semester One			T	P	C
ICT	451	Artificial Intelligence (CAD/CAM)	2	1	2
ICT	453	ICT Integrated Project/Thesis I	2	4	3
		Total	**4**	**5**	**5**

Year Four: Semester Two			T	P	C
ICT	452	Multimedia Application	1	2	2
ICT	454	ICT Integrated Project/Thesis II	2	4	3
		Total	**3**	**6**	**5**

Total credit hours for ICT courses – 32 out of the minimum of 120 credit hours.

6.4.3 Metal Products Design (MPD) - Course Structure

Year Two: Semester One			**T**	**P**	**C**
ICT	251	ICT Application in MPD I	1	2	2
ICT	253	Desktop Publications II	1	2	2
		Total	**2**	**4**	**4**

Year Two: Semester Two			**T**	**P**	**C**
ICT	252	Computer Aided Design (CAD) I	1	2	2
ICT	254	ICT Application in MPD II	1	2	2
		Total	**2**	**4**	**4**

Year Three: Semester One			**T**	**P**	**C**
ICT	351	Computer Aided Design (CAD) II	1	2	2
ICT	353	Data Management Application	1	2	2
		Total	**2**	**4**	**4**

Year Three: Semester Two			**T**	**P**	**C**
ICT	352	Industrial Computer Applications	0	4	2
		Total	**0**	**4**	**2**

Year Four: Semester One			**T**	**P**	**C**
ICT	451	Artificial Intelligence (CAD/CAM)	2	1	2
ICT	453	ICT Integration in Project/Thesis I	2	4	3
		Total	**4**	**5**	**5**

Year Four: Semester Two			**T**	**P**	**C**
ICT	452	Multimedia Application	1	2	2
ICT	454	ICT Integrated Project/Thesis II	2	4	3
		Total	**3**	**6**	**5**

Total credit hours for ICT courses – 32 out of the minimum of 120 credit hours.

6.4.4 Ceramics - Course Structure

Year Two: Semester One			**T**	**P**	**C**
ICT	251	ICT Application in Ceramics I	1	2	2
ICT	253	Desktop Publications II	1	2	2
		Total	**2**	**4**	**4**

Year Two: Semester Two			**T**	**P**	**C**
ICT	252	Computer Aided Design (CAD) I	1	2	2
ICT	254	ICT Application in Ceramics II	1	2	2
		Total	**2**	**4**	**4**

Year Three: Semester One			**T**	**P**	**C**
ICT	351	Computer Aided Design (CAD) II	1	2	2
ICT	353	Data Management Application	1	2	2
		Total	**2**	**4**	**4**

Year Three: Semester Two			**T**	**P**	**C**
ICT	352	Industrial Computer Applications	0	4	2
		Total	**0**	**4**	**2**

Year Four: Semester One			**T**	**P**	**C**
ICT	451	Artificial Intelligence (CAD/CAM)	2	1	2
ICT	453	ICT Integrated Project/Thesis I	2	4	3
		Total	**4**	**5**	**5**

Year Four: Semester Two			**T**	**P**	**C**
ICT	452	Multimedia Application	1	2	2
ICT	454	ICT Integrated Project/Thesis II	2	4	3
		Total	**3**	**6**	**5**

Total credit hours for ICT courses – 32 out of the minimum of 120 credit hours.

6.4.5 Fashion Design and Clothing (FDC) - Course Structure

Year Two: Semester One			**T**	**P**	**C**
ICT	251	Figure and Garment simulation I	1	2	2
ICT	253	Desktop Publications II	1	2	2
		Total	**2**	**4**	**4**

Year Two: Semester Two			**T**	**P**	**C**
ICT	252	Computer Aided Design (CAD) I	1	2	2
ICT	254	Figure and Garment simulation II	1	2	2
		Total	**2**	**4**	**4**

Year Three: Semester One			**T**	**P**	**C**
ICT	351	Computer Aided Design (CAD) II	1	2	2
ICT	353	Data Management Application	1	2	2
		Total	**2**	**4**	**4**

Year Three: Semester Two			**T**	**P**	**C**
ICT	352	Industrial Computer Applications	0	4	2
		Total	**0**	**4**	**2**

Year Four: Semester One			**T**	**P**	**C**
ICT	451	Artificial Intelligence (CAD/CAM)	2	1	2
ICT	453	ICT Integrated Project/Thesis I	2	4	3
		Total	**4**	**5**	**5**

Year Four: Semester Two			**T**	**P**	**C**
ICT	452	Multimedia Application	1	2	2
ICT	454	ICT Integrated Project/Thesis II	2	4	3
		Total	**3**	**6**	**5**

Total credit hours for ICT courses – 32 out of the minimum of 120 credit hours.

6.5 Modular Course Description

Description of the Module Layout

- ***Course:*** Name of the course title to pursue in a semester or semester's activity.

- ***Credit:*** Number of academic hours apportioned to the activity
- ***Description/Objective:*** Brief description of the subject and goals of the activity.
- ***Level:*** I, II, III, or IV defines the year levels.
- ***Topics:*** The topics at this level that are covered by this activity.
- ***Teaching/Learning Strategies:*** This explains the modalities of teaching learning associated with this activity.
- ***Assessment and Evaluation:*** Formative and summative assessments of in-class and laboratory work.
- ***Resources:*** Links to resources of this activity, as well as other related activities buy-in.

6.5.1 Year One – Modules Description

Module One – Semester One

Course: .....ICT 151 Introduction to Computers (2,1,2)

Credit: .....2 Hours

Description/Objective: .....To introduce students to the rudimentary concepts of ICTs, develop an understanding of the nature of the components of computer systems and explore emerging trends in technology.

Level: .....I **(Textiles, Metal Products Design - MPD, Ceramics, Fashion Design and Clothing - FDC)**

Topics: .....History And Evolution of Computers; Types of Computers; Introduction to the Functional Behaviour of Digital Computer Systems, Peripherals, Input and Output, and Storage Devices; Computer Hardware and

Software; Graphical User Interfaces (GUI); Networks and the Internets; Programming Languages; The Future of Computers.

Teaching/Learning Strategies:.....lecture, demonstration, discussion, project and experiential learning.

Assessment and Evaluation: .....Formative assessments – assignment, tests, quizzes, mid-semester and end-of-semester exams; summative assessments of in-class and laboratory work.

Resources:

1. Brian, W. K. and Sawyer C. S. (2005). *Using Information Technology: A Practical Introduction to Computers and Communications.* New York: The McGraw-Hill Companies, Inc.
2. O'Leary, T. J. and O'Leary L. I. (2005). *Computing Essentials 2005.* New York: The McGraw-Hill Companies, Inc.
3. Leon, A. and Leon M. (1999). Introduction to Computers. Cherma: Land/Consultancy Services Pvt. Ltd

Module Two – Semester One

Course: .....ICT 153 Introduction to Computer Skills (1,2,2)

Credit: .....2 Hours

Description/Objective:.....Develop appropriate skills and practices to help in the awareness, effective manipulation and handling of operating systems, and software applications.

Level:.....I **(Textiles, MPD, Ceramics & FDC)**

Topics:.....Understanding Graphical User Interfaces; Introduction to Operating Systems (OS) and Software Applications; Windows

Platform and File Management; Digital Media; Types of User interfaces; BIOS; OS and Hardware Operations; Commands, Options and Graphical Interface; Special Systems; Basic file management tasks (open, edit, save, create folder, close files).

Teaching/Learning Strategies:.....Demonstration, discussion, project methods and experiential learning.

Assessment and Evaluation: .....Formative assessments – assignments, mid-semester and end-of-semester exams; summative assessments of in-class and laboratory work.

Resources:

1. Brian and Sawyer (2005). *Using Information Technology: A Practical Introduction to Computers and Communications.* New York: The McGraw-Hill Companies, Inc.
2. Shelly, Cashman and Vermaat (2007). *Discovering Computers 2007: A Gateway to Information Web Enhanced Introductory*. USA: Thomson Course Technology, Inc.
3. Leon, and Leon (1999). *Introduction to Computers.* Cherma: Land/Consultancy Services Pvt. Ltd

Module Three - Semester Two

Course: .....ICT 152 Desktop Publications I (1,2,2)

Credit: .....2 Hours

Description/Objective:.....This course covers MS Word and Outlook:

1. For students to learn to use MS Word to design eye catching posters, handouts, memos, agendas and minutes; present reports and assignments; publish and edit web documents.

2. To encourage learners to use MS Outlook to handle and respond email messages, schedule meetings and events digitally, and organizing information corroboratively.

Level:.....I **(Textiles, MPD, Ceramics & FDC)**

Topics:

MS Word (Version - Current): *Formatting Content* - Create custom styles for text, tables, and lists, control pagination, format, position, and resize graphics using advanced layout features; *Organizing Content* - Sort content in lists and tables, perform calculations in tables, modify table formats, summarize document content using automated tools; *Customizing MS Word* - Create and modify forms, document background, document indexes and tables, endnotes, footnotes, captions, and cross-references; *Collaborating* - Modify tracked changes options, publish and edit web documents, manage document versions, protect and restrict forms and documents; *Formatting Documents* - Create, edit, and run macros, customize menus and toolbars and modify Word default settings.

MS Outlook (Version – Current): Messaging - originate and respond to e-mail and instant messages, attach files to items, modify e-mail message settings, a personal signature for messages and delivery options, create and edit contacts, accept, decline, and delegate tasks; *Scheduling* - create and modify appointments, meetings, events, update and cancel, and respond to meeting requests, customize calendar settings; *Organizing* - create and modify distribution lists, link contacts to other items, create and modify notes, assign items to categories, preview and print items.

Teaching/Learning Strategies:.....Demonstration, problem-solving, lecture and experiential learning.

Assessment and Evaluation:

1. Formative assessments and evaluation of students' assignments, tests and mid-semester examination.
2. Summative assessments of project works.

Resources:

1. Wallace, W. (2007). Office 2007 for Dummies. Indiana: Indianapolis, Wiley Publishing, Inc.
2. Cox, J., & Preppernau J. (2007). Microsoft® Office Word 2007 Step by Step. USA: Microsoft Press.
3. Vander, V. E. (2007). PowerPoint 2007: The Missing Manual. United States of America: O'Reilly Media, Inc.

Module Four - Semester Two

Course: .....ICT 154 Introduction to Computer Networking & Internet Technique Application (1,2,2)

Credit: .....2 Hours

Description/Objective: .....This course covers Introduction to Computer Networking and Internet Technique Application:

Introduction to Computer Networking: To introduce students to the fundamentals of networking, configuring network components and sharing of files on a network in their own environment to facilitate access to information, support learning, and research work.

Internet Technique Application: To enable students develop the knowledge and skills to use the Internet and email effectively in learning, evaluation, communication, research, problem solving, and in lifelong learning.

Level: .....I **(Textiles, MPD, Ceramics & FDC)**

Topics:

Introduction to Computer Networking: Introduction to a variety of Computer Networks; Hardware and Software for Computer Network; Configuring Network Components; Sharing resources; Network neighbourhood; Peer networking with different operating systems; adding a Wireless Peer Computer; Internet Connection Sharing (ICS); sharing folders and documents.

Internet Technique Application: This course covers areas such as History and Fundamentals of Internet, and Internet Surfing and Email; searching for educational content on the web; Internet Safety and Online referencing; Internet Software manipulation; Downloading and Uploading files; identify key words and terms such as URL, HTTP, Digital Blogs, RSS, FAQs; Evaluate Online Resources; Search Engines.

Teaching/Learning Strategies:

1. Lecture, demonstration, problem-solving, and experiential learning.
2. Discussions should explore the advantages and disadvantages of internet and networking.

Assessment and Evaluation:

1. Formative assessments and evaluation of students' assignments, tests and mid-semester examination
2. Summative assessments of project works and end-of-semester examination.
3. Summative evaluation explores students' performance in assignments, tests, and mid- and end-of-semester examinations.

Resources:

1. Oram, A. (Ed). (2001). *Peer to Peer: Harnessing the Power of Disruptive Technologies*. First Edition. Canada: O'Reilly & Associates, Inc.

2. Mario, F. and Manuela P. (2008). *Encyclopedia of Internet Technologies and Applications*. New York, Hershey: Information Science reference
3. Kurose, F. J. And Ross W. K. (2005). *Computer Networking: A top-down Approach Featuring the Internet*. (3rd Ed). New York: Pearson Education, Inc.

6.5.2 Year Two – Modules Description

Module One - Semester One

Course: .....ICT 251 ICT Application in Textiles I (1,2,2)

Credit: .....2 hours

Description/Objective: .....For students to understand and apply ICT knowledge and skills in planning, research, evaluation and problem solving, to enhance efficiency of ICT integration in Textiles subject area.

Level: .....II (**Textiles**)

Topics: .....Exploration of ICT opportunities in Textiles technology, chemistry and design; ICT application in some mandatory textile courses such as Fabric Structure, Textile Design; hands-on application with 2-D and 3-D computer courseware.

Teaching/Learning Strategies: .....Lecture, demonstration, problem-solving, and experiential learning.

Assessment and Evaluation:

1. Formative assessment of exploratory projects, quiz at the end of each hands-on application to prompt students on progress and show changes required for success of technology application in subject area.
2. Summative assessment of ICT application in subject areas.

Resources:

1. Lynette, K. (2007*). Adobe Photoshop CS3: Simplified Tips & Tricks*. Indianapolis, Indiana: Wiley Publishing, Inc.
2. O'Leary, T. J. and O'Leary L. I. (2005). *Computing Essentials 2005*. New York: The McGraw-Hill Companies, Inc.

Module Two - Semester One

Course:.....ICT 253 Desktop Publications II (1,2,2)

Credit:.....2 Hours

Description/Objective:.....Students should learn how to make a presentation in MS PowerPoint and how to make this presentation attractive, well-organized in project/course works and research.

Level:.....II (**Textiles, MPD, Ceramics & FDC**)

Topics:.....This course covers Microsoft (MS) PowerPoint:

Part one: This session is a basic introduction to creating a PowerPoint presentation: Basic ICT tasks (open and close files, save, print, cut, copy, paste); creating a new presentation; basic text editing; using and adapting templates and themes; Inserting tables, diagrams, and charts into a presentation; re-ordering and deleting slides; adding notes and printing your slides.

Part two: Exploring multimedia features of PowerPoint presentation using slide transitions; animation schemes and custom animation; working with multimedia, adding video clips and hyperlinks; delivering a presentation, e-rehearsing slide show timings; using a data projector in presentation; Showing a presentation on two screens or displays.

Teaching/Learning Strategies:.....Demonstration, problem-solving, lecture and experiential learning.

Assessment and Evaluation:

1. Formative assessments and evaluation of students' assignments, quiz and mid-semester examination.
2. Summative assessment of product works in subject areas.

Resources:

1. Wallace, W. (2007). Office 2007 for Dummies. Indiana: Indianapolis, Wiley Publishing, Inc.
2. Cox J., & Preppernau J. (2007). Microsoft® Office Word 2007 Step by Step. USA: Microsoft Press.
3. Vander, V. E. (2007). PowerPoint 2007: The Missing Manual. United States of America: O'Reilly Media, Inc.

Module Three - Semester One

Course: .....ICT 251 ICT Application in MPD I (1,2,2)

Credit: .....2 Hours

Description/Objective:.....For students to identify and apply their knowledge and understanding of ICT skills in design and fabrication of metal products such as ornamental decorative piece, lighting fixture, furniture and cutlery set.

Level:.....II (**MPD**)

Topics:.....Exploration of ICT opportunities in Metal Products Design; practical application (2-D and 3-D software) in jewellery design, modelling, fabrication and finishing; design and Products simulation.

Teaching/Learning Strategies:.....Demonstration, problem-solving, and experi-ential learning.

Assessment and Evaluation:

1. A formative assessment through student discussion and observation, encouraging students to assess their thinking for successful completion of projects.
2. Assess students' design, models and products simulation. During summative evaluation - exhibition, provide students with written/oral feedback.

Resources: Explore instructional materials for the assigned computer application programme**.**

Module Three - Semester One

Course:.....ICT 251 ICT Application in Ceramics I (1,2,2)

Credit:.....2 Hours

Description/Objective:.....For students to apply their knowledge and understanding of ICT skills in design techniques and problem solving in Ceramics.

Level:.....II (**Ceramics**)

Topics:.....Exploration of ICT opportunities in Ceramics design, chemistry and technology; practical application (2-D and 3-D software).

Teaching/Learning Strategies:.....Demonstration, laboratory, inquiry/problem-solving, and experiential learning.

Assessment and Evaluation:

1. A formative assessment through student discussion and observation, encouraging students to assess their thinking for successful completion of projects.
2. Assess students' design, models and products simulation. During summative evaluation - exhibition, provide students with written/oral feedback.

3. Review of student portfolio to provide written/oral feedback on completion and comprehension of tasks given.

Resources: Explore instructional materials for the assignable computer application programme**.**

Module Four - Semester One

Course:.....ICT 251 Figure and Garment simulation I (1,2,2)

Credit:.....2 Hours

Description/Objective:.....For students to apply their knowledge and understanding of ICT skills in life drawing, illustration and clothing design in Fashion.

Level:.....II (**FDC**)

Topics:.....Exploration of ICT applications in Fashion Life Drawing and Illustration; basic, clothing and jewellery designs; practical application (2-D and 3-D computer applications).

Teaching/Learning Strategies:.....Demonstration, problem-solving, and experiential learning.

Assessment and Evaluation:

1. A formative assessment of assignments, quiz and project works.
2. An evaluation of test on illustration, clothing and jewellery designs.
3. Review of student portfolio to provide written/oral feedback on completion and comprehension of tasks given.

Resources: Explore instructional materials for the assignable computer application programme**.**

Module Five - Semester Two

Course:.....ICT 252 Computer Aided Design (CAD) I (1,2,2)

Credit:.....2 Hours

Description/Objective:.....To encourage students to identify, understand and apply digital technology in subject areas, to enable learning, and presentations of course works and assignments.

Level:.....II **(Textiles, MPD, Ceramics & FDC)**

Topics:.....This course explores history and development of CAD; vector-based graphics such as CorelDraw and Adobe Illustrator; discussion of benefits and limitations of vector-based software and hands-on experience with one; hands-on application includes basic tasks (print, new, open and close, save as, exit), menus, workspace, tools; application manipulation in subject area; exploring the link between vector-based and bitmap graphics software.

Teaching/Learning Strategies:.....Lecture, discussion, demonstration, problem-solving, and experiential learning.

Assessment and Evaluation:

1. A formative assessment of the assigned in-class work in the form of exploring the difference between vector-based and bitmap graphics software.
2. A summative assessment in which students complete an assignment requiring the presentation of 2-D (vector-based) works in subject areas.
3. Review of student portfolio to provide written/oral feedback on completion and comprehension of tasks given.

Resources:

1. Lynette, K. (2007*). Adobe Photoshop CS3: Simplified Tips & Tricks*. Indianapolis, Indiana: Wiley Publishing, Inc.

Module Five **-** *Semester Two*

Course: .....ICT 254 ICT Applications in Textiles II (1,2,2)

Credit: .....2 Hours

Description/Objective: .....To equip students to identify and apply courseware skills and knowledge in subject areas, to enhance efficiency in teaching and learning, planning, research, and problem solving.

Level: .....II **(Textiles)**

Topics: In this course, further exploration of ICT avenues in Textiles technology, chemistry and design; broad issues concerning ICT application and hands-on experience with textiles related courseware; application of SWOT model to ICT integration in Textiles (exploring the pros and cons).

Prior Knowledge: .....ICT 251 ICT Applications in Textiles I

Teaching/Learning Strategies: .....Lecture, discussion, demonstration, problem-solving, and experiential learning.

Assessment and Evaluation:

1. Formative assessment of exploratory projects, quiz at the end of each hands-on application to prompt students on progress and show changes required for success of technology application in subject area.
2. Summative assessment of ICT application in subject areas (Textiles technology, chemistry and design).

3. Discussions should explore the scores students achieved in project works and quiz.

Resources:

1. Wray, G. R., Murphy B. J. M., Baker J. E. and King T. G. (1984). Computers in the World of Textiles. England: The Textiles Institute.

Explore instructional materials for the assignable computer application programme**.**

Module Six - Semester Two

Course: .....ICT 254 ICT Applications in MPD II (1,2,2)

Credit: .....2 Hours

Description/Objective:.....Aims at equipping students to understand and apply ICT skills and knowledge in design, fabrication, rendering and simulation of jewellery and metal products.

Level:.....II (MPD)

Topics: In this course, further exploration of ICT avenues in Metal Products Design; practical application of 3-D software in design, modelling, fabrication and finishing.

Prior Knowledge: .....ICT 251 ICT Applications in MPD I

Teaching/Learning Strategies:.....Demonstration, laboratory, inquiry/problem-solving, and experiential learning.

Assessment and Evaluation:

1. Assess students' design, models and products simulation. During summative evaluation - exhibition, provide students with written/oral feedback.
2. Review of student portfolio to provide written/oral feedback on completion and comprehension of tasks given.

Resources: Explore instructional materials for the assignable computer application programme**.**

Module Seven **-** *Semester Two*

Course: .....ICT 254 ICT Application in Ceramics II (1,2,2)

Credit: .....2 Hours

Description/Objective: .....Aims at equipping students to understand and apply the skills and knowledge in ceramic design simulation and rendering techniques.

Level: .....II (**Ceramics**)

Topics: In this course, further exploration of ICT avenues in Ceramics design, chemistry and technology; broad issues concerning ICT application and hands-on experience with 3-D courseware.

Prior Knowledge: .....ICT 251 ICT Applications in Ceramics I

Teaching/Learning Strategies:.....Demonstration, laboratory, inquiry/problem-solving, discussion and experiential learning.

Assessment and Evaluation:

1. Assess students' design, models and products simulation.
2. Summative evaluation - exhibition, provide students with written/oral feedback.
3. Review of student portfolio to provide written/oral feedback on completion and comprehension of tasks given.

Resources: Explore instructional materials for the assignable computer application programme**.**

Module Eight *- Semester Two*

Course: .....ICT 254 Figure and Garment simulation II (1,2,2)

Credit: .....2 Hours

Description/Objective: Aims at equipping students to identify and apply the skills of rendering clothing on figures, digital drapery and fabric simulation.

Level: .....II (**FDC**)

Topics: In this course, further exploration of ICT avenues in fashion life drawing and illustration; basic, clothing and jewellery designs; broad issues concerning ICT application and hands-on experience with any 3-D software; industrial methods of draping; textile design/colour; modelling fabric on a figure; catwalk simulation.

Prior Knowledge: .....ICT 251 Figure and Garment simulation I

Teaching/Learning Strategies:.....Demonstration, problem-solving, and experiential learning.

Assessment and Evaluation:

1. A formative assessment of assignments, quiz and project works.
2. An evaluation of test on illustration, clothing and jewellery designs.
3. Review of student portfolio to provide written/oral feedback on completion and comprehension of tasks given.

Resources: Explore instructional materials for the assignable computer application programme**.**

6.5.3 Year Three – Modules Description

Module One *- Semester One*

Course: .....ICT 351 Computer Aided Design (CAD) II (1,2,2)

Credit: .....2 Hours

Description/Objective: To encourage students to identify and use digital technology to produce, edit, manipulate and render a wide variety of images, objects and designs.

Level: .....III **(Textiles, MPD, Ceramics & FDC)**

Topics: This course explores bitmap or image-editing graphics software (Adobe PhotoShop). The discussion includes exploring workspace, image manipulation; working with selections; layer basics; masks and channels; image retouching and repairing; painting and editing; basic pen tool techniques; vector masks, paths, and shapes; advanced layer techniques; creating special effects; preparing images for two-colour printing; producing and printing consistent colour; import images from digital camera and scanner; software application concept is based on subject area.

Teaching/Learning Strategies:.....Lecture, discussion, demonstration, problem-solving, and experiential learning.

Assessment and Evaluation:

1. A summative assessment in which students complete an assignment requiring the presentation of 2-D (vector-based and bitmap graphics) works in subject areas.
2. Review of student portfolio to provide written/oral feedback on completion and comprehension of tasks given.

Resources:

1. Fitzgerald, M. (2008) PhotoShop CS3: *Restoration and Retouching Bible.* Indianapolis, Indiana: Wiley Publishing, Inc.

Module Two **-** *Semester One*

Course:.....ICT 353 Data Management Application (1,2,2)

Credit:.....2 Hours

Description/Objective:.....For students to obtain hands-on experience and to apply some statistical software, by carrying out descriptive statistical analysis (pie or bar chart, frequency, tables) of several data-sets in quantitative research.

Level:.....III **(Textiles, MPD, Ceramics & FDC)**

Topics: Understanding the fundamentals of statistics; statistical techniques for analysing quantitative data; hands-on experience with any statistical software such as StatGraphics, MS Excel or SPSS (Statistical Package for the Social Sciences); the user interface; display of data, using indicators and graphics; performing statistical analyses, such as frequency distribution, cross tables, analysis of variance, non-parametric tests, regression analysis, distribution-free statistics; interaction with other software (input and output of data); data transformation and data selection; graphic possibilities; creating conveniently arranged tables; the Data Protection Act, the Computer Misuse Act, and other legal and ethical issues related to ICT.

Teaching/Learning Strategies: Lecture, discussion, demonstration, problem-solving, study/field trips and experiential learning.

Assessment and Evaluation:

1. A formative assessment of the assigned in-class and project works, and quiz.

2. Summative discussion should explore study trips findings, analysis discussion and interpretations.

Resources:

1. Marmel, E. (2008). *Master Visually: Excel 2007*. Indianapolis, Indiana: Wiley Publishing, Inc.
2. Leedy, D. P. and Ormrod E. J. (2005). *Practical Research: Planning and Design*. (8th Ed.) Upper Saddle River, New Jersey: Pearson Education, Inc.

Module Six *- Semester Two*

Course: .....ICT 352 Industrial Computer Applications (0,4,2)

Credit: .....2 Hours

Description/Objective: .....To acquaint learners with industrial experience of technological processes, observing and discussing the correlation between CAD and CAM, and artificial intelligence.

Level: .....III **(Textiles, MPD, Ceramics & FDC)**

Topics: .....This is a field experience focusing CAD/CAM operations in the industry. Students have a whole semester stay in the industry to observe the correlation between CAD and CAM and write a report for presentation.

Teaching/Learning Strategies: .....Lecture, study/field trips and experiential learning.

Assessment and Evaluation:

1. A summative evaluation in which the industry sends written/oral feedback to the department for reviews.

2. Review of student portfolio and report to provide on completion and comprehension of industrial training.

6.5.4 Year Four – Modules Description

Module One *- Semester One*

Course: .....ICT 451 Artificial Intelligence (CAD/CAM) (2,1,2)

Credit: .....2 Hours

Description/Objective: .....To introduce students to the knowledge and act of producing artefacts or products using both software and hardware technologies from the very beginning of design process, to the end of production line.

Level: .....IV **(Textiles, MPD, Ceramics & FDC)**

Topics: Discussion on industrial technologies, role and impact on subject areas and the industry; Concepts on CAD/CAM; why use CAD/CAM in subject areas ramification; the merits and demerits of CAD/CAM.

Prior Knowledge: .....ICT 352 Industrial Computer Applications

Teaching/Learning Strategies: .....Lecture, demonstration, discussion, process, study/field trips and experiential learning.

Assessment and Evaluation:

1. Formative assessment through discussion and observation on industrial technologies, encouraging students to assess their faculty on CAD/CAM concepts.
2. Summative assessment of software and hardware technologies in subject areas.

Resources:

1. Lugar, F. G. (2005). *Artificial Intelligence.* (5th Ed). London: Pearson Education Limited.
2. Kurose, F. J. & Ross, W. K. (2005). *Computer Networking: A top-down Approach Featuring the Internet.* (3rd Ed). New York: Pearson Education, Inc.

Module Two *- Semester One*

Course:.....ICT 453 ICT Project/Thesis I (2,4,3)

Credit:.....2 Hours

Description/Objective:.....For students to acquire and understand the skills and knowledge of ICT integration, and apply to the transformation of their everyday activities.

Level:.....II **(Textiles, MPD, Ceramics & FDC)**

Topics:.....Independent research into technologically related issues in subject area, problems and solutions; Students are expected to write, defend and present technical reports.

Teaching/Learning Strategies:.....Lecture, problem-solving, study/field trips and experiential learning.

Assessment and Evaluation:

1. Summative assessment in the form of report (written/project), and presentation of thesis/project works.

Resources:

1. Leedy, D. P. and Ormrod E. J. (2005). *Practical Research: Planning and Design*. (8th Ed.) Upper Saddle River, New Jersey: Pearson Education, Inc.

Module Three **-** *Semester Two*

Course: .....ICT 452 Multimedia Application (1,2,2)

Credit: .....2 Hours

Description/Objective: .....Aims at helping students to understand and apply the skills and knowledge to market artefacts using the internet and other available technologies.

Level: .....II **(Textiles, MPD, Ceramics & FDC)**

Topics: .....The role of multimedia application in Textiles, MPD, Ceramics and FDC; types of multimedia and current trends; Introduction to web page design using any html application; Internet, television and radio merchandising of products; multimedia and communication; the use and abuse of multimedia; the use of digital audio and video equipment and related editing software.

Teaching/Learning Strategies: Lecture, demonstration, discussion and experiential learning.

Assessment and Evaluation:

1. Formative assessment through discussion and observation of technology application in subject area, encouraging students to assess their faculty on Multimedia Applications.
2. Summative assessment of software and hardware technologies in subject areas.

Resources:

1. Kroenke, D. M. (2006). *Database Processing: Fundamentals, Design and Implementation.* New Jersey: Pearson Education, Inc. www.mhhe.com
2. Lindstrom, M. and Andersen T. F. (2000). *Brand Building on the Internet.* London: Kogan Page Ltd.

3. Lazer, J. (2006). *Web Usability: A User-Centred Design Approach.* New York: Pearson Education, Inc.
4. Daintith, J. (Ed) (2004). *Oxford Dictionary of Computing.* (5th Ed). New York: Oxford University Press.

Module Four *- Semester Two*

Course: .....ICT 454 ICT Project/Thesis II (2,4,3)

Credit: .....2 Hours

Description/Objective: .....For students to acquire and apply the skills and knowledge of ICT integration, to the transformation of their everyday activities.

Level: .....II **(Textiles, MPD, Ceramics & FDC)**

Topics: .....Continuation of the course ICT 453 ICT project/thesis I; Students are expected to submit their final thesis/project reports on ICT related topics.

Teaching/Learning Strategies: Lecture, problem-solving, study/field trips and experiential learning.

Assessment and Evaluation:

1. Summative assessment in the form of report (written/project), and presentation of thesis/project works.

Resources:

1. Leedy, D. P. and Ormrod E. J. (2005). *Practical Research: Planning and Design*. (8th Ed.) Upper Saddle River, New Jersey: Pearson Education, Inc.
2. Daintith, J. (Ed) (2004). *Oxford Dictionary of Computing.* (5th Ed). New York: Oxford University Press.

6.6 Logistics

The proposed framework has taken account of these resources for effective delivery in methodology to achieve the said objectives:

- 2 - Computer Laboratories
- 2 - LCD Projectors
- 2 - Scanners
- 2 - Printers
- Internet connectivity
- Courseware for Textiles, Metal Products Design, Ceramics, and Fashion Design and Clothing.

6.7 Description and Interpretation of the Proposed IMF

The IMF proposed to DIA aims at providing a holistic ICT-based training of students for today's technology-based industry, society and the knowledge-based economy. In this framework, virtually all ICT ramifications have been covered, giving student the introduction, intermediate and advance knowledge and skills in ICT. The framework has the vision of using ICT as a catalyst to achieve the visions and policies of DIA, the University and also Ghana ICT4AD Policy. However, students trained in this context invariably have the requisite resources needed to man institutions, organisations and industries culminating in the socio-economic achievements of those visions and missions.

Although DIA runs three Visual Arts disciplines, the framework proposed four modular course structures in view of a possible curricular restructuring. The four modular course structures include Textiles, Metal Products Design (MPD), Ceramics and Fashion Design and Clothing (FDC). In the framework, year one students take the same foundation courses and then separate into the respective disciplines after the first year. Each discipline has a total of 32 credit hours, forming a quarter of the minimum

120 credit hours for graduation. A total of 20 credit hours have been added which means that the existing computer-based modules structure has maximum of 12 credit hours. In the existing computer-based modules structure of DIA, year four students do not offer any ICT modules and this however has been curtailed in this framework. Also, students have the opportunity to undertake industrial attachment for a whole semester.

Moreover, in the proposed IMF two courses are run concurrently with a total of four credit hours per semester. Some of the modules focused on subject-integration of mandatory courses which deal with courseware application in pertinent subject areas. The issue of increased credit hours explains the totality of ICT integration experience an individual derives in a subject area. This bestows onto the student mastery learning in a subject area of study.

The framework has set out course structure and module description. Course structure describes the layout of modules by sequence and pattern of teaching learning experiences. Module description (content) describes in detail each module including objectives, contents, teaching/learning strategies and assessment and evaluation. Effective teaching and learning modalities indicated in the framework define the approaches leading to acquisition of knowledge and skills. The framework is developed to equip students both in knowledge and skills of ICT in subject areas, to facilitate teaching and learning; in professions, socio-economic activities, and in lifelong learning experiences. This ultimately provides a holistic ICT-based training of students for today's technology-based industry, society and the knowledge-based economy. The discussion of how the framework was pretested, is looked at in the next chapter.

CHAPTER SEVEN

PRETEST OF THE PROPOSED ICT MODULAR FRAMEWORK (IMF) FOR THE DEPARTMENT OF INDUSTRIAL ART (DIA), KNUST

Overview

This chapter provides information on the assessment of the Proposed ICT Modular Framework, considering evaluation of the framework; the purpose of evaluating the framework; evaluating ICT instructional materials; evaluating the individual and the framework using observation of subjects, class scores and checklist. Lastly, validity and validation of the hypothesis.

7.1 Assessment of the Proposed IMF

The presentation of the ICT Modules in the Department of Industrial Art (DIA) to students or subjects was intensely and conservatively carried out for two academic years (2007/08 – 2008/09). This provided valuable opportunities for the researcher who had adequate time to pretest the Modules for feedbacks. The researcher had ample time of 10 hours/5 courses a week with students of DIA. The researcher taught, assessed and examined students just like a subject teacher does.

The ambit of the pretest process included year one, two and three students from the three Sections of DIA. Students were taught in line with the substantive time-tables of DIA. Moreover, a computer laboratory and teaching materials were provided by the Department. In-class sessions were set out with projected screen from a laptop for demonstration and illustration.

With teaching and learning, students were taught on a wide range of ICT skills and knowledge concepts. They were exposed to the rudiments of computers through to CAD/CAM, Computer-Mediated Instruction (CMI) and Computer-Mediated

Multimedia (CMM) system concepts. Students were instructed based on a cross shades of teaching methods such as lecture, demonstration, project or problem-solving, and illustration. Although study trip forms part of some modules of the teaching/learning strategies, this was done in part when the department organized excursions and industrial attachments to some industries for students to link CAD and CAM in a single operation. Meanwhile, this gave the students experiential learning experiences, hands-on applications of software and courseware in subject areas.

The university's policy governing assessment and examination was strictly followed. Students were periodically assessed through assignments, in the form of project works, quizzes and tests. Also, as a requisite for the promotion of students in their course of study, the students took mid-semester exams and end-of-semester examination. The assessment of the framework, as indicated by Posner (1992) and Cangelosi (1990), was considered in the purview of the two types of evaluation decisions that is formative and summative assessment.

Assignments played a formative role in the evaluation process, by shaping instruction and the selection and use of instructional materials. This provided feedbacks for the researcher to take decisions which improved some modules in the framework. Whereas, summative evaluation was carried out at the end of each semester for four semesters, a decision as to whether to recommend the framework was the expedient. Summative evaluation focused on the end results of the IMF in terms of its success or failure.

7.2 Evaluation of IMF

Evaluation provides relevant information for further developments and expansion of any programme. For any project, or initiative, evaluation provides useful data and information on the degree to which the initiative/project is meeting the

objectives (standards). Evaluation, therefore, is conducted to "examine and report on the strengths and weaknesses of programmes, policies, personnel, processes, products/outcomes, and organizations to improve their effectiveness" (Thompson & Modupe, 2003). However, Cronbach (as cited in Yakubu, 2000) identifies evaluation in the context of education as the collection and use of information to make decisions about an educational programme. On the basis of this, a programme could be examined and modified if necessary.

Two commonly cited dimensions of evaluation are formative and summative. Formative evaluation refers to an on-going process, which can be conducted at any stage. The purpose of formative evaluation is to assess and monitor progress with intentions to make adjustments and improvements to the project (Calvert, 1997; Collins & Berge, 1995; Nguyen & Kira, 2000; Yakubu, 2000). Formative evaluation of educational technology, therefore, tends to contribute to the development of the educational technology in use. Summative evaluation, on the other hand, focuses on the end results of a project in terms of its success or failure. It therefore tends to review the effects of educational technology to justify its implementation (Thompson & Irele, 2003).

Nacino-Brown, *et al.,* (1982) are also of the view that evaluation in the context of education is a process used to obtain information from testing, from direct observation of behaviour, from essays and from other devices to assess a student's overall progress towards some predetermined goals or objectives. In the light of Nacino-Brown, *et al.,* (1982) assertion, test instruments such as *Observation, Class Score and Checklist* were used to validate the evaluation of the framework. The validity of the test instruments to obtain authentic information was a priority. Information obtained with these instruments was weighed against the standard of

providing a holistic ICT-based training of students for today's technology-based industry, society and the knowledge-based economy.

7.2.1 The Purpose of Evaluating IMF

Evaluation is conducted to determine the value of something. Posner (1992) explained that the following questions should be weighed against purpose of the evaluation: why determine its value? What would one do with this information? This dissertation seeks to develop ICT Modular Framework for the Department of Industrial Art, KNUST to provide a holistic ICT-based training of students for today's technology-based industry, society and the knowledge-based economy. To determine whether the framework indeed met the objective to provide a holistic ICT-based training of students, giving them contemporary ICT educational experiences; the framework had to be evaluated to provide information for making decisions about its integration in DIA curricula.

7.2.2 Evaluating the ICT Instructional Materials

The basic rule for software selection, 'the 15-minute rule' was used as a modality for the integration of new software. New software were introduced as a means of refining the ICT modular courses both in subject areas and as a statuary subject, these were considered under 'the 15-minute rule'. Subsequently, both intuitive and installation concepts of the software were subject of consideration, ensuring easy and quick installation besides their applications. The software impacted significantly on the teaching and learning experience, especially focusing on the subject relevance in the three Visual Art programmes.

However, based on Studnicki (2008) assertion that the title of software should not be used for the course title because of the evolving nature of technology, in view

of this only notable and relevant software applications were designated. A preponderance of instructional software or courseware applications will be selected base on phenomenon at the time. This invariably helps to manage software coercion as the student acquires contemporary ICT learning experience at different year levels.

7.2.3 Evaluating the Individual and the IMF

Identification of behavioural objectives in course objectives is one important step to take when evaluating by observation. According to Nacino-Brown, *et al.*, (1982), when objectives stated in such a way that there is no mention of the ultimate behaviour expected of the students then they are called non-behavioural objectives. Beyond this, they explained that in stating the objectives of a course or unit, specific measureable student learning or changes in student behaviour will take place as a result of instruction and this should be stated. Objectives stated in this fashion are known as behavioural objectives. Moreover, behavioural objectives make use of verbs like recite, identify, apply, pick out and so on. In the framework students' performance are immediately measureable owing to the definite description/objective stated which indicates the task to achieve.

The framework offers both behavioural and non-behavioural objectives. Behavioural objective is specifically measurable in courses requiring ICT application in subject areas. When a student acquires the skill and knowledge in a courseware, it is an expectant effort by the student to exhibit or apply that behaviour in solving problems in his subject of study. On the other hand, non-behavioural or aim/goal objective course expresses general knowledge acquisition of ICT as a subject, for example studying the rudiments of computers, operating systems, networking or web site designing, among others are in fact, basic ICT concepts that have no bearing on

any subject. This concept only aids or serves as the basis to study other programmes or courseware.

In educational evaluation many types decisions are to be made and many varieties of information are useful (Cronbach, 1975). Cronbach added that evaluation is a diversified activity and no one set of principle will suffice for all situations. In view of these, evaluation of the framework focused on three tiers of test instruments that are Observation, Class Scores and Checklist.

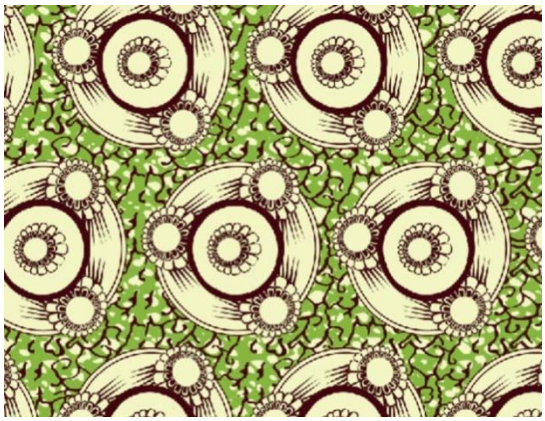
7.2.3.1 Observation of Students

The observation of the students of DIA is expressed under three main domains that are cognitive, affective and psychomotor. Bloom (as cited in Nacino-Brown, *et al.,* 1982) classified behavioural objectives as belonging to cognitive, affective and psychomotor. Cognitive domain deals exclusively with the mind and mental activities or skills. Bloom further explained that cognitive has two levels of realm; at the lower level of the realm are knowing and understanding skills of knowledge and comprehension. At the higher level of the realm are the skills of synthesis and evaluation. As each succeeding mental skill level is attained, with reference to specific concepts, it is implied that all the preceding levels are contained in the higher level.

As a result, students were introduced to various facets of ICT knowledge including the rudiments of ICT skills, and CAD applications in subject areas. With this, students were made to understand through demonstrations, illustrations, self-practice and problem-solving. This aided their knowing and understanding skills of knowledge and comprehension. These are the fundamental realms of cognitive skills. In actualising the students understanding of the various knowledge concepts,

assignments and projects works were given for them to exercise the cognitive skills of application and analysis. Students were able to proficiently and comprehensively apply their understanding of the acquired knowledge in assignments and project works.

However, students exercised or attained the higher realm of *cognitive skills* when they were able to analyse, synthesise and evaluate the knowledge acquired in assignments, mid-semester and end-of-semester examinations. The following plates are some students' works from the three Sections of the Department. These include 2- and 3-dimensional designs with computer application software such as Adobe PhotoShop, Rhinoceros, and WeavePoint, among others. Significantly, PhotoShop, Rhinoceros, and WeavePoint are maiden computer application software to be introduced by the researcher. This tremendously reduced the traditional processes of designing and solving problems thereby giving students the impetus to cognitively use modern technology to solve from simple to sophisticated problems in subject areas. A case in point is the replacement of point paper and colour pencils with WeavePoint software. Students were able to rapidly and effectively produce sophisticated weave structures using the computer.



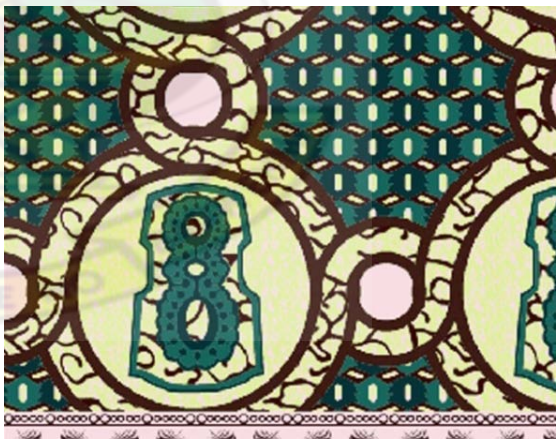
Yvette Poh-lemi – 1164707

Osew Joshua Nartey– 9873306

Rita Obo Biney – 9873606

Boakye A. A. Kwaatemaa – 9869706

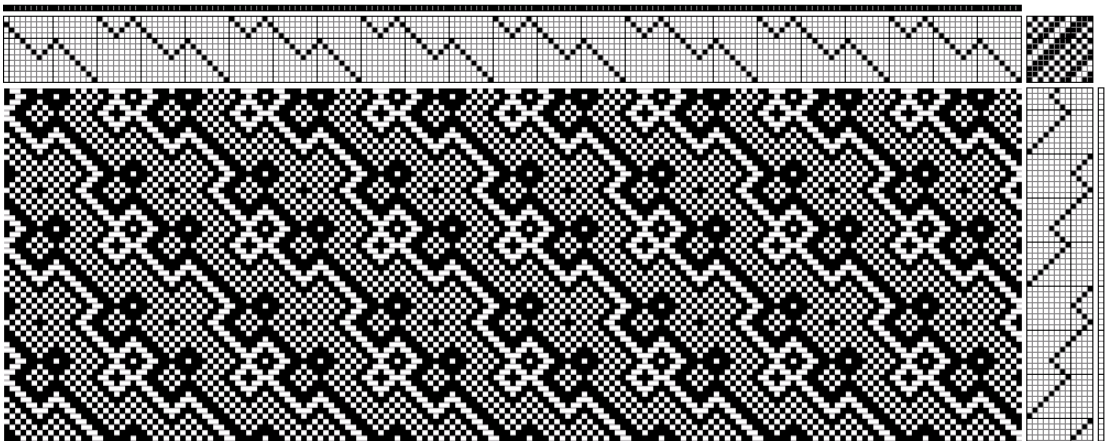
Konadu Afia Addai - 9864706



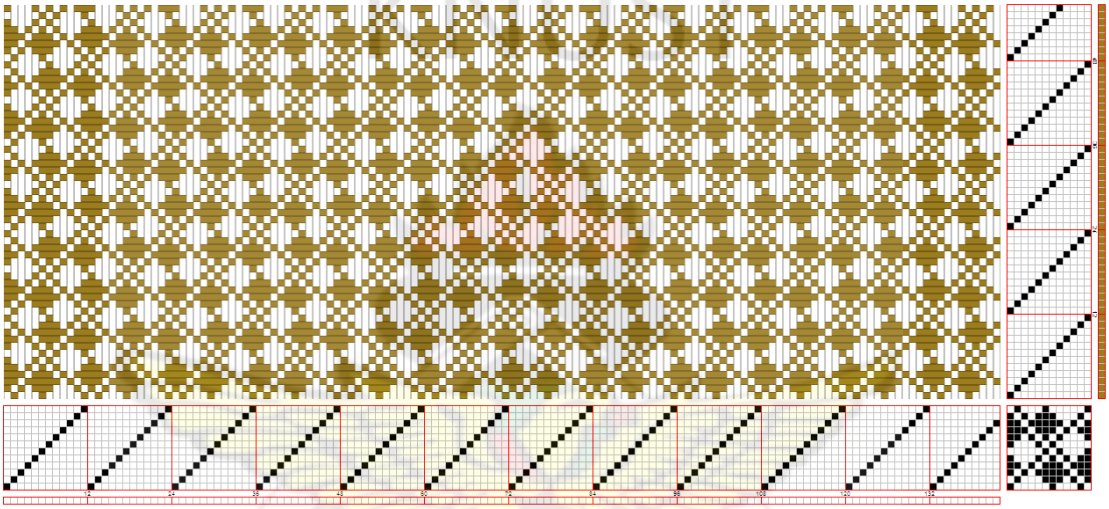
Alabi Patrick Bortey -1154407

Plate 7.1: A collection of Knock-off, Adaptation and Novelty of Fabric Designs

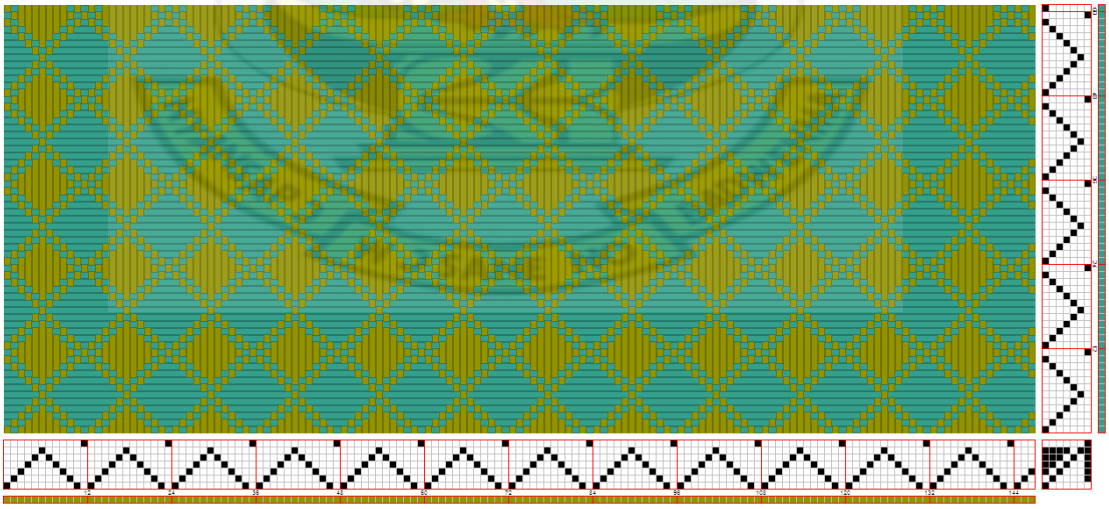
Courtesy: Textiles Students (Year Two)



Felicia Fordjour– 9871106 (*Twill Weave*)



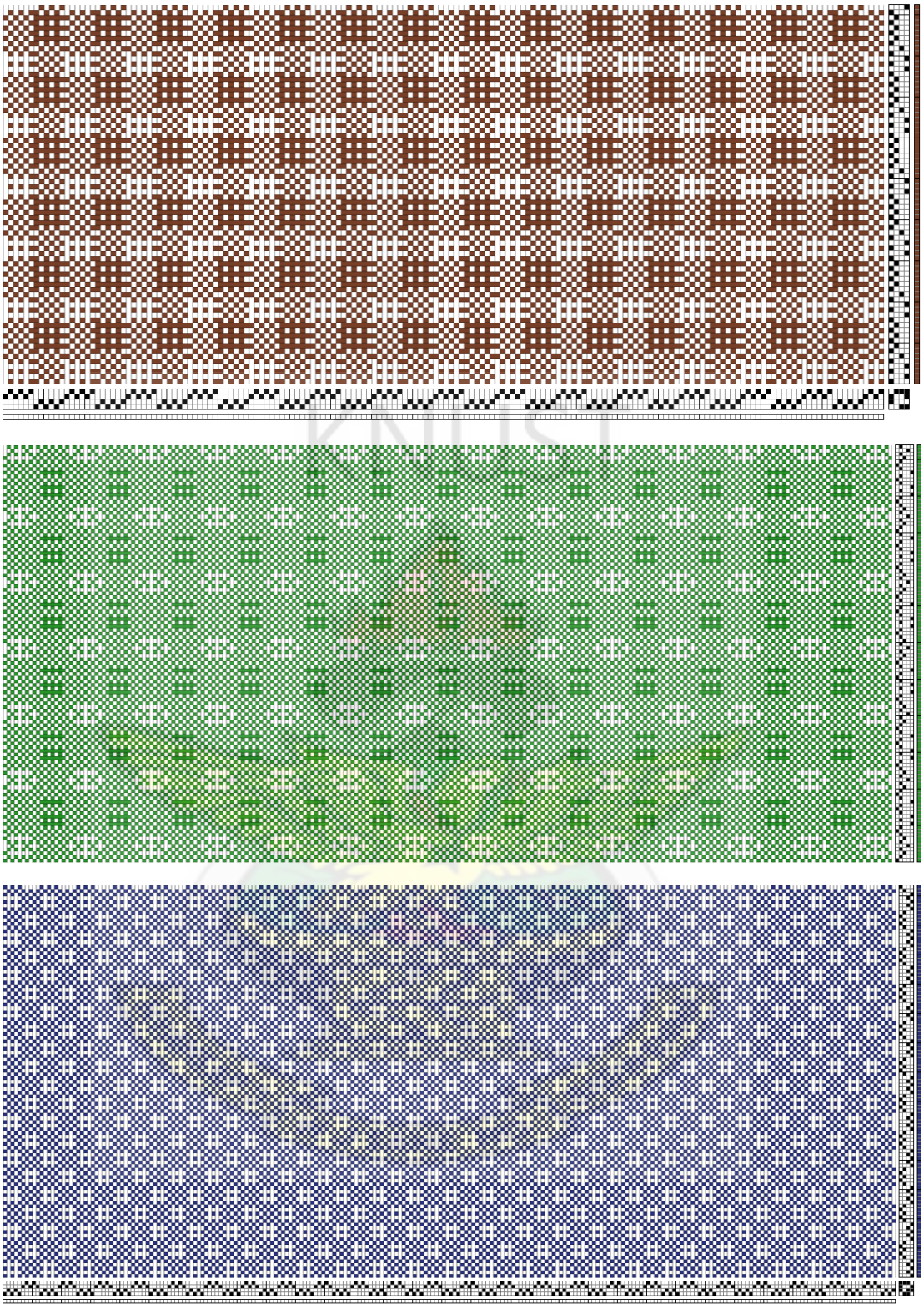
Elizabeth Anoah Baafi– 9868706 (*Honeycomb Weave*)



Benjamin Tawiah - 9876006 (*Honeycomb Weave*)

Plate 7.2: A collection of Twill and Honeycomb weaves

Courtesy – Textiles Students (Year Three)



Benjamin Tawiah - 9876006

Plate 7.3: A collection of Huckaback weaves

Courtesy – Textiles Students (Year Three)

Benjamin Yeboah - 1166307

Emmanuel Clottey - 1158607

Plate 7.4: A Semester Project consisting of a jewellery box, pendant, bangle and a decorative piece

Courtesy – Metal Products Design Students (Year Two)

Raphael Kwatsikor – 9877206

Wendy Opoku – 9874306

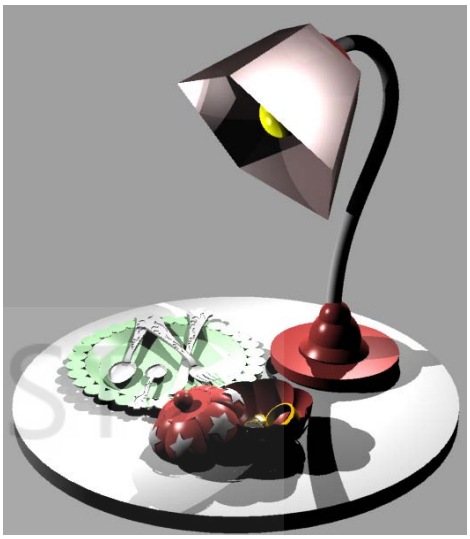
Adolphine Tetteh-Allotey– 9876206

Lily Owusu– 9874906

Plate 7.5a: An End of Semester Project comprising a set of cutlery, jewellery set and box, and a lamp shade

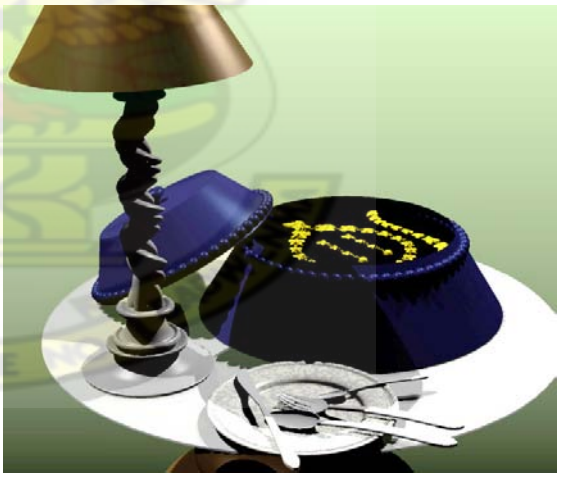
Courtesy: Metal Products Design Students (Year Three)

Susana Eyram Kumah– 9872306



Sandra Adu-Mends– 9865406

Nyarko Asare Afua – 9868106

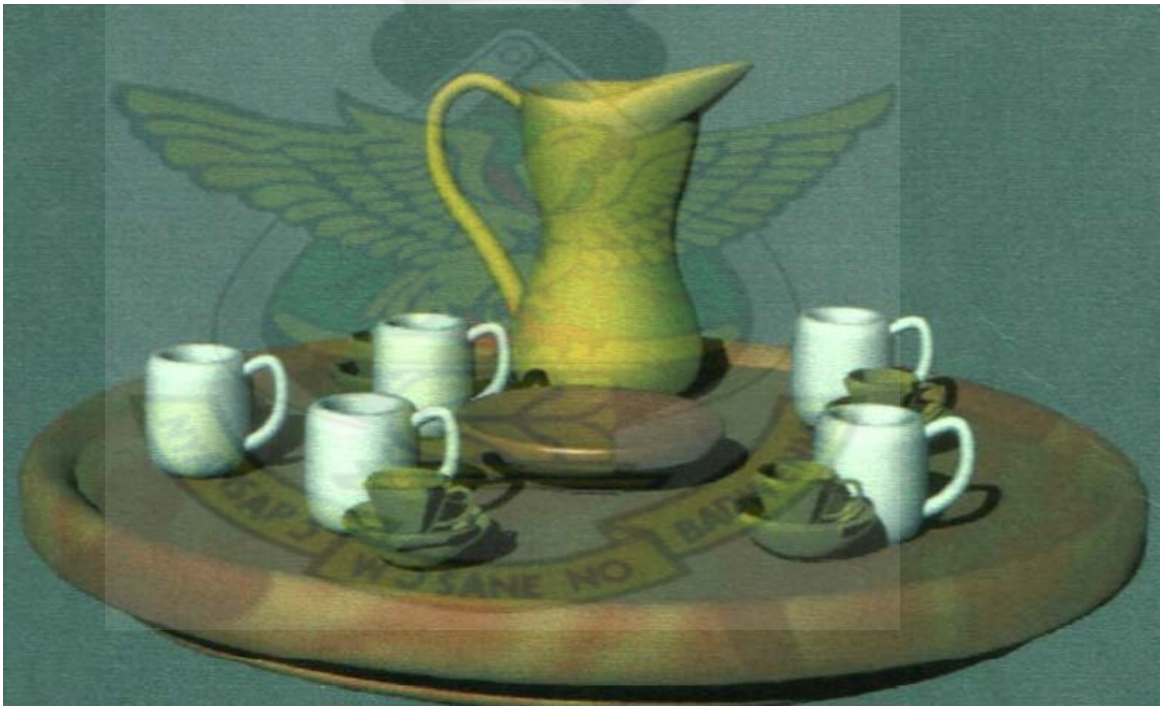


Janice Debrah Phyllis – 9870506

Plate 7.5b: An End of Semester Project comprising a set of cutlery, jewellery set and box, and a lamp shade

Courtesy – Metal Products Design Students (Year Three)

Afriyie Vera Boateng– 1157807 Eugenia Lawson - 1161607



Eugenia Lawson - 1161607

Plate 7.6: Studio works and a tea set

Courtesy – Ceramics Students (Year Two)

Collins Amoh Amoabeng - 1155007

Eric Owusu – 1164207

Plate 7.7: A Project work on Mix-media

Courtesy - Ceramics Students (Year Two)

In part, the experiential learning approach of ICT made some students to apply cognitive, affective and psychomotor skills during examinations. This is indicative of mastery learning implicit in the framework for students to gain a holistic learning experience of ICT literacy. The *affective domain* as stated by Bloom (as cited in Nacino-Brown R. *et al.*, 1982), concerns the emotional aspect of a person make-up which influences the attitudes, interests, appreciation and values. Students' affective skills grew and intensified when they were able to apply from simple to sophisticated ICT skills in subject areas. They were able to use both software and courseware to execute coursework such as idea developments of design and also simulate or render final artefact, all on the computer. Moving away from the traditional approach and putting digital technology above it, increased students' affective skills towards the behavioural objectives implicit in the framework.

Bloom also noted that the *psychomotor domain* deals with reflex, visual, tactile, and auditory skills in discriminating and physical abilities, involving hands on application. The interactive nature of some software or courseware, which involves coordinating the keyboard, mouse, sound and the display in a single activity or instructing students to do one thing or the other, leveraged their psychomotor skills. The development of the physical skills is extremely important as the development of proper attitudes, interests and values in students. In conjunction, both Visual Art and ICT education impart knowledge and skills through Visual, Aural/Auditory, Read/Write and Kinaesthetic (VARK) models of learning in students. It naturally follows then that having exposed the students to these three domains, significantly, they have had a holistic ICT-based training from the behavioural and non-behavioural objectives learning experience.

7.2.3.2 Class Performance

To achieve an internal validity, true-experimental research design (post-test-only control group design) was employed. With this, Leedy and Ormrod (2005) explained that at times one may be unable to locate a suitable pretest so as to conduct a post-test which is characteristic of this study. As indicated at the beginning of this chapter that the experimental group spans from 2007/08 to 2008/09 academic years. There is another group called the control group, 2005/06 to 2006/07 academic years. In part, these two groups, of course, define the modalities to assess the IMF based on class scores. Because the control group was observed under different experimental conditions such as course contents, teacher's educational background and teaching style, among others, the post-test-only control group design was employed. This was used to determine the observation of the experimental group after experiencing the framework. A control group according to Leedy and Ormrod (2005), is a group that receives either no intervention or a 'neutral' intervention and in this case it is the 2005/06 to 2006/07 academic years' group.

In true experimental research, one manipulates the independent variable and examines its effect on another, dependent variable. Careful controls of these variables draw definitive conclusions about cause-and-effect relationships. In this case, the confounding variables such as teacher's educational background and instructional method and style, instructional materials, students ICT background, mode of assessment, students' affection and course contents (framework) were held constant. The independent variable in this case is the course contents (cause) in the framework. The course content when taught with those variables held constant should have effect on both the behavioural and learning outcomes of the students. Therefore, the behavioural and learning outcomes (effect) are dependent on how well the course

contents have been structured against the variables held constant, to meet such challenges or expected outcomes.

As noted, the internal validity of a study is the approximate truth about inferences regarding cause-effect or causal relationships. Thus, the preceding discussion on cause-and-effect relationships of the framework on the behavioural and learning outcomes of students is explored in detail. Davis (2007) stated that in order for an experiment to follow a true-experimental design, it must employ the following criteria:

1. Random selection of subjects
2. Use of control groups
3. Random assignments to control and experimental groups
4. Random assignment of groups to control and experimental conditions.

As described earlier the post-test-only control group of the true-experimental design was used. To begin with, students were randomly selected according to academic years which include Year One, Two and Three. They were grouped into 2005/06 to 2006/07 academic years (Group A) and the 2007/08 to 2008/09 academic years (Group B). Moreover, Group A and Group B (Figure 7.1 & 7.2) represent students' overall performance for two academic years respectively. Leedy and Ormrod (2005), proposed Post-test-Only Control Design illustrated in Table 7.1 with random assignment to control and experimental groups.

In Table 7.1, Group A as indicated is the control group with no intervention from the framework, whiles Group B is the experimental group with treatment or experimental condition. The Group B had teaching and learning experience from the framework for two years.

Table 7.1: Post-test-Only Control Design

Random Assignment	Group	Time – Two Years	
	Group A	-	Observations
	Group B	Treatment	Observations

However, the observations recorded in Figure 7.1 are students' weighted average per academic year. In Figure 7.1, Ceramics students for 2005/06 and 2007/08 academics years were not registered for the computer-based courses, indicating the shortfalls for those years (for detailed students' performance see Appendix C).

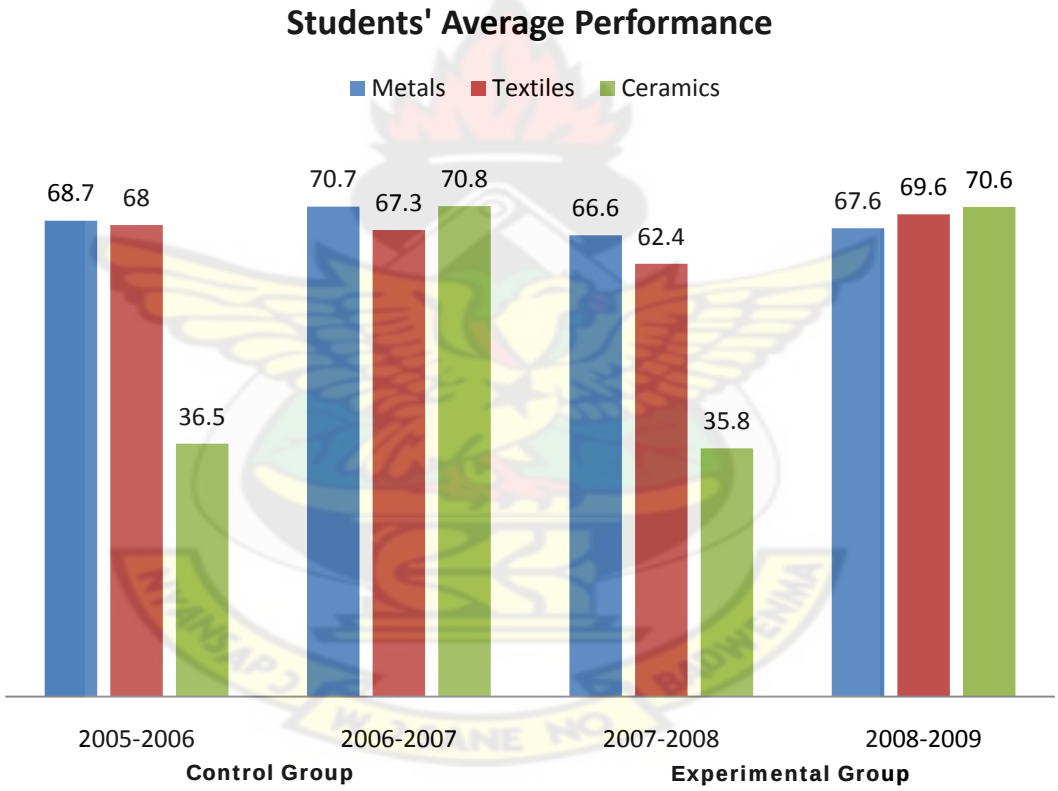


Figure 7.1: Students' Average Performance for Year Two and Three Textiles, Metal Products Design and Ceramics

The distribution of the bars for the experimental group (2007/08) shows, of course, habituation learning with marginal drops from the previous year. Because students were introduced for the first time to the framework, it naturally follows then that marginal drops are predictable. These drops could occur as a result of some

factors (confounding variables) which are held constant in this context that is they were factors for comparisons. In the following year (2008/09), there are marginal increases which explain the point first made about habituation learning theory, hence, establishes affirmatively the mastery learning concept of the framework. In conjunction, though performance of the control group is relatively higher compared to the experimental group, it should be noted that there are confounding variables which could interfere with the treatment of the experimental group.

In Figure 7.2, 2006/07 academic year performance is unavailable because the computer system could not generate the marks but making do with the rest is vital. Here, the experimental group indicates a subtle growth margin between the years. This nonetheless explains the dynamic and fashionable manner the framework has been tailored to give holistic ICT educational experience to students. However, comparing the averages of both groups, there is a steady increase in the experimental group. This indicates how well students at this level met the goal objectives of the modules in the framework. From the discussion, the cause-effect relationships to establish the internal validity of this study explains that the framework had impacted on the behavioural and learning outcomes of students in DIA during those academic years.

Inferentially, the researcher was unable to reach or retrieve some class scores for Ceramic and Foundation students from the Exams Office of DIA by reason of unavailability of those marks and failure on the part of the Exams Officer to register the students for those ICT courses. But this whatsoever did not jeopardise the validity of the test process.

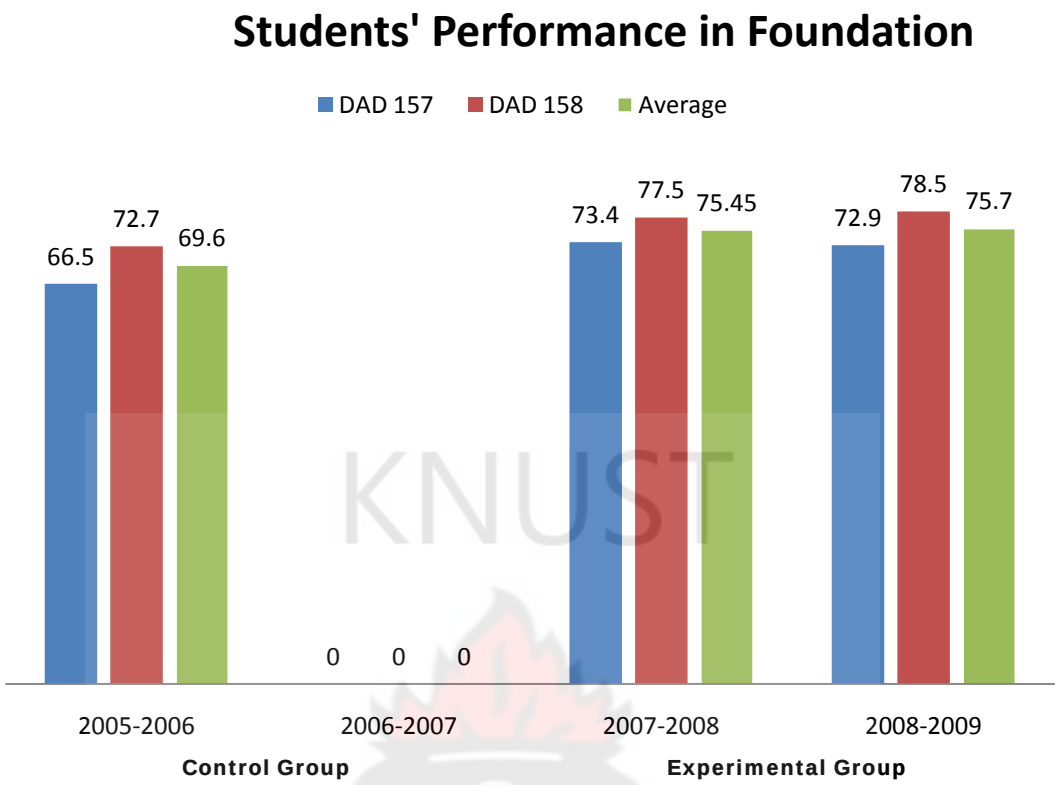


Figure 7.2: Students' Performance in Year One (Foundation)

7.2.3.3 Checklist (Aptitude Test)

As might be expected, the use of checklist further deepen the evaluation process, and gave across cut solution to determine whether indeed students have experienced the relevancy of behavioural and goal objectives implicit in the framework. This instrument was used to evaluate the learning experience at the end of 2008/09 academic year. This measured the construct validity of the framework. It was also used to make decision about individual contributions to the refinement of the framework. In-class exercises were embarked upon to test students' basic ICT knowledge and skills. Copies of the checklist (see Appendix D) were administered to students in year one, two and three, totally three hundred.

Consequently, statistical data (Appendix E, F and G) were generated from the responses and collated for this study. Statistical interpretations in the bar charts

presented variables and responses from students. The measure of this study corroborates the construct validity that the approximate truth of the conclusion of a study accurately reflects its construct. The construct of this research is to develop ICT Modular Framework to provide a holistic ICT-based training of students for today's technology-based industry, society and technology-based economy.

The pretest of the framework using the checklist yielded these responses. In Figures 7.3, 7.4 and 7.5, there is a habituation of experience, where because of long exposure to a concept measured in varieties of modes, students had mastery over it. The constant applications of the concept that is, file management which is a basic phenomenon of everyday use of computer, shows progress of learning experience in year two (Figure 7.4) and three (Figure 7.5). In the year one chart, 'print a document', 85 of the students can print files well, 10 can do it but still need to practice and lastly, 5 are starting to learn this. Progressively, students in year two and three could do this, including other variables in the charts. The three charts demonstrate growth in the learning experiences of students.

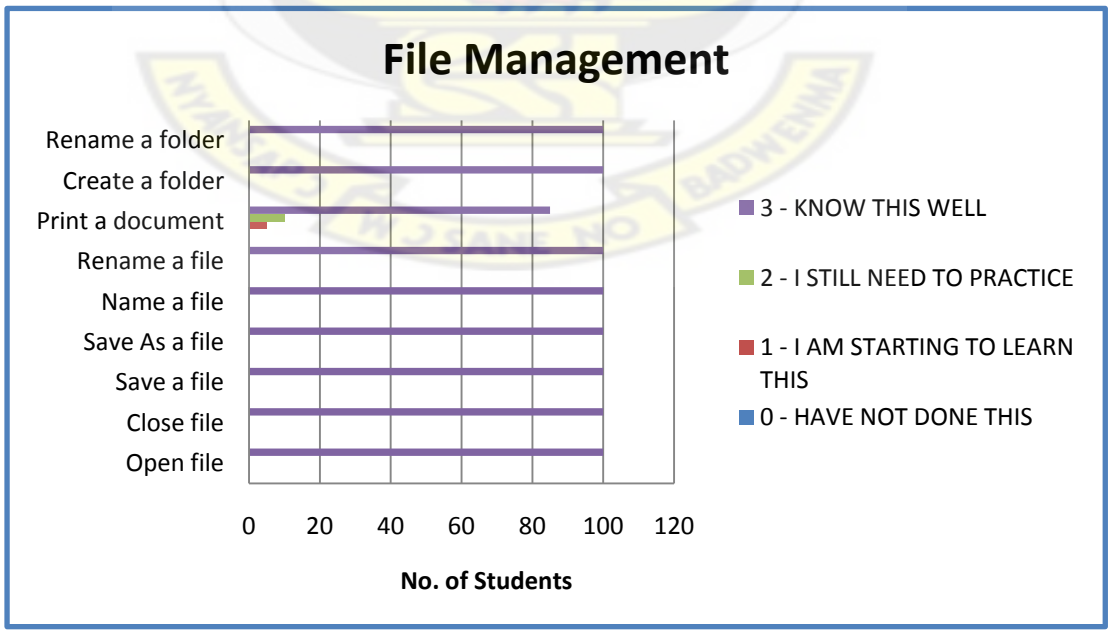


Figure 7.3: Year One – File Management

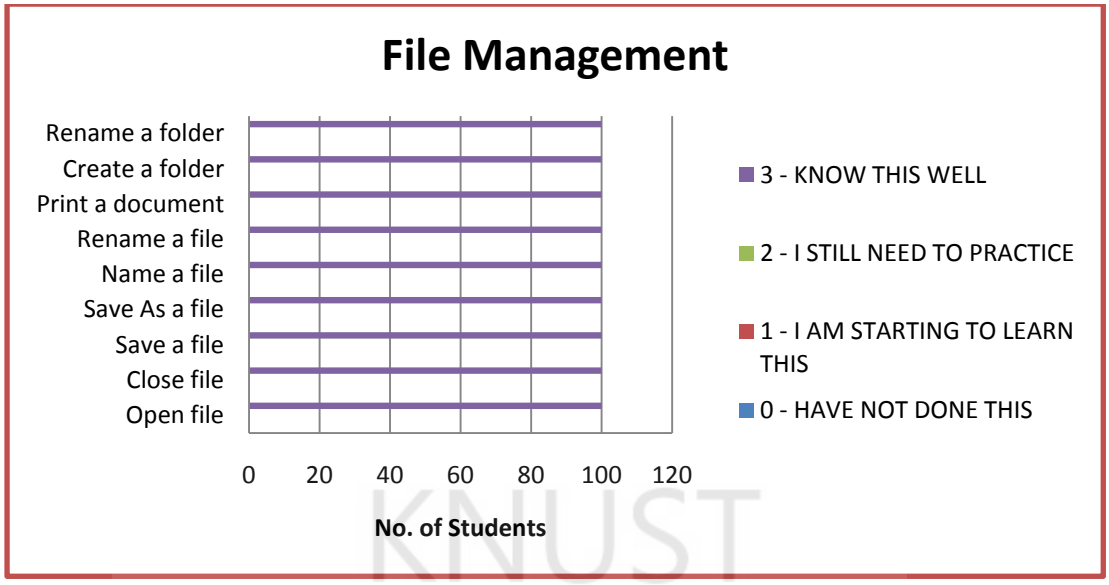


Figure 7.4: Year Two – File Management

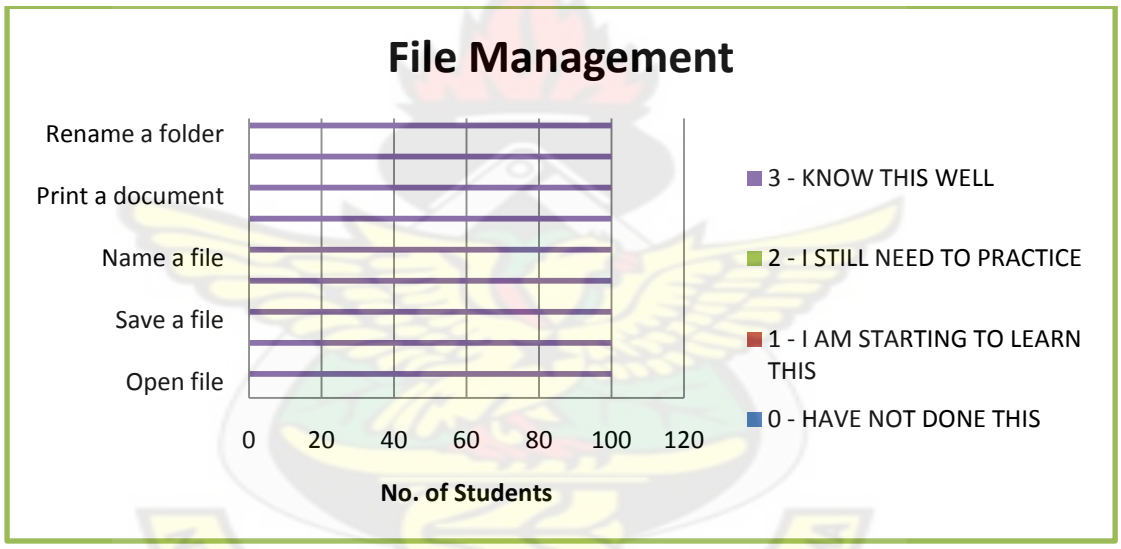


Figure 7.5: Year Three – File Management

However, Word Processor (MS Word) is used by students to submit assignment, reports and other documents in either hardcopy or softcopy. In Figure 7.6 and 7.7, because students were newly introduced to the application, they expressed variations in their learning experience. 10 out of 100 students (Graphics in Figure 7.6) explained that they still need to practice to be able to insert, reposition and resize graphics and then 5 out of 100 in Figure 76.7 also, show adjustment after a period. Moreover, 90 and 95 respectively (Graphics) know this well, able to insert graphics

and reposition and resize it with captions and borders if necessary. With the variable (Figure 7.6), 5 stated that they still need to practice to be able to insert tables and customise them to their satisfaction. With the 'Text attributes' variable, 10 students noted that they still need to practice and 5 also noted, 'I am starting to learn this.' In Figure 7.7, 7 still need to practice. 'Typing a basic document' posed a challenge as quite a number of the students lack basic typing skills. In the chart, 8 still need to practice and 5 starting to learn and 87 know this well. But the following year (Figure 7.7), 5 still need to practice typing a basic document, showing a reduction.

That notwithstanding, after long exposure explaining the mastery learning of the framework, in Figure 7.8, students noted that they could do the entire variables well. On the average, 97.1% of the students could use the application well.

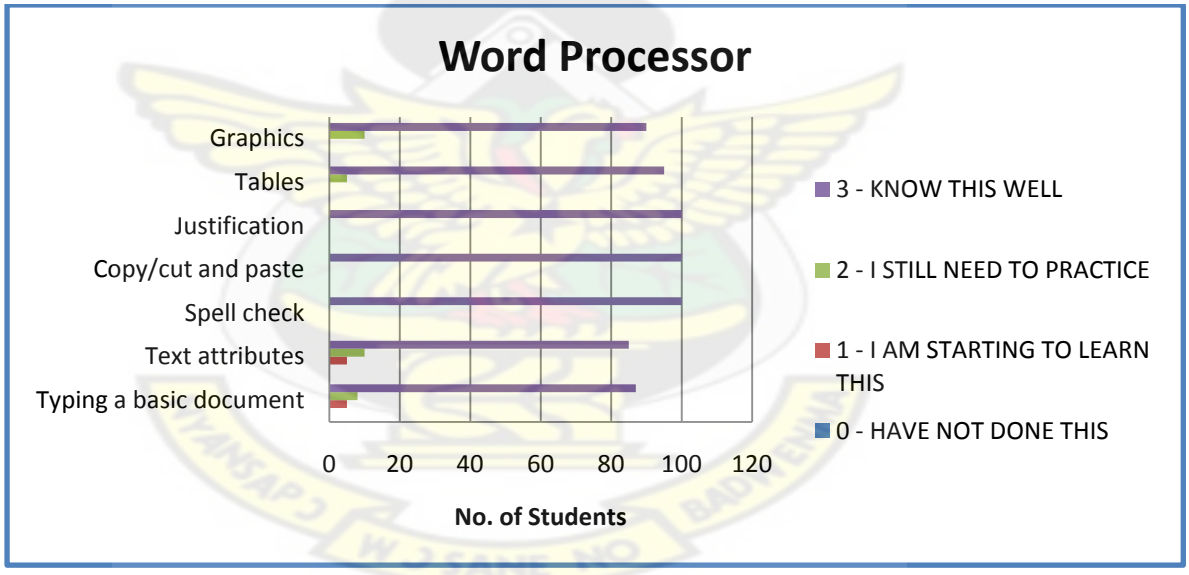


Figure 7.6: Year One – Word Processor

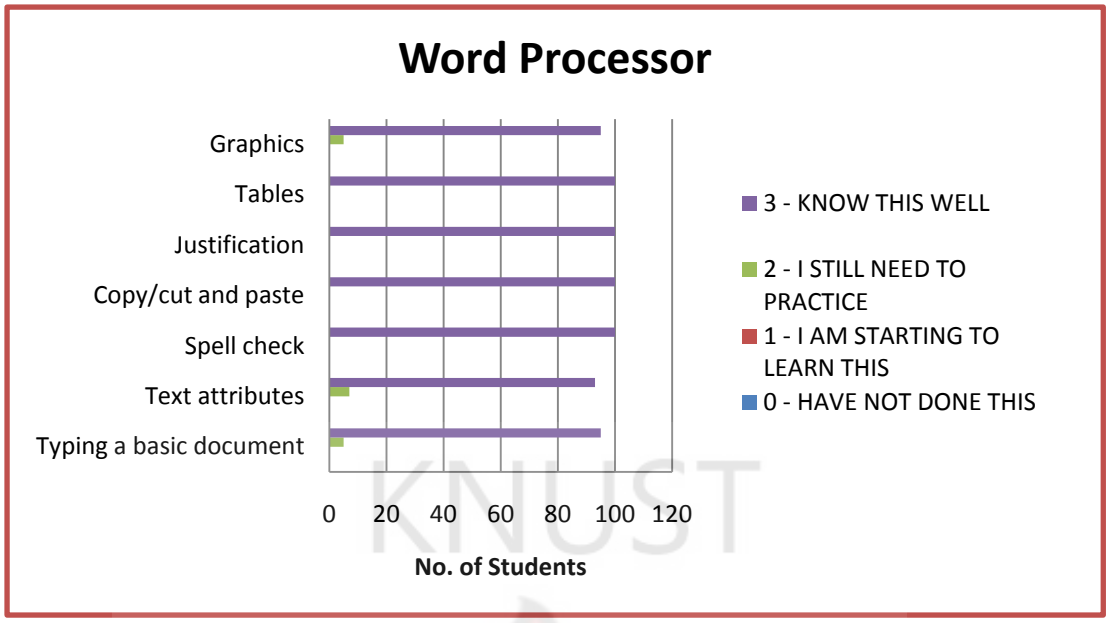


Figure 7.7: Year Two – Word Processor

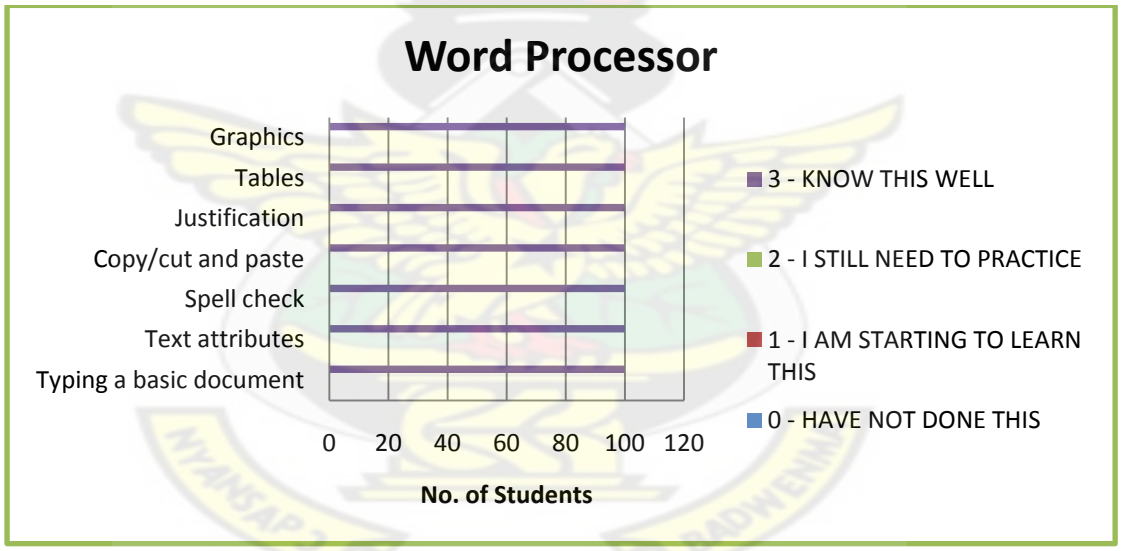


Figure 7.8: Year Three – Word Processor

To communicate electronically on the computer, E-Mail (Electronic mail) is used to transmit data, text files, digital photos, or audio and video files from one computer to another over an intranet or the Internet. In Figure 7.9 (year one), some students had difficulty with the concepts of 'dial-up and attachments' hence, explain their inability to effectively access internet facilities and personal computers. Seventy (70) students (Dial-up) out of 100 'could know this well' and the remainder, 30 still

need to practice to setup a dial-up connection at home. But in Figure 7.10 and 7.11, it has reduced to 10 and 5, respectively, because of the mastery learning experiences the students had. Further, out of 100 (Figure 7.9 and 7.10), for 'attachments', 2 respectively indicated that they were able to send and receive basic attachments with assistance but the rest (98) could do this well without any assistance. The Percentage for E-mail of those who know this well, 97.3% of the students know how to do these (see variables for E-mail, Figure 7.11) without any assistance.

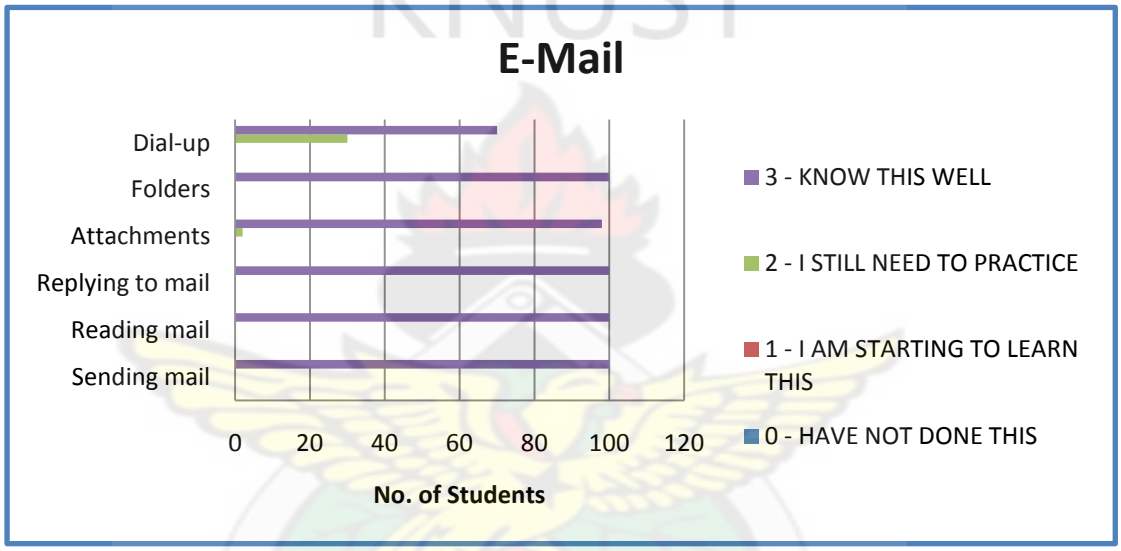


Figure 7.9: Year One – E-Mail

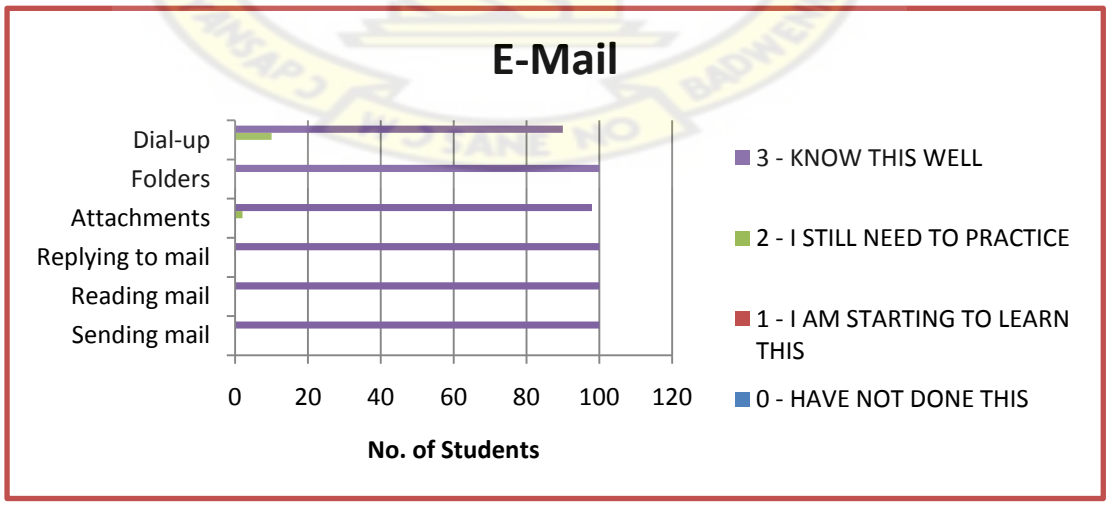


Figure 7.10: Year Two – E-Mail

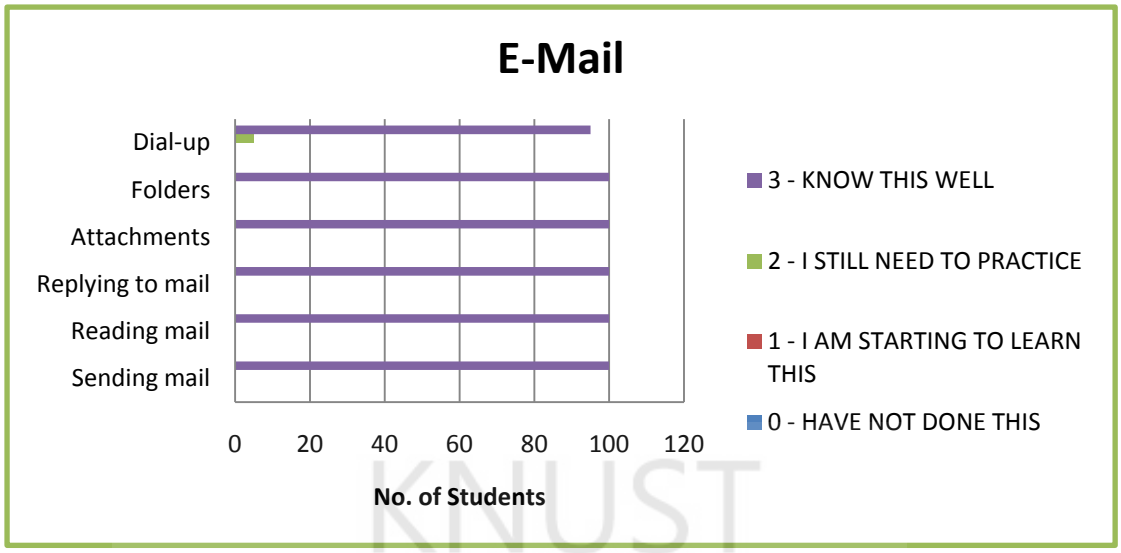


Figure 7.11: Year Three – E-Mail

World Wide Web (WWW) is a computer-based database of information resources that combines text and multimedia. The information on the World Wide Web can be accessed and searched through the Internet (Comer, 2008). It consists of a collection of internet sites and often referred to simply as "the Web." In Figure 7.12 students were asked whether they patronize web resource facility. In the cases presented, 100 (Searching) indicated that they were able to make use of a variety of search engines with considerable success. 8 out of 100 (Favourites) stated that they were able to add simple favourites and use them too, whiles 92 were able to add and file favourites in folders.

Two out of 100 (Navigating) noted that they were able to navigate by clicking on links, using favourites and typing in the web address, whiles 98 noted that they were able to navigate in all possible ways on the Web. In view of these on the average, 97% of the students exhibited comprehension of teaching and learning experiences in the framework. Subsequently, year two (Figure 7.13) and year three (Figure 7.14) contrarily demonstrated 100% ability to apply what they were taught which met both behavioural and goal objectives inherent in the framework.

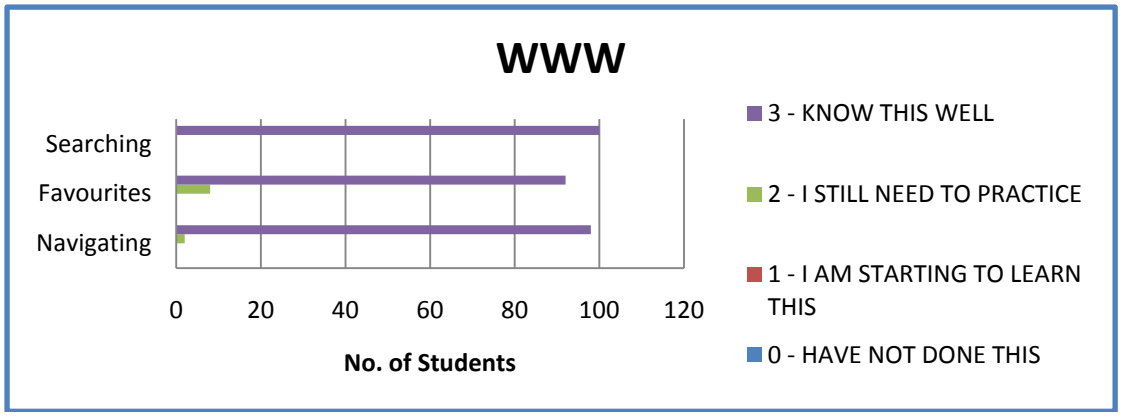


Figure 7.12: Year One – WWW

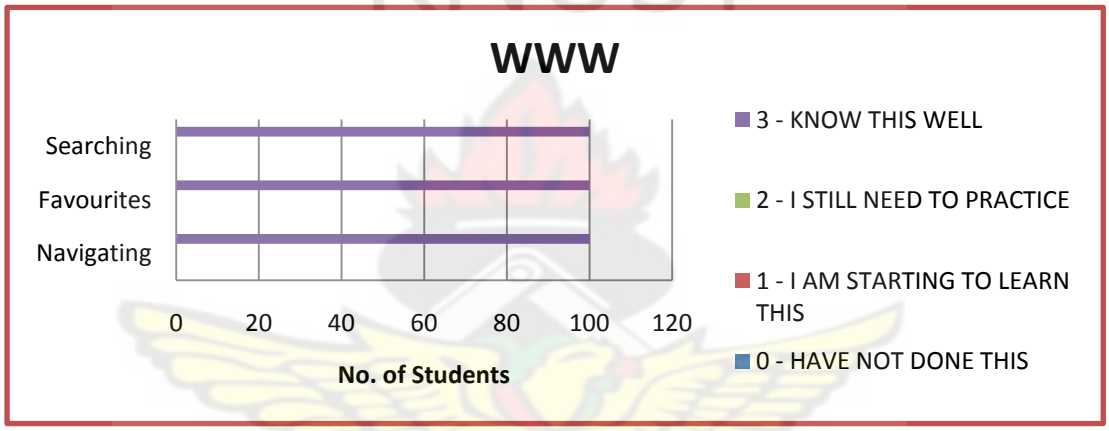


Figure 7.13: Year Two – WWW

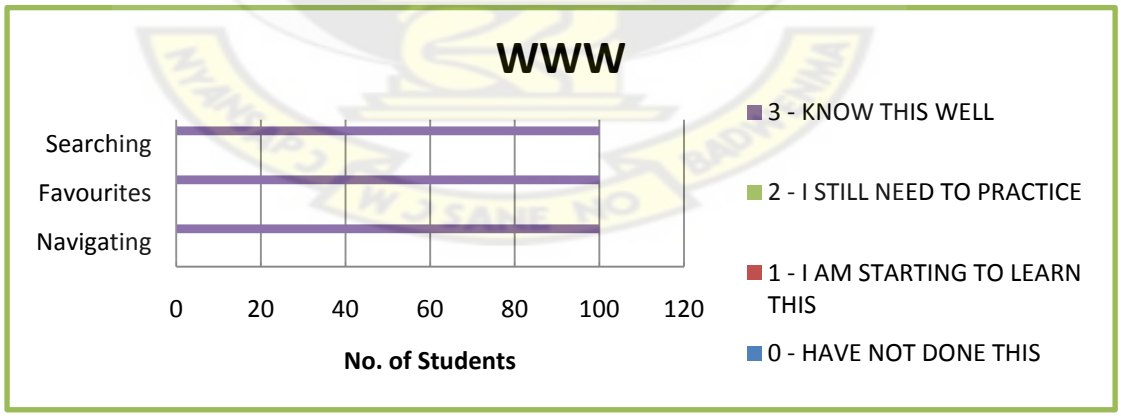


Figure 7.14: Year Three – WWW

From the discussion, it had been noted that mastery learning which gives the student sufficient time to develop his potential in a given subject matter or area was

demonstrated. Accordingly, year three students were able to effectively and efficiently apply their knowledge and skills which bring to bear the cognitive, affective and psychomotor skills they experienced. Students' ability to manipulate those software and courseware attributes at any given time nonetheless describes the holistic ICT-based training that the framework has to offer. Also, with the knowledge of concepts, principles, theories, and skills acquired in relation to those applications, students should be able to apply that knowledge to understand advanced versions of those concepts, principles, skills and theories.

7.3 Summary of Findings of the Pretest of IMF

The internal validity of the study has been quantitatively discussed at length. Having observed the validity of the study against the behavioural objectives, class scores and checklist (aptitude test), it indicatives fact that the framework has a holistic ICT educational experience to offer students. The following are the main results of the pretest process:

- The behavioural objective of the framework had been exercised through domains such as cognitive, affective and psychomotor skills. With this, learners were able to know, understand, synthesise and evaluate ICT knowledge and skills.
- Due to the extension of the credit hours from 12 to 32, and the well organised scope and sequence of the ICT courses, there was ample time for the teaching and learning of ICT. This gave learners mastery learning experience of ICT education.

- The evaluation findings from the class scores and the checklist validate that learners have acquired ICT working knowledge and skills for today's technology-based industries and knowledge-based economy.
- The affirmative results of the pretest process revealed that the framework is feasible for integration into DIA curriculum, and also serves as an ICT literacy model for other Visual Arts Disciplines.

7.4 Validity

Validity refers to the degree to which a test measures what it is supposed to measure. It is the extent to which a test predicts what it is designed to do. The measure of validity in this context is the test of hypothesis for the study. The hypothesis states that the development of ICT Modular Framework for the Department of Industrial Art, KNUST will provide a holistic ICT-based training of students for today's technology-based industry, society and the knowledge-based economy. In a perspective, a construct validity according Trochim (2006), is the approximate truth of the conclusion that your operationalization accurately reflects its construct. The construct is 'a holistic ICT-based training of students' and the pretest of the framework shows that there is a behavioural objective fulfilments – application of cognitive, affective and psychomotor skills, and mastery learning resulting from more credit hour and the integrative structure of course contents. In effect, these however reflect the construct that students who experience teaching and learning of the framework should have a holistic ICT knowledge and skills to fit into the job market, society and have a lifelong learning leverage.

Subsequently, the findings of behavioural objectives, class scores and checklist reveal that the framework is feasible and could suffice as a model for other Visual Arts Disciplines. This explains the external validity of this study. The external

validity of a study is the extent to which one can generalize findings to a larger group or other contexts.

7.5 Validation of Hypothesis

The existing interdisciplinary computer-based modules run by the Department lack the needed application programmes (software) in content, instruction, course outline and description, and lack educational experience in scope and sequence for the Visual Arts programmes that the Department runs. There is no coherent and comprehensive framework on ICT literacy to reflect the much talked about technology-based education. In view of this, the dissertation seeks to develop ICT Modular Framework for the Department of Industrial Art, KNUST to provide a holistic ICT-based training of students for today's technology-based industry, society and the knowledge-based economy.

The proposed framework in chapter five establishes that more credit hours have been added to give students mastery learning experience as compared to the existing structure. Students will have the opportunity to undertake industrial attachment for a whole semester. The results of the pretest of the ICT modular framework provide affirmative implications thereby validating the hypothesis of the study. Indeed, the proposed framework for DIA provides a holistic ICT-based training of students for today's technology-based industry, society and the knowledge-based economy.

CHAPTER EIGHT

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8. 1 Summary

The Department of Industrial Art is responsible for the training and production of high-level manpower in the respective disciplines (Textiles, Metal Products Design, and Ceramics) for the Ghanaian economy with the requisite knowledge and skills for today's technology-based industries. At the beginning of this dissertation, there was a conjecture that DIA's existing computer-based modules structure, contents and instructions are limited in scope and sequence and lacked the needed computer application programmes (software). This, however, defeats the culture of excellence, leadership in innovation and technology set by the university. As a result of the aforementioned problems, examining the existing computer-based modules structure of the three sections of DIA was extensively canvassed. This also included a preliminary survey to establish students' and graduates' views and impressions about the computer-based modular course the Department of Industrial Art offers.

The university has the vision of advancing knowledge in science and technology for sustainable development in Africa. This was not contained in the findings of the examination of the existing computer-based modules. In the findings, students' response to the administered copies of questionnaire indeed proved that there was the need to revise the entire computer-based modular course structure. The assessment of DIA computer-based modules structure was indicative of the fact that the scope and sequence component of the current ICT modules in DIA should be revised, in order to produce graduates with requisite knowledge and skills to meet current challenges in the information age. The detailed discussion, findings and recommendation of the examination of the current ICT modules were in chapter three.

The recommendation stipulates that, to meet the current demand of knowledge-based, information-rich and technology-based socio-economic activities, there is the need for the consolidation of coherent and comprehensive ICT modules in the programmes of the DIA curriculum. This will help produce graduates with prerequisite competencies, quality and technology-based education, that are required by today's institutions, organisations and industries.

As indicated by Ibn-Chambas (1998), the ability of our country to compete and face the challenges of the 21st century undoubtedly depends on the quality of tertiary education. In effect, the developed ICT Modular Framework for the Department of Industrial Art, KNUST, will meet the short and long term missions and visions of the university and the department. This would provide a holistic ICT-based training of students for today's technology-based industry, society, institutions and knowledge-based economy. The Ghana ICT4AD Policy objective is to engineer an ICT-led socio-economic development process with the potential to transform Ghana into a middle income, information-rich, knowledge-based and technology-driven economy and society. This policy direction is achievable in Art Education only when ICT-integrated Visual Arts educational experience is given to students.

In Chapter five, a survey was conducted to establish the tier of ICT awareness, education, implementation, use and integration among students and professionals. In the findings, there were some key issues such as, close to 90% of respondents were responsive of the word ICT but 75.4% neither know the ramifications of ICT concepts nor could differentiate between IT and ICT; also, 96% of the respondents could not define the term ICT or properly enumerate the advantages to which they used ICT facilities. Lastly, limited human resource capacity characterized all these problems.

The proposed framework is designed to correct the adverse findings implicit in the discussion of Chapter Five.

The framework offers students mastery ICT learning experience as a result of more credit hours, and expanded scope and sequence of ICT theories, knowledge and skills to attain both behavioural and goal objectives. Students have the opportunity to undertake industrial attachment that is learning to combine design and manufacturing processes under a single operation. In the sense, students observe and understand the correlation between CAD/CAM operations. The framework offers a multiplicity of teaching and learning experiences. This encourages creative thinking ability to apply cognitive, affective and psychomotor skills in some desktop publishing, data management, graphics, multimedia and programming applications software in subject areas. The framework also serves as a guide to the development and implementation of an ICT modular course in other Visual Art Disciplines at the tertiary level (see Appendix H for a sample). In view of this, the praxis of integration of the framework in DIA was tested.

The integration of the framework into DIA curriculum during the pretest period augmented the pedagogy and learning of ICT-based education at the Department. The study of the framework poses confirmatory implications that it should be absorbed into DIA curriculum structure. The pretest of the framework was discussed under the following evaluation instruments: observation, class score and checklist. The observation of students was looked at under three main domains of behavioural objectives which are cognitive, affective and psychomotor skills. Detailed discussion of these domains is in Chapter Seven. The behavioural objectives of the framework were exercised which gave students the theoretical and experiential learning experience with emphasis on subject-relevance. The robustness of the

framework was also confirmed. The evaluation study findings under the true-experimental design and check-list also suggest that the framework successfully contributed to ICT-based education at DIA. These instruments however confirmed the internal validity and mastery learning experience of the framework.

The strength of the framework depends on how well it is implemented. In that, the framework is just a model and the strength predominantly depends on how much resources both human and material are made available for the individual learner. On the other hand, there is the characteristic of weakness if the Department does not provide the requisite resources such as computer laboratory, computers, CBL and CBT software, and qualified instructors to implement the framework. In addition, failure to conduct periodic reviews of the framework could result in its weakness.

8.2 Conclusions

Developing lifelong learners is central to the objective of this dissertation, by ensuring that the individual learner has the intellectual abilities of reasoning and critical thinking through the use of ICT. The examination of the existing computer-based modules in the programmes of the Department of Industrial Art, KNUST was done to formulate an ICT modular framework to provide an in-depth ICT-based Visual Art Education. This included the discussion of the existing computer-based modular course structure and description, the methodology of instruction and a preliminary investigation, and thus there is evidence that ICT as a modular course had never been comprehensively taught in DIA. There had been several shortcomings including limited use of computer application programmes; inadequate teaching period and contents for computer-based courses; and lastly, some computer-based courses are not relevant to the various subjects of study. The framework was

developed against the backdrop of observations. Moreover, the discussion of findings in chapter five also recommended the need to develop the framework.

The development of a comprehensive and coherent ICT Modular Framework for the Department of Industrial Art is to augment the teaching and learning of ICT in the area of Visual Art Education. In the framework, virtually all ICT ramifications have been covered, equipping students with the introduction, intermediate and advance knowledge and skills in ICT. It is developed to equip students both in knowledge and skills application of ICT in subject areas, to facilitate teaching and learning; in professions, socio-economic activities, and in lifelong learning experiences. Primarily, the framework is developed to provide a holistic ICT-based training of students for today's technology-based industry, society and the knowledge-based economy.

The pretest study findings of the pretest process suggest that the model was successfully applied to the ICT-based Visual Art Education at DIA. Both the behavioural and goal objectives of the framework were met. The behavioural objectives of the framework were attained with the learners being able to know and understand, synthesise and evaluate ICT knowledge and skills. The goal objectives of the ICT Modular Framework are: First, to train students in the theoretical and practical aspects of ICT in Textiles, Metal Products Design, Ceramics, and Fashion Design and Clothing; Second, to equip students with a coherent and broad understanding of the principles, methodologies, and applications of ICT in the modern world for them to become lifelong learners; Third, to train students to acquire ICT working knowledge and skills for today's technology-based industries and knowledge-based economy; lastly, to serve as a multi-modal approach to other Visual Art Disciplines for the development of comprehensive ICT modular courses.

The framework provides students a learner-centred learning experience thereby confirming Dewey's assertion that if an educational process is not based on the experience of the learner's internal condition and his external environment, then it is not relevant. Hence, the study is a plus to the pedagogy and learning of Art Education, providing the individual the optimum and well rounded ICT-based Art Education in the 21st century.

Pedagogy

Bloom (1975) explained that subjects which are required, sequential, closed and emphasize convergent thinking should employ mastery learning strategies. Implicit in this formulation is the assumption that ICT-based education serves a spine for today's educational system. In this fashion, ICT-based education is required and therefore the framework was developed to provide students mastery learning of ICT-based education. Students are taught to use ICT to solve basic to complex problems in subject areas.

Contributions to Knowledge in Art Education

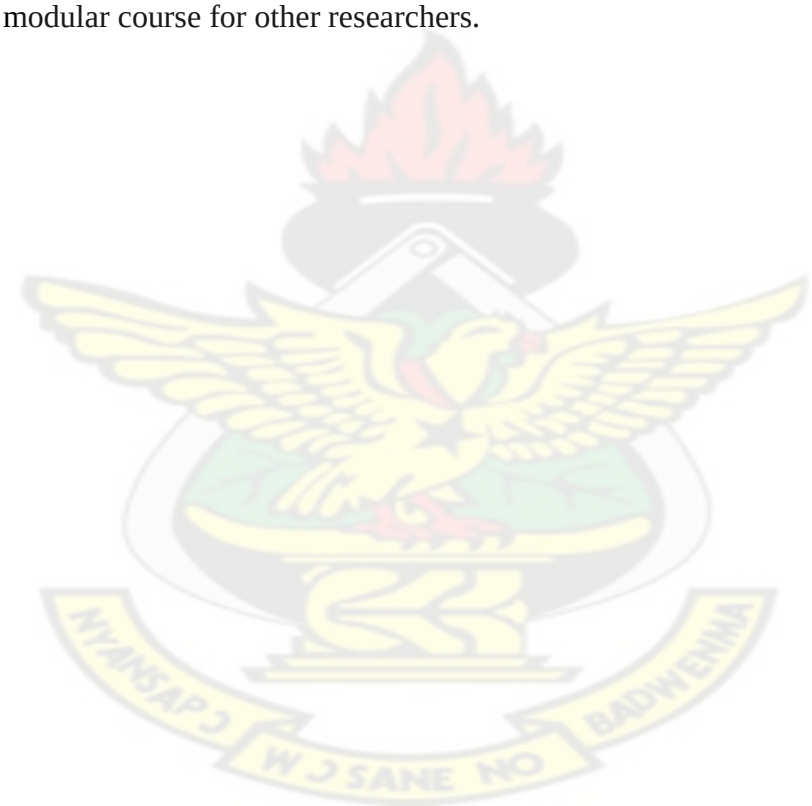
The ICT Modular Framework developed in this dissertation has been used as a theoretical model for the pedagogy and learning experience of ICT-based education at the Department of Industrial Art, KNUST. The framework had provided a model of teaching and learning necessary to guide the future development of ICT-based curriculum for Art Education at the tertiary level. However, the modality used to pretest the framework contributes toward theories for evaluating ICT in Visual Arts Education at the tertiary level.

8.3 Recommendations

The Ghana ICT4AD Policy stated that Ghana is currently facing a human resource problem in technical and managerial skill areas and more so in ICT skills. The study has attempted to solve the human resource problem by providing multi-modal approach to the teaching and learning of ICT to produce requisite human capital for today's industry, society and the knowledge-based economy. Based on the findings of this study, the following recommendations are presented for the integration of the framework at DIA and other Visual Art Disciplines at the tertiary level:

1. The framework should serve as a multi-modal approach to learning of ICT and as a vehicle to encourage creativity and creative thinking of learners in Visual Art Education at the university level.
2. Upon the discreet and systematic examination of the existing computer-based modules of DIA hence the development of the ICT Modular Framework, the department should integrate the comprehensive and coherent ICT modular framework in its curriculum.
3. This comprehensive ICT Modular Framework should serve as a model for the development and implementation of ICT modular course in other Visual Art Disciplines at the tertiary level of education.
4. The assessment procedure employed in the pretest of the framework develops a model for future evaluation of the framework contents, to make decisions about the individual and the framework.
5. The framework upon implementation should be revised every three successive years for efficient teaching and learning of ICT.

6. When the framework is implemented requisite resources both human and materials should be adequately provided so that the framework can meet the goal of serving as a catalyst for the Department and the University in achieving their visions and missions.
7. The researcher would liaise with departments for smooth implementation, integration and review of the framework.
8. Implication for further studies, the research work provides a methodological procedure of evaluation, development, implementation and pretest of a modular course for other researchers.



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APPENDICES

Appendix A1

Questionnaire

This is to ascertain the level of ICT awareness, education, implementation, use, integration, and instruction.

Section A: Demographic Information

Personal information, please check mark [√] ***or fill in the blanks, ones that are applicable.***

I. Name(Optional):.....

II. Age group: (a)15-20years[*] (b)21-25years*[*] (c)26-30years*[*] (d)31-35years*[*] (e)36-40years*[*] (f)above 41years*[*]*

III. Gender: Male[ ] */ Female*[ ]

IV. In which Region do you stay? .....

V. What is your status? (a) Student[ ] *(b) Lecturer*[ ] *(c) HOD*[ ] *(d) Graduate/Service Personnel*[ ] *(e) Demonstrator*[ ] *(f) Other*.....

VI. If a lecturer, what subjects do you lecture?.....

VII. If a student, what is your programme of study and school?.....

VIII. Which year are you? (a) 1st Year[ ] *(b) 2nd Year*[ ] *(c) 3rd Year*[ ] *(d) 4th Year*[ ] *(e) 5th Year*[ ] *(f) 6th Year*[ ] *(g) 7th Year*[ ].

IX. If other, what do you do and at where?.....

SECTION B: Concepts on IT and ICT

1. a. Have you read/heard of the term Information Technology(IT)? Yes[ ]/No[ ].
   b. If Yes, through which medium/media did you get to know? Check mark the appropriate ones: Television[ ] Radio[ ] Newspapers[ ] Internet[ ] Literature[ ] or none of the above.
2. a. Have you read/heard of the term Information and communication Technology (ICT)? Yes[ ] / No[ ].
   b. If Yes, through which medium/media did you get to know? Check mark the appropriate ones: Television[ ] Radio[ ] Newspapers[ ] Internet[ ] Literature[ ] or none of the above.
3. Which of them are you familiar with? IT[ ] / ICT[ ] Both [ ] or none of them[ ]
4. What do you understand by Information Technology (**IT**)?.....

.....

5. What do you understand by Information and Communication Technology (**ICT**)?.....

.....

6. What is the difference between IT and ICT?.....

.....

7. To what advantage(s) have you used IT/ICT?.....

.....

8. Which devices, tools or machines do you term as ICT?.....

.....

SECTION C: General Information

Please check mark [√] ***and fill in the blanks.***

1. In general, what do you understand by the word curriculum?.....

   .....

2. a. Do you think Ghanaians need a national ICT curriculum? Yes[ ] / No[ ].
   b. If Yes, why?.....

.....

3. a. Is there a National Policy on ICT Education? Yes[ ] / No[ ].
   b. If Yes, when and how did you get to know?.....

.....

4. Do you think much have been done (ICT) in terms of education, implementation and use? Yes[ ] / No[ ].
5. To what extent can you rate ICT Education in the country? (a) Very poor[ ] (b) poor[ ] (c) average[ ] (d) good[ ] (e) Very good[ ] (f) excellent[ ].
6. In terms of education, what suggestions will you give when it comes to developing an ICT curriculum for students?.....

.....

7. Which sectors of the economy do you see this ICT concepts being used?.....

   .....

8. Do you think ICT is the answer to the problems of developing countries such as Ghana? Yes[ ] / No[ ].
9. State what you think it can do?.....

.....

10. a. Do you think there are cultural barriers that impede the implementation, process and use of ICT? Yes[ ] / No[ ].
    b. If Yes, state?.....

.....

11. a. In terms of use, do you think Ghanaians are patronizing ICT effectively and efficiently? Yes[ ] / No[ ].
    b. If No, why?.....
12. List some difficulties faced by Ghanaians as to the use of ICT?.....
.....
13. a. Do you think the integration of ICT into our socio-economic activities can help to alleviate poverty? Yes[ ] / No[ ].
    b. If Yes, how?.....
.....
a. Do you think ICT has integration or can be used in all disciplines? Yes[ ]/No[ ].
    b. If No, then list otherwise?.....
14. Is there gender equity in the study and use of ICT? Yes[ ] / No[ ].
15. How does the future look like for Ghana after integrating ICT into our socio-economic activities? (a) bright[ ] (b) bleak[ ] (c) trailing behind our colonial masters [ ] (d) developed country[ ].

Appendix A2

Section D: This is to establish students' and graduates' views and impressions about the computer-based modular course the Department of Industrial Art offers.

Please check mark the following.

1. a. Have you ever studied any Computer application programme as part of your course of study? Yes[ ]/ No[ ]

b. If Yes, which of the following computer application programme(s) have you studied? Windows[ ] CorelDraw[ ] Adobe PhotoShop[ ] Adobe Illustrator[ ] Adobe PageMaker[ ] Rhino[ ] Ms Word[ ] Ms Excel[ ] Ms Publisher[ ] 3D StudioMax[ ] WeavePoint[ ] Ms Power Point[ ] Maya[ ].

Any other:……

2. Have you undertaken a computer literacy course outside DIA programmes? Yes[ ] / No[ ]
3. What has been your impression about the computer application programme(s) in relation to your course of study? (a) poor[ ] (b) average[ ] (c) good[ ] (d) very good[ ] (e) excellent[ ]
4. In terms of content and assessment, how will you rate the computer application course(s) studied? (a) poor[ ] (b)good[ ] (c)very good[ ] (d) excellent[ ] (e) Average[ ]
5. Do you think the objectives of the programme (i.e. Textiles, Metals and Ceramics) have been met? Yes[ ] / No[ ]
6. Do you think the current ICT courses run by the department lack certain computer application programme(s)? Yes[ ] / No[ ]
7. If yes, state them/no, why?.....
8. Do you think the teaching periods allocated for computer application courses are adequate? Yes[ ] / No[ ]
9. Do you think your department should have its own Information Technology Curriculum or syllabi and Instructors? Yes[ ] / No[ ]
10. What would you have suggested to the department when it is developing its own ICT Modules?……

Appendix B

Interview Guide

To determine the calibre of school products the industry needs in terms of ICT knowledge and skills.

1. Do you employ school products from the university into your departments?
2. What sought of ICT skills do you require from these products?
3. Do you have special computer application programmes that you would want students to study before seeking employment in your company?
4. What advice or suggestion will you give to a department in the university who wants to review its ICT modules?

Appendix C

Students ICT Course Performance for 2005/06 to 2008/09 Academics Years

Metal Products Design

Year	DAD 263	DAD 264	DAD 359	DAD 358	AVG
2005-2006	68.6	68.7	68.1	69.2	68.65
2006-2007	68.9	69.3	65.9	78.6	70.675
2007-2008	64.5	73.4	68.6	59.7	66.55
2008-2009	62.8	69	67.6	70.8	67.55

Textiles

Year	DAD 263	DAD 264	DAD 359	DAD 358	AVG
2005-2006	68.9	72.1	66.9	64.2	68.025
2006-2007	67.5	68.9	67	65.8	67.3
2007-2008	65.4	58.2	66.1	60	62.425
2008-2009	66.9	71.5	68.6	71.3	69.575

Ceramics

Year	DAD 263	DAD 264	DAD 359	DAD 358	AVG
2005-2006	74.5	71.4	0	0	36.475
2006-2007	71.2	70.3	70.7	70.8	70.75
2007-2008	74	69.2	0	0	35.8
2008-2009	68	70	71	73.5	70.625

Foundation

Year	DAD 157	DAD 158	AVG
2005-2006	66.5	72.7	69.6
2006-2007	0	0	0
2007-2008	73.4	77.5	75.45
2008-2009	72.9	78.5	75.7

Appendix D

Self-Assessment of Basic ICT Skills - Checklist

ICT SKILL	HAVE NOT DONE THIS 0	I AM STARTING TO LEARN THIS 1	I STILL NEED TO PRACTICE 2	KNOW THIS WELL 3
File Management				
Open file	I cannot do this	I have opened files before but may need assistance to do so.	I can only open files in the word processor or the Web browser, but not both	I can open files in both the word processor and Web browser
Close file	I cannot do this	I have closed files before but may need assistance to do so.	I can only close files in the word processor or the Web browser, but not both	I can close files in the both word processor and Web browser
Save a file	I cannot do this	I have saved files before but may need assistance to do so.	I can only save files in the word processor or the Web browser, but not both	I can save files in both the word processor and Web browser
Save As a file	I cannot do this	I have saved files in a different location or under a different name before but may need assistance to do so.	I can only save files in a different location or under a different name files in the word processor or the Web browser, but not both	I can save files in a different location or under a different name in both the word processor and Web browser
Name a file	I cannot do this	I have named files before but may need assistance to do so.	I can only name files in the word processor or the Web browser, but not both	I can name files in the word processor and Web browser
Rename a file	I cannot do this	I have renamed files before but may need assistance to do so.	I can only rename files in the word processor or the Web browser, but not both	I can rename files in the word processor and Web browser

Print a document	I cannot do this	I have printed files before but may need assistance to do so.	I can only print files in the word processor or the Web browser, but not both	I can print files in the word processor and Web browser
Create a folder	I cannot do this	I have created and named a folder before but may need assistance to do so.	I can only create and name a folder in explorer, but not in other locations, or vice versa.	I can create and name a folder in Windows Explorer and within file dialogue boxes of the word processor and Web browser
Rename a folder	I cannot do this	I have renamed a folder before but may need assistance to do so.	I can only rename a folder in explorer, but not in other locations, or vice versa.	I can rename a folder in Windows Explorer and within file dialogue boxes of the word processor and Web browser
Word Processor	0	1	2	3
Typing a basic document	I type very slowly and make many errors	I type very slowly but only make a few errors	I type fairly quickly and do not make too many errors	I type very quickly and accurately
Text attributes	I cannot do this	I only use text attributes when I can remember how to do it	I use most text attributes but not all	I can use all the text attributes, like font style and size, bold, underline, italics, text colour
Spell check	I cannot do this	I struggle to use the spell checker, but try	I usually use the spell checker, but do not know all its options	I am very familiar with the spell checker and all its features
Copy/cut and paste	I cannot do this	I often have difficulty doing a copy/cut and paste operation	I usually do copy/cut and paste accurately, but sometimes have difficulty	I am able to copy/cut and paste with ease within and between applications
Justification	I cannot do this	I have difficulty understanding justification	I am able to left and centre justify text	I am able to justify text to my satisfaction
Tables	I cannot do this	I am able to insert a basic table	I am able to insert a table and add and	I am able to insert tables and customise

			delete columns and rows	them to my satisfaction
Graphics	I cannot do this	I am able to insert a graphic but not move it or resize it	I am able to insert, reposition and resize graphics	I am able to insert and graphics and reposition and resize it with captions and borders if necessary
E-Mail	0	1	2	3
Sending mail	I cannot do this	I am able to send a basic e-mail to one user	I am able to send e-mail to a user and CC another user. I am also able to send to mailing lists	I am able to send and forward e-mail to individuals, multiple users, mailing lists, discussion lists.
Reading mail	I cannot do this			I am able to read e-mail
Replying to mail	I cannot do this	I am able to reply to an e-mail message that I have read	I am able to replay an e-mail message and include the original in the reply.	When I reply to e-mail I am able to dictate who the reply goes to and how much of the original mail is included in the reply.
Attachments	I cannot do this	I am able to send attachment, but not receive, or vice versa. I sometimes have difficulty with this	I am able to send and receive basic attachments	I am able to manage file attachments fully. I am also able to receive and send attachments.
Folders	I cannot do this	I am able to store mail in folders, but sometimes have trouble creating folders	I am able to store mail in folders	I am able to manage mail by storing it in folders and trays.
Dial-up	I cannot do this	I do not regularly dial up for Internet access, but have done it.	I am able to dial up to the Internet	I am able to dial up to the Internet and am able to understand the reason when it does not always work successfully
WWW	0	1	2	3

Navigating	I cannot do this	I am able to navigate by clicking on links	I am able to navigate by clicking on links, using favourites and typing in the web address	I am able to navigate in all possible ways on the Web
Favourites	I cannot do this	I am able to use favourites but not add them	I am able to add simple favourites and use them too	I am able to add and file favourites in folders. I am able to customise the favourites list
Searching	I cannot do this	I am able to do simple searches for information but must admit that I have not quite mastered it	I am able to conduct simple searches quite successfully, but do not use a variety of techniques	I am able to make use of a variety of search engines with considerable success
Total				

Courtesy: Educator Development for ICT Framework (2000). Retrieved June 14, 2009, from http://www.school.za/edict/edict/index.htm

Appendix E

Checklist Results for Year - One

File Management	**0**	**1**	**2**	**3**
Open file	0	0	0	100
Close file	0	0	0	100
Save a file	0	0	0	100
Save As a file	0	0	0	100
Name a file	0	0	0	100
Rename a file	0	0	0	100
Print a document	0	5	10	85
Create a folder	0	0	0	100
Rename a folder	0	0	0	100

Word Processor	**0**	**1**	**2**	**3**
Typing a basic document	0	5	8	87
Text attributes	0	5	10	85
Spell check	0	0	0	100
Copy/cut and paste	0	0	0	100
Justification	0	0	0	100
Tables	0	0	5	95
Graphics	0	0	10	90

E-Mail	**0**	**1**	**2**	**3**
Sending mail	0	0	0	100
Reading mail	0	0	0	100
Replying to mail	0	0	0	100
Attachments	0	0	2	98
Folders	0	0	0	100
Dial-up	0	0	10	90

WWW	**0**	**1**	**2**	**3**
Navigating	0	0	2	98
Favourites	0	0	8	92
Searching	0	0	0	100

0 - HAVE NOT DONE THIS
1 - I AM STARTING TO LEARN THIS
2 - I STILL NEED TO PRACTICE
3 - KNOW THIS WELL

Appendix F

Checklist Results for Year - Two

File Management	**0**	**1**	**2**	**3**
Open file	0	0	0	100
Close file	0	0	0	100
Save a file	0	0	0	100
Save As a file	0	0	0	100
Name a file	0	0	0	100
Rename a file	0	0	0	100
Print a document	0	0	0	100
Create a folder	0	0	0	100
Rename a folder	0	0	0	100

Word Processor	**0**	**1**	**2**	**3**
Typing a basic document	0	0	5	95
Text attributes	0	0	7	93
Spell check	0	0	0	100
Copy/cut and paste	0	0	0	100
Justification	0	0	0	100
Tables	0	0	0	100
Graphics	0	0	5	95

E-Mail	**0**	**1**	**2**	**3**
Sending mail	0	0	0	100
Reading mail	0	0	0	100
Replying to mail	0	0	0	100
Attachments	0	0	2	98
Folders	0	0	0	100
Dial-up	0	0	10	90

WWW	**0**	**1**	**2**	**3**
Navigating	0	0	0	100
Favourites	0	0	0	100
Searching	0	0	0	100

0 - HAVE NOT DONE THIS
1 - I AM STARTING TO LEARN THIS
2 - I STILL NEED TO PRACTICE
3 - KNOW THIS WELL

Appendix G

Checklist Results for Year - Three

File Management	**0**	**1**	**2**	**3**
Open file	0	0	0	100
Close file	0	0	0	100
Save a file	0	0	0	100
Save As a file	0	0	0	100
Name a file	0	0	0	100
Rename a file	0	0	0	100
Print a document	0	0	0	100
Create a folder	0	0	0	100
Rename a folder	0	0	0	100

Word Processor	**0**	**1**	**2**	**3**
Typing a basic document	0	0	0	100
Text attributes	0	0	0	100
Spell check	0	0	0	100
Copy/cut and paste	0	0	0	100
Justification	0	0	0	100
Tables	0	0	0	100
Graphics	0	0	0	100

E-Mail	**0**	**1**	**2**	**3**
Sending mail	0	0	0	100
Reading mail	0	0	0	100
Replying to mail	0	0	0	100
Attachments	0	0	0	100
Folders	0	0	0	100
Dial-up	0	0	5	95

WWW	**0**	**1**	**2**	**3**
Navigating	0	0	0	100
Favourites	0	0	0	100
Searching	0	0	0	100

0 - HAVE NOT DONE THIS
1 - I AM STARTING TO LEARN THIS
2 - I STILL NEED TO PRACTICE
3 - KNOW THIS WELL

Appendix H

A model of ICT Modular Course for other Visual Art Disciplines

This is a model of ICT modular course for other Visual Art Disciplines to buy into. Courseware application refers to software designed specifically for a particular purpose, for example WeavePoint, for designing weave structures.

Year One Semester One			**T**	**P**	**C**
ICT	151	Introduction to Computers	2	1	2
ICT	153	Introduction to Computer Skills	1	2	2
		Total	**3**	**3**	**4**
Year One Semester Two			**T**	**P**	**C**
ICT	152	Desktop Publications I	1	2	2
ICT	154	Intro. to Computer Networking & Internet Technique Application	1	2	2
		Total	**2**	**4**	**4**
Year Two: Semester One			**T**	**P**	**C**
ICT	251	Courseware Application I	1	2	2
ICT	253	Desktop Publications II	1	2	2
		Total	**2**	**4**	**4**
Year Two: Semester Two			**T**	**P**	**C**
ICT	252	Computer Aided Design (CAD) I	1	2	2
ICT	254	Courseware Application II	1	2	2
		Total	**2**	**4**	**4**
Year Three: Semester One			**T**	**P**	**C**
ICT	351	Computer Aided Design (CAD) II	1	2	2
ICT	353	Data Management Application	1	2	2
		Total	**2**	**4**	**4**
Year Three: Semester Two			**T**	**P**	**C**
ICT	352	Industrial Computer Applications	0	4	2
		Total	**0**	**4**	**2**

Year Four: Semester One			**T**	**P**	**C**
ICT	451	Artificial Intelligence (CAD/CAM)	2	1	2
ICT	453	ICT project/thesis I	2	4	3
		Total	**4**	**5**	**5**

Year Four: Semester Two			**T**	**P**	**C**
ICT	452	Multimedia Application	1	2	2
ICT	454	ICT project/thesis II	2	4	3
		Total	**3**	**6**	**5**

Total credit hours for ICT courses – 32.