CHALLENGES OF FLIPPING THE CLASSROOM IN TECHNICAL DRAWING: CASE OF KIAMBU INSTITUTE OF SCIENCE AND TECHNOLOGY, KENYA

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT FOR THE AWARD OF THE DEGREE OF MASTER OF EDUCATION IN THE SCHOOL OF EDUCATION OF KENYATTA UNIVERSITY

DECEMBER, 2016
DECLARATION

I confirm that this research thesis is my original work and has not been presented in any other university/institution for certification. The thesis has been complemented by referenced works duly acknowledged. Where text, data, graphics, pictures or tables have been borrowed from other works- including the internet, the sources are specifically accredited through referencing in accordance with anti-plagiarism regulations.

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This study is dedicated to all my students in the past, present and future.

May you seek and never lack learning opportunities.
ACKNOWLEDGMENT

I am very appreciative of the support of the staff of the Educational Communication and Technology Department and especially that of my supervisors, Professor H.O. Ayot and Professor S. R. Ondigi.

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LIST OF ABBREVIATIONS AND ACRONYMS

BL  Blended Learning
BOM  Board of Management
CAD  Computer Aided Drafting/Design
CD  Compact Disc
CM  Computer Mediated
DLP  Digital Literacy Programme
DQS  Diploma in Quantity Surveying
DRG  Drawing
DVD  Digital Versatile Disc
F2F  Face to Face
FCA  Flipped Classroom Approach
GoK  Government of Kenya
ICT  Information and Communication Technology
IMIS  Integrated Management and Information System
ISP  Internet Service Provider
IWB  Interactive Whiteboard
KATTI  Kenya Association of Technical Training Institutes
KCSE  Kenya Certificate of Secondary Education
KICD  Kenya Institute of Curriculum Development (formerly KIE)
KIE  Kenya Institute of Education
KIST  Kiambu Institute of Science & Technology
KNEC  Kenya National Examinations Council

Mbs  Megabytes per second

MoEST  Ministry of Education, Science & Technology

PDF  Portable Document File format

PPP  PowerPoint Presentation

TVET  Technical and Vocational Education and Training

TIVETA  Technical, Industrial, Vocational and Entrepreneurship Training Authority
ABSTRACT

The Flipped Classroom Approach (FCA) originated from the United States of America (USA) in 2007. It functions by utilizing the time that is traditionally meant for homework to deliver lesson content via information and communication technology (ICT). Subsequent face-to-face (F2F) sessions in the classroom dwell on hands-on activities. The enhanced interactions between the teacher and the learners makes a teacher “the guide by the side” rather than “the sage on the stage”. At Kiambu Institute of Science & Technology (KIST) in Kenya, there is insufficient time to handle practical work, hence the need to adopt the FCA. An increase in the contact time in the classroom could potentially contribute to better academic performance. In this case study, the purpose was to identify the challenges of flipping a Technical Drawing class. Four tools were used in the study, namely, content analysis of the syllabus, a checklist on ICT resources, a trainee questionnaire and a schedule of observations for the cooperating tutor. Technical Drawing was identified for the study because it lent itself to the use of FCA through its practical nature. Furthermore, it was mandatory for all trainees in the Building and Civil Engineering department at KIST. Content analysis of all topics in the syllabus was done to identify those that could be effectively taught by flipping the classroom. Up to 92 per cent of the topics identified required manipulative skills and could be effectively flipped. A sample class of 27 trainees from the Diploma in Quantity Surveying programme selected through purposive sampling was used in the study lesson. The trainees filled a questionnaire on their experience which was analyzed to establish the major challenges they encountered. 89 per cent and 69 per cent of the trainees did not have access to personal computers and smartphones respectively. This made them heavily dependent on ICT resources at KIST. Moreover, 85 per cent of trainees did not have adequate computer skills. The study lesson was delivered by a cooperating tutor who filled the schedule of observations detailing his experience in utilizing the FCA. His main challenge was packaging the lesson content for easier access by trainees. The checklist used to examine the capacity of the physical and information communication technology (ICT) infrastructure to support the FCA at KIST revealed that online delivery of lesson was limited by poor data connection speeds. The offline delivery was the preferred solution. The study concluded that, unless the challenges were overcome, only a moderate level of success in achieving the learning outcomes could be obtained by flipping the classroom. The study recommends that the FCA be utilized in Technical and Vocational Education Training (TVET) institutions such as KIST provided that the trainees have basic computer skills to access online and offline resources. The study also recommends that tutors should have basic proficiency in ICT and be willing to try out new learning and teaching approaches. The researcher suggests a replication of the study should be undertaken at other TVET institutions.
CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

When a trend that changes the way business is done gains global significance, one can easily talk of a revolution. Information and communication technology has radically changed the way human beings interact. What role does digital technology, specifically computers, play in the delivery of content at different levels of education? This question has universal significance as it impinges on teaching methods and approaches.

In a typical classroom situation, frontal teaching, in which a teacher delivers a lesson by talking and writing on a chalkboard or whiteboard, takes place. The learners sit, mostly passively, at their desks and listen, take notes, make sketches and solve given problems in writing. They may also copy the lesson’s assignment to be done later as homework. This routine is repeated across many subjects even though the method may not lend itself well to some of them. Where learners do not understand the day’s lesson, the teacher usually does not have the time to meet with them individually during the normal class period. In the subsequent lesson, the teacher reviews the homework assignments and only rarely do additional questions from students get enough attention of the teacher because of time constraints.

Little effort is made to cater for individual differences and the “one-size-fits-all” approach continues to disadvantage the learners. This observation has also been made by Brennan (2003) in his work on pedagogy in the online environment.

There is need for educators to replace this essentially group-centred and teacher driven instructional model with one that focuses on individual learning needs. This can be achieved by using information and communication technologies.
Indeed, technology competency is a basic skill for the modern worker. For instance, the situation in the United States of America (USA) is that around 95% of the workforce was expected to use technology for their work by the year 2000 (Oblinger & Maruyama, 1996);
The situation may not be very different in the rest of the world due to globalisation in various sectors, including education.

One of the models of instruction which has been gaining prominence is the Flipped Classroom Approach (FCA). Digital technologies are utilised to create individual learning spaces instead of relying only on the group learning space (Hamdan, McKnight & Arfstrom, 2013). Originating from the USA, the FCA places a high premium on digital instructional videos. Flipping or inverting the classroom involves using the time that is usually taken up by homework to introduce a theory or a concept via a video presentation. The video presentation may be watched by the learner online or offline, depending on the learning environment. Consequently, classroom time which is normally spent on expository sessions is instead optimised for hands-on practical activities.

With the individual learners engaging the teacher and each other, clarifications of the new concept or skill can then be made during the class sessions.

American high school science teachers Jonathan Bergmann and Aaron Sams are often credited with coining the phrase “Flipped Classroom” in 2007 (Tucker, 2012).

Indeed, the process of flipping or inverting the classroom vests in the computer a very central role. This implies that only countries that have an adequate information and communication technology (ICT) infrastructure and the concomitant technological know-how may be able to derive the benefits of the FCA.
This requirement excludes many African countries with underdeveloped ICT infrastructure from flipping the classroom.

However, this situation can be rectified with proper planning, formulation and implementation of a public ICT policy. Rwanda is the first African country to have been supplied with the XO (generic name) machines by One Laptop Per Child Project. Around 1.4 million children in the world have been provided with the devices in 35 countries including Haiti, Afghanistan, Brazil and Uruguay (Beaumont, 2010).

The organisation's mission statement is to create educational opportunities for the world's poorest children by using rugged, low-cost, low-power laptops.

Already, the Kenya Government has initiated a programme to provide tablets to pupils in primary schools (GoK, 2015). In the foreseeable future, Kenya will have a technologically savvy population of teachers and learners at all levels of education which enjoy the benefits of the FCA. Kenya ranks among the countries with fairly established ICT infrastructure. According to Kroes (2011), Kenya is one of Africa's most innovation-friendly economy and possesses a legal framework that allows space for new ideas while preventing chaos. The government has an attitude to openness and open data unparalleled on the continent, providing a valuable raw material from which to construct new ideas. In the financial sector, the Mpesa (trade name) and similar mobile payment platform have revolutionised the way business is done. One can anticipate similar innovations in the educational sector. The FCA can be utilized in principle, but the Kenyan situation is such that the FCA is still a relatively unknown concept amongst teachers.

As the ICT infrastructure and technological awareness of teachers and learners in Kenya improve, the benefits of the FCA will become even more achievable.
It may perhaps be argued that flipping a classroom is not a completely new educational practice in Kenya and elsewhere. This is partly true when one considers the subjects literature in English and Fasihi (literature in Kiswahili).

The learners are required to read the set books outside the normal class time so as to familiarise themselves with the story.

Learners then spend more time with the teacher discussing themes and protagonists during class time and less time on how the plot of the story develops.

The fundamental difference between the foregoing situation and the FCA is the utilisation of ICT including new mobile technology. Globally, there has been an increase in teachers' and learners' enlightenment in the use of technology such as mobile phones and social media. For instance, it has been reported that Kenya is a 50% smartphone market with 50% of all mobile phones being sold currently in Kenya across all manufacturers being smartphones (Gicheru, 2014).

Lack of adequate time for practice was the primary factor that the researcher based the study on. In his study on causes of poor performance in the external Kenya National Examination Council (KNEC) examinations at selected TVET institutions that included Kiambu Institute of Science and Technology (KIST), Gatundu (2014), identified challenges such as lack of learning resources, provision of modern training equipment and inadequate time for practical lessons. Adopting the FCA for teaching Technical Drawing subject at KIST was deemed by the researcher to be a suitable instructional intervention for increasing the practice time in class. KIST is a post-school training institution that offers technical, vocational education and training (TVET). It also offers business courses in accounting. It has an ICT infrastructure that is continually being improved. The FCA had not been utilised at KIST.
1.2 Statement of the Problem

The FCA has gained global acceptance as a teaching approach with several benefits and some limitations. It especially allows learners to have more time for practising in class. More practice can result in better academic performance. In this regard, Gatundu (2014) found that the unsatisfactory pass rates at KIST in external examination was due in part to inadequate practice time. The researcher confirmed through his experience in teaching Technical Drawing that trainees did not have sufficient time for practice in class. This could be alleviated by flipping the Technical Drawing class, an intervention which had not yet been tried before. The problem being handled by the study was to identify the challenges attendant upon this intervention.

1.3 Purpose of the Study

The purpose of this study was to determine the challenges of adopting the FCA as an additional teaching approach in the Technical Drawing subject at KIST with a view to increasing class practice time. Delivery of content in a selected topic using the FCA provided a means of establishing the main challenges that faced trainees and the cooperating tutor in the use of the FCA. By and large, flipping the classroom had the potential of raising the performance levels of the trainees in external (KNEC) examinations. The study made it possible to recommend best practices in content delivery when using the FCA at KIST and other TVET institutions.

1.4 Specific Objectives of the Study

This study was conducted in line with the following objectives:

a) To establish the extent to what degree of success lesson objectives for a selected topic could be achieved by utilizing the FCA in teaching Technical Drawing within the Diploma in Quantity Surveying programme at KIST.
b) To identify the main challenges confronting trainees participating in the FCA in teaching Technical Drawing from the Diploma in Quantity Surveying syllabus at KIST.

c) To identify the main challenges confronting the cooperating tutor while utilizing the FCA in teaching a given topic in Technical Drawing from the Diploma in Quantity Surveying syllabus at KIST.

1.5 Research Questions

a) To what degree of success could lesson objectives of a selected topic in Technical Drawing from the Quantity Surveying diploma programme be delivered using the FCA at KIST?

b) What would be the main challenges facing trainees participating in the FCA in learning Technical Drawing at KIST?

c) What would be the main challenges facing the cooperating tutor when using the FCA in teaching a topic from the Technical Drawing syllabus at KIST?

1.6 Significance of the Study

The study sought to identify challenges of a new delivery mode in Technical Drawing subject for the Diploma in Quantity Surveying programme at KIST. The results from flipping the classroom in Technical Drawing would be useful for enriching curriculum implementation at KIST, possibly even in other subjects.

Given the benefits of a learner-centered curriculum implementation, it would contribute towards attainment of training goals at KIST and by extension at other TVET institutions as established by the Ministry of Education, Kenya. Given that the Government of Kenya had declared its intention to provide laptops for primary schools pupils that from the year 2014, the FCA presents a real opportunity for computer
mediated learning in Kenyan learning and training institutions. Findings from this study could contribute to the development of policy on digital curriculum implementation.

1.6 Assumptions

The assumptions of this study were:

i) That KIST had a working ICT infrastructure to support the FCA and this was largely the case during the study period.

ii) That the cooperating tutor identified for the teaching using the FCA would cooperate fully and not withdraw before the conclusion of the study and this was the case.

iii) That all the participants' attitude towards activities relating to the FCA during the period of study would be positive and that all responses given would be truthful. This was also the case.

1.8 Limitations of the Study

The scope of this study was to identify challenges of adopting the FCA in teaching a given topic in Technical Drawing subject at Kiambu Institute of Science and Technology (KIST). Being a TVET institution in Kiambu County, Kenya, KIST was the study locale due to the fact that, to the best of the researcher's knowledge, the FCA had neither been applied nor studied at any other Kenyan learning institution. This being a baseline study, the anticipated limitations were:

a) Only one class being taught using the FCA in the Technical Drawing subject from the diploma in Quantity Surveying programme at KIST. This was meant to eliminate other learner-based characteristics inherent in different classes.

b) Only one lesson being taught by the cooperating tutor and for only one given topic in Technical Drawing. This was to avoid extraneous factors that could be introduced by teaching many topics. The researcher was of the opinion that the
challenges identified by teaching one lesson of a selected topic could be identified so that subsequent lessons would be continually improved.

1.9 Delimitations of the Study

a) The academic performance of trainees in Technical Drawing when using the FCA was not assessed because this would have required an extended period of study.

b) During the study period, the FCA was not used in exclusion of the usual teaching methods applied in Technical Drawing. It simply served as an additional pedagogical intervention.

1.10 Theoretical Framework

The study was founded on two theories:

a) The Cone of Experience Theory by Dale, (1969) regarding learning styles. The researcher appreciated the benefits of audiovisual learning encompassed in the FCA. There was extensive use of PowerPoint presentations (PPP) in the packaging of the lesson content.

b) Constructivism by Jonassen (1994) as a philosophical basis on teaching and learning. In as far as this theory reinforces the need for learners to use their prior knowledge (constructs) to learn new content, the FCA provided an excellent opportunity for trainees to interact with new content. The lesson content was delivered in PPP slides starting from the very familiar and building up to the new.

Two models were also applied in the study. Firstly, the ACTIONS model by Bates, (2005) informed the selection of teaching media in delivering the Technical Drawing lesson content.
Secondly, the ASSURE model by Heinich, Molenda, Russell, & Smaldino, (2002) guided the research during the preparation and use of all instructional media that were used in the flipped Technical Drawing lesson.

1.11 Conceptual Framework

The conceptual framework used in the study is depicted below:

**Figure 1.1: Conceptualized Research Variables for the Study**

![Conceptual Framework Diagram]

(Source: Researcher)

1.11.1 The Independent Variables for the Study

a) **Technical Drawing Subject Characteristics** are factors such as rationale, content, teaching and evaluation methods, among others. Technical Drawing was chosen for the study because it is a common subject that is indispensable in all engineering fields. It has a strong emphasis on practical skills which can be demonstrated through the FCA. The FCA lends itself well to those subjects that involve step-by-step exposition and can, therefore, be captured on audiovisual media as observed by Chipps (2012).

b) **Trainee Characteristics** include the age, entry behavior, psycho-social attributes and ICT competence, among others. The study sought to establish the
experience and perceptions of the trainee regarding the utilization of the FCA.
The FCA is particularly suited to teaching adult learners as found at KIST.
"The time adults spend in training is precious, given all the other demands on
them. So when they are in a classroom – let them work together on activities
that help them apply and retain their learning." (Dudek, 2013, blog post)
c) **Environmental Factors** are external factors such as the physical location,
infrastructure, climate, among others. The ICT infrastructure at KIST was
evaluated in this study to assess its capacity to support the FCA.
d) **Tutor Characteristics** encompass qualities that enable a teacher to facilitate
effectively in a learning environment. They include academic and professional
qualifications, psycho-social and physical attributes. The study sought to
identify the practical and attitudinal requirements by a tutor to adopt the FCA.
The researcher was able to get the cooperation of a tutor who was competent
and willing to use the FCA at KIST during the study period.

1.11.2 The Intervening and Dependent Variables for the Study

This study was underpinned by constructivism and Dale’s Cone of Experience.
Constructivism is the educational philosophy that emphasizes a learning process
focusing on primary concepts and not mere presentation of isolated or unrelated facts.
Learning styles evolve from learning and teaching processes and it is for this reason
that the study identified learning styles as an intervening variable. Equally, the study
identified teaching methods as the other intervening variable. Together, learning styles
and teaching methods have influenced the emergence of blended learning (BL) systems
or models of which the FCA is one of the more recent. "A rotation model closely
matches the concept of a flipped classroom. Set by a fixed schedule, students move
between required online interaction and required face-to-face interaction."
By flipping a selected lesson, the FCA constituted the dependent variable being investigated in this study, with the main focus being the challenges faced by trainees and the cooperating tutor.

The researcher notes that a teaching approach is not a teaching method *per se* and concurs with Bennett, Jason, Gudenrath & McIntosh (2012) to the effect that the FCA is not a methodology but an ideology. BL methods arise from insights arrived at by marrying traditional delivery methods with computer mediated (CM) delivery modes. Traditional delivery methods tend to follow rigid principles which have advantages as well as limitations. For instance, the lecture method is suitable for large adult presentations and cannot be used effectively for teaching children. The lecture method is also unsuitable for imparting practical skills. By applying educational communication and technology in varying degrees, blended learning systems can be created which are more effective for learning and teaching. It is largely within the context of blended learning that the FCA operates. An approach results from “borrowing” from two or more methods: For example, the traditional lecture (lecture method) being delivered in video format (audio-visual method). According to a study by Chipps (2012): “Students felt that the elements of the flipped class were more effective; videos at home were better than lectures in class, and group work in class was better than independent work at home.” (Chipps, 2012, p. 41)

According to Dale’s Cone of Experience (1969), instructional media increases in effectiveness from textual (symbolic) to audio-visual (iconic) with simulations and real-life experiences (enactive) being the most effective. Consequently, the study used visual (PPPs) material and actual drawing in flipping the lesson. Within the study period, the principle of a teacher being the guide by the side rather than the sage on the stage (King, 1993) was put into operation.
1.12 Operational Definition of Terms

In the context of this study, the terms used are defined as follows:

**Attitude** – Positive or negative predisposition towards an entity.

**Blended Learning** – Hybridization of traditional or face-to-face teaching with distributed / non-residential teaching, usually computer mediated.

**Computer Mediated Learning** – Use of a computer as an interface between the trainee, the content and the tutor.

**Curriculum Implementation** – Teaching processes by which set instructional objectives are achieved.

**Degree of success in Achievement** – Achievement of the learning objectives ranging from *low* (not achieved), *moderate* (partially achieved) and *high* (fully achieved).

**Digital Technology** – Devices and platforms that process content in digital formats such as computers, cameras, smart phones, applications, among others.

**Face-to-Face Interaction** – Direct interaction of trainees and the tutor.

**Flipping the Classroom** – Switching the usual class (teaching) time with homework time so that learning activities are followed by practice during class time.

**Information Communication Technology** – Technologies that are used to access, gather, manipulate and present or communicate information.

**Major Challenge** – A hindrance that prevents set learning objectives of the taught lesson to be fully achieved.

**Presentation** – Video, audio and textual content accessible by trainees via digital technology.

**Technical Drawing** – Academic discipline which deals with manual or digital drawing practices for communicating in specialised fields.
CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.1 Introduction
This chapter discusses various aspects of curriculum implementation and present
development of the FCA as a form of blended learning (BL) by citing relevant
eamples. It delves into the degree of success experienced when using the FCA in a
number of subjects within different learning environments. Advances in digital media
that support the FCA are outlined. It argues for ICT competence of teachers and
learners and also identifies the major challenges that have accompanied the use of this
approach. It provides an objective basis for the utilization of the FCA in teaching
Technical Drawing subject at KIST, and other TVET institutions.

2.2 The Place of the FCA in TVET Institutions
There is little or no local research on the FCA in Kenya. Indeed, most of the literature
cited in this study was obtained from online sources since local publications on the
subject were not available. To address poor performance in KNEC examinations by
TVET institutions, the FCA could contribute through improved curriculum
implementation. Teaching by any method or approach constitutes a part of curriculum
implementation. In the absence of previous research, the adoption of the approach at
KIST was essentially a baseline study. By identifying the major challenges that
impeded the effective use of the FCA as a means of teaching Technical Drawing, the
study could open avenues for further local research on the approach relating to
curriculum implementation.
2.2.1 Curriculum versus Teaching Subjects

In the broadest sense, curriculum is the sum of all that needs to be learnt. That would suggest that curriculum is all the teaching subjects to be learnt at a given level, that is, all the syllabi. But it can also imply all that needs to be learnt in a subject or discipline, for example, the Mathematics curriculum. Regardless of whether one takes a broad or a narrow view of curriculum, Eisner (1994) categorizes curriculum in three forms. These are the explicit or official curriculum, the hidden curriculum and the absent curriculum. The explicit curriculum is what is intended to be taught and is stated in the designed syllabus. The hidden curriculum is what is learnt without being included in the official syllabus. For example, “Students who successfully compete for grades are not only rewarded with grades, but also with admission to honors classes.” (Eisner, 1994)

In the example above, students end up learning to be competitive, although this outcome is not included in the official curriculum.

As for the absent curriculum, it refers to what is supposed to be covered from the syllabus but is omitted for various reasons. Teachers are the implementers of curricula and they are supposed to apply their skills as well as knowledge in this undertaking. As such, they require regular upgrading of their skills and knowledge levels to match changes taking place in society and the world at large. The Kenya Association of Technical Training Institutes (KATTI) held a regional conference from 25th to 30th of August, 2013 in Mombasa where one of the subthemes referred to “Science, Technology and Innovations in TVET” and another addressed the issue of “The Future TVET Instructor”. This underscores the importance given to the quality of TVET curriculum implementers. Without effective curriculum implementation, the stated aims of KATTI would be difficult to achieve.
2.2.2 Curriculum Implementation versus Teaching Methods

As espoused by Hoover and Patton (2005), curriculum implementation may be viewed as the process of integrating, arranging, intervening, managing and monitoring instructional content within the learning environment. A teaching method is the means by which instructional content is delivered. Therefore, a teaching method is clearly an integral part of curriculum implementation. The official or explicit curriculum is, logically, the one to be implemented through appropriate teaching methods.

The implementation should be done with high fidelity. Fidelity refers to translating the intentions contained in the curriculum in their totality (Gresham, MacMillan, Beebe-Frankenberger & Bocian, 2000). It is crucial that this happens, otherwise there would be no justification of efforts to implement any syllabus within a given curriculum. Curriculum implementation results with extremely low or no fidelity if it is done without proper planning and coordination. Hoover and Patton (2005) have identified five key components of curriculum implementation which are:

- Content
- Evidence-based Interventions
- Instructional Arrangements
- Class Management Procedures
- Progress Evaluation

Table 2.1 illustrates the five components of curriculum implementation.
### Table 2.1: Components of Curriculum Implementation

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Examples</th>
</tr>
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<tbody>
<tr>
<td><strong>Content</strong></td>
<td>Subject area knowledge, skills, ways of thinking and outcomes connected with the approved research-based curriculum</td>
<td>• TEP / TVET syllabi by Kenya Institute of Curriculum Development</td>
</tr>
<tr>
<td><strong>Evidence-based Interventions</strong></td>
<td>Research-based and validated teaching interventions</td>
<td>• F2F instruction</td>
</tr>
<tr>
<td><strong>Instructional Arrangements</strong></td>
<td>Application of group-work, pairs, or individual work to facilitate acquisition of content and skills</td>
<td>• Peer teaching</td>
</tr>
<tr>
<td><strong>Class Management Procedures</strong></td>
<td>Classroom arrangements established to manage learning, and behaviour and also facilitate opportunities to learn</td>
<td>• Collaborative/Cooperative learning groups</td>
</tr>
<tr>
<td><strong>Progress Evaluation</strong></td>
<td>Regular assessment of learners’ progress toward curricular benchmarks/objectives (formative and summative monitoring)</td>
<td>• Independent practice</td>
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<td></td>
<td></td>
<td>• Self-monitoring</td>
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<td>• Positive behaviour support</td>
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<td>• Proximity control</td>
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<td>• Shaping</td>
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<td>• Curriculum-based measurement</td>
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<td></td>
<td></td>
<td>• Performance-based assessment</td>
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<td></td>
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<td>• KNEC results analyses</td>
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</tbody>
</table>

(Adapted from Hoover & Patton, 2005)
Another view of curriculum implementation describes it as a process which
"... includes translation of planned or officially designed course of study by the
teacher into syllabuses, schemes of work and lessons to be delivered to students."
(Nzomo, 2013, p.49).
This view anticipates an interplay of the teacher, the course content and the student.
In undertaking this study, the researcher depended on the official Technical Drawing
syllabus within the diploma curriculum at KIST. By implementing the syllabus
through use of the FCA, a modern intervention in the implementation of the
curriculum at KIST was being adopted.

2.3 The Flipped Classroom Approach as an Evidence-based Intervention
The FCA is a fairly recent intervention in classroom interactions. This is attested by
Houston and Lin (2012). They suggest that Jonathan Bergmann and Aaron Sams, both
chemistry teachers at Woodland Park High School, USA, were the initiators.
In 2007, the teachers wanted to solve the problem of finding the time to teach lessons
missed by absent students. Their solution was to record and annotate lessons using
some software and then posting them online. Absent students were provided with an
opportunity to watch missed lesson, but so did the students who had not missed class.
The online material could be utilised to review and reinforce classroom lessons by all
students. Bergmann and Sams realized they could radically change the way they used
normal class time and coined the phrase "flipping the classroom" (Tucker, 2012).
Importantly, more interaction was observed between the learners themselves as well as
between the learners and the teachers. The level of accountability for the learning
process was raised on the part of all participants.
As stated in the foregoing sections, the FCA is a relatively new concept in teaching.
However, teachers have in the past assigned students work which required learning the
concepts first before applying the same concepts. This was always deemed to be an assignment, not a lesson to be learnt. With the advent of computer mediated (CM) instruction, the paradigm has shifted. Information and communication technology provides necessary support for learning outside of the class time and results in valuable time for face-to-face (F2F) interaction amongst the learners themselves and their teacher being gained. This indicates that the FCA is, in fact, a form of blended learning (BL). Being an approach means the FCA can be integrated or blended with a given teaching method.

While there is no one model of the FCA, the core idea is to flip the common instructional approach: With teacher-created videos and interactive lessons, instruction that used to occur in class is now accessed at home, in advance of class. (Tucker, 2012, p. 82).

There appears to be a lot of emphasis on use of video in the utilisation of the FCA.

In more sophisticated learning setups, custom-made flip-cameras have been provided to learners who are then able to capture content for use in their lessons (Miller, 2009).

The importance of videos is further underscored by Alvarez (2011), who posits that flipping the classroom enables the teacher to record on video the same steps that would be presented to students within a lesson plan. Subsequently, the structure of the video should include an overview of the lesson, the content and ends with a summary.

Could the FCA work without videos? Whereas the researcher accepted that videos do provide a very effective visual impulse, the researcher was also of the opinion that any visual stimuli packaged for use in the FCA could serve the same end. The FCA should not be limited to videos only. The visual impulses should, however, exclude text-only material, such as lesson notes. In the Kenyan situation, it is conceivable that teachers and learners could make use of inexpensive mobile technologies such as smartphones to capture relevant content for classroom use.
It would be wise to widen the visual stimuli used in the FCA to include graphic presentations such as PowerPoint® and the use of Web 2.0 (social media such as Facebook® and Whatsapp®), among others.

The researcher opines that these tools have the advantage of being already in use and it would be relatively simple to adapt them for learning and teaching. Ultimately, it is very important that the teacher decides:

- Whether to flip a lesson since not all lesson content can be flipped.
- When to flip a lesson.

By opting to flip, the teacher would be actually blending the learning process. This enables learners and teachers to reap the benefits accruing from blended learning.

2.4 The Flipped Classroom Approach and Blended Learning

A working definition of blended learning (BL) or hybrid learning is the combination of face-to-face instruction (F2F) with computer-mediated (CM) instruction (Osguthorpe & Graham, 2003). The researcher supports this definition because it reflects BL as the outcome of mainly two historically distinct models of teaching and learning. The first is the traditional F2F learning systems where learning tends to be group-centered. In this system, learning typically occurs in a teacher-directed environment with person-to-person interaction in a physical, synchronous, high fidelity learning environment.

The second model of teaching and learning is the fairly more recent distributed learning systems in which the computer plays a central role and makes it possible for learning to be individualized. Significantly, distance learning systems emphasize self-paced learning. Learning interactions typically occur in an asynchronous, low fidelity environment (Osguthorpe & Graham, 2003).
BL represents a trend that has grown with advances in science and technology and the FCA, avoiding text only, increases the level of fidelity through use of audio-visual content.

In the Kenyan context, BL has found application in tertiary institutions such as Kenyatta University’s Digital School of Virtual & Open Learning. This institution offers some degree programmes, courses and units using Open Learning and Distance Learning delivery systems.

Buruburu Girls secondary school in Nairobi, Kenya, provides an example of BL at the secondary school level. Students and teachers work together to produce digital content for subjects such as Geography, History, Biology and Chemistry. They capture presentations on video and package this content on CDs for later use by students and teachers (Ndirangu, 2013). Accountability no longer rests only on the shoulders of the teacher in the flipped classroom. Students are also accountable for their own learning (Chipps, 2012). These innovations at Kenyan learning institutions do not constitute the FCA because they were not designed to cover specific lesson content before classroom interactions. However, but they could be adapted to serve this end.

### 2.5 Current Learning Innovations in Kenya

The use of computers, which is a key component of ICT, can be traced back to the 1970s and that of the Internet from 1993 (Ford, 2007) in Kenya. In recent years, Kenya has seen a great breakthrough in the use of mobile phones which includes mobile internet connectivity. The majority of people still use mobile phones as communication devices for voice calls and texting but many users also appreciate mobile phones as information devices. They use their mobile devices (simple cell phones, smartphones and tablets) to view e-mails, get news updates and browse the internet.
These are now an integral part of the daily routine, especially amongst the youth like in the study group at KIST. They could be integrated into educational processes.

In the educational sector, the potential to access information using mobile devices exists but their use is sub-optimal. In fact, learners are discouraged in many secondary schools to operate mobile phones, but they find use in tertiary institutions such as KIST. It only during the examination period when their use is prohibited. Smartphones and tablet computers come with different specifications such as the screen size, clock speeds, internal and expandable memory sizes, wireless connectivity and the capacity of the battery. For mobile internet connectivity, a provider is required. The main providers in Kenya are Safaricom, Airtel Kenya and Orange Kenya. Since their key business is not educational services, other parties have to develop educational content. The content can be delivered through mobile applications (apps).

Either native apps or web-based apps can be utilised. The former are installed programs that can function offline and only require updates, whereas the latter only work online. There is also the choice of mobile operating systems (OS) such as iOS® by Apple, Android® by Alphabet (formerly Google Inc.) and Windows-Mobile® by Microsoft. All mobile apps running on various platforms can be obtained at no cost or upon payment. Stores such as Google Play™, iOS App Store™, and Windows Phone Store™ provide a repository from which users can install mobile apps. Although mobile devices present an attractive delivery mode for content, they do also have drawbacks. These include the initial and running costs as well as the technical proficiency of users. They also include distraction of the user from the main learning activities, for example, through games.

The Government of Kenya (GoK) realizes the potential of mobile devices to transform the way learning takes places and plans to make available 1.2 million tablets. In the
space of two years, all public primary schools should be covered (Techweez, 2015, Blog post). The annual budget for the fiscal year 2015/2016 by the GoK provides Kshs. 17.58 billion for the following items (GoK, 2015):

- **Policy and Strategy**: Deployment of ICT learning devices to schools
- **Digital Content Management**: Development of digital content
- **Program sustainability**: Building the capacity of teachers
- **Device and Infrastructure Management**: Computer laboratory for class 4 to class 8

All public schools throughout the country will benefit. This amount for the digital literacy programme (DLP) is less than the initial budget of Kshs. 24 billion earmarked for laptops. The DLP is been carried out within the context of development of digital content, power supply to schools, teachers preparation and deployment on multiple platforms. The Kenya Institute of Curriculum Development (KICD) is mandated to put in place digital content. Through the Rural Electrification Authority, those primary schools which do not have power are will be connected.

Over 61,000 teachers have also been trained in a process whereby 150 master trainers visit different schools to train teachers (GoK, 2015).

Private initiatives that are geared towards adoption of mobile learning have come up. At the primary school level, eLimu tablet are available that incorporate content from the official curriculum. They package the content within animations, videos, music, games and interactive. According to eLimu, the tablets are designed "to make not only an educational, but also a social impact. eLimu includes extended learning content that focuses on responsible citizenship (environmental, human rights, civic justice and even curriculum on personal financial literacy.)" (e-Limu, 2015). They list some of the advantages their product give to the teachers and learners which include lesson plans.
and student performance reports on each subject or quiz taken. Also available is a teachers’ forum every forth Saturday of the month where online questions posted by learners are answered. Teachers and learners can access the offline Wikipedia.

Yet another private initiative is Elimu TV, an entirely different educational provider that aims at broadcasting secondary school content as a free-to-air channel on television. The company intends to reach learners who have missed the opportunity for normal school attendance.

They have so far developed video content for Mathematics, Physics, Biology and Kiswahili and carried out testing via the Signet Platform (Elimu Digital Media, 2015). With these and other public as well as private initiatives striving to deliver lesson content using digital media, there is huge potential of using the FCA in Kenyan learning institution.

2.6 Benefits of the Flipped Classroom Approach

In the BL literature, the most common reason provided for adopting BL is that it combines the best of the traditional and the modern CM worlds. Osguthorpe and Graham (2003) identified six reasons why one might chose to design or use a BL system:

- Pedagogical richness which occurs as a result of using interactive rather than transmissive strategies.
- Access to knowledge where the learner’s flexibility and convenience are put into consideration. Care has to be taken so as not to sacrifice the social interaction and human touch they found in a F2F classroom.
- Social interaction through an increase level of active learning strategies, peer-to-peer learning strategies, and learner centered strategies.
• Personal agency whereby the learners are put in control of the learning process and can pace themselves individually.

• Cost effectiveness is achieved through reaching a large, globally dispersed audience in a short period of time with consistent, semi-personal content delivery.

• Ease of revision of content covered.

According to Liles (2012), flipping the classroom offers advantages such as:

• Differentiated instruction. One can assign specific videos to help students to gain background information based on the individual student's needs, thus catering to a wide range of ability levels.

• Instructional hours are better spent helping students apply and demonstrate knowledge, and practice skills correctly with the instructor's assistance. Students do not waste time practising concepts incorrectly since they receive guided practice from the teacher.

• Provide all students opportunities to practise using 21st Century skills and technology in the classroom. Multimodal delivery is made possible where students view a video repeatedly, rather than listening to lectures once only. Students that do not have Internet access at home can borrow instructor-created DVDs to view at home.

• Fostering interactive note taking and allowing the student the opportunity to generate questions that can be asked in class when clarity is needed.

• Absent students do not miss out on lessons and important information. They can access a lesson and information, then perform practical sessions according to their own schedules.
• Resources that include creating own videos and presentations with freeware and using the *Khan Academy* videos in a different subjects.

### 2.7 Limitations of the Flipped Classroom Approach and their Mitigation

As is usual with any concept, there are a number of drawbacks that make use of the FCA challenging. The limitations may actually amount to misconceptions and November (2012) has identified five such misconceptions about the approach:

i) Implementing the FCA reduces the importance of the teacher.

The truth is that if the teacher has provided students with enough resources and set up opportunities for students to think deeply, new questions will arise that possibly may not be asked during a normal class session. The teacher has to have a good grasp of the content since the need to cater for individual differences becomes more acute.

ii) Learners rarely sit at home watching teaching videos.

Certainly, learners may be more attracted to watching videos of an entertaining nature rather than educational ones. In an FCA setting, it is up to the teacher to provide presentations that combine interaction and pedagogy. For example, by including hyperlinks within a presentation, a teacher can quiz students and provide them with immediate feedback and explanations within the same presentation. Presentations should be short, 5- to 10-minute segments. “No student is going to accept a barrage of 1 hour long lessons that they have to view at home on a regular basis.” (Truss, 2011, Blog post)

iii) Majority of learners have limited or no access to the Internet.

Because of the technological advantages that computers have vis-à-vis learning, the FCA as an intervention is most effective when ICT is involved. Schools should provide facilities outside timetable allowing learners to use school computers, possibly in a library or media centre. Where possible, learners could borrow
ICT devices for a given duration. With the advent of cheaper smartphones, many learners have the potential to access alternative internet connections away from the classroom. Where internet connections are limited or non-existent, teachers could provide audio and video material burned on CDs or DVDs so they could be accessed on learners' home CD/DVD players. Furthermore, schools could share their resources as well as those of the surrounding community centres to make access to presentations easier for learners.

iv) Lack of control and accountability.
The teacher may neither be able to control when the learners access the presentation used in a flipped lesson, nor what they do with it. However, the teacher can and should require that every learner submits to reflections, asks questions, and express any concerns at the beginning of the lesson. Those who do not make contributions should be encouraged to state any challenges they might be having.

v) Teacher and learners do not have adequate ICT knowledge and skills.
Indeed, the FCA calls for some proficiency in the use of ICT. An expert who is not necessarily a teacher can nevertheless assist in making the presentations for the classes at the beginning. School managers could facilitate training of a few teachers who then cascade the knowledge and skills to the rest. An arrangement between schools could also lead to sharing of competent teachers and personnel. As also suggested by Tucker (2012), the FCA requires the instructor to explain a concept in a clear, concise, bite-sized chunk of four-to six-minutes video lesson. This can pose a tremendous instructional challenge if the instructor does not understand how to integrate ICT in his/ her lessons.
2.8 The 4 Cs of ICT

The acronym ICT is derived from information and communication technology or alternatively, information and communications technology.

ICT is more than computers and the Internet. According to Tongia, Subrahmanian and Arunachalam, (2005), information communication technology is the result of 4 C’s. These are computing, communication, content and human capacity. Computing has undergone several generational changes which have made hardware and software to be less and less expensive. Arising from these changes is the development of different types of communication of varying complexity. This makes software training still relatively expensive. This also applies for content since even old content has to be repackaged for digital transmission. Human capacity is often overlooked when dealing with ICT issues. Since end-users have to interact with hardware and software, due consideration has to be made on how to optimize this interaction. The development of user-friendly computer applications serves this end.

Depending on the applications, ICT can be divided into two broad categories (Tongia, Subrahmanian & Arunachalam, 2005). The first category includes applications that depend a lot on traditional telecommunications networks, including the Internet. This enables on-demand communication, hence providing information specific to the user’s needs as well as convenience. Some examples of this category are blended learning (BL), e-commerce and e-governance. The second category requires applications that work mostly independent of the user, for example, weather monitoring and reporting systems. From the foregoing, it is crucial that teachers and learners need adequate preparation to make the competent to use of the applications within ICT.
2.9 ICT Competence of Teachers and Learners

In 2004 the Government of Kenya adopted the e-Government Strategy that emphasizes transformation of Government services from manual to digital-based operations. The specific objectives include:

- Improved coordination of government agencies to reduce duplication of efforts
- Enhanced efficiency in utilization of resources
- Improved competitive position of the country through provision of timely information and delivery of services.
- Reduced transaction costs
- Engagement of citizens and the private sector through digital and on-line service provision. (MoE, 2006)

Education is intended to actualise these objectives by equipping all parties with appropriate ICT competencies, skills and merging innovations.

It, therefore, arises that one of the required characteristics of an effective teacher is knowledge and skills in ICT. According to Hague and Payton (2010), there is need for ‘digital literacy’ on the part of teachers. In utilizing the FCA most effectively, it is necessary to have ICT support. It is therefore paramount that teachers as well as learners to be digitally literate.

Digital literacy means the ability to communicate and represent knowledge in different contexts for different audiences. These include visual, audio and textual modes.

"Schools are increasingly encouraged to embed the use of ICT in all subject areas across both the primary and secondary curricula...to ensure that technology-use enhances teaching and learning rather than simply becoming an add-on."

(Hague & Payton 2010, p.3). This view is supported by Prensky (2008) who states that the only role for technology should be to support learners teaching themselves with
some guidance from their teachers. He cautions that using the old pedagogy of telling or lecturing in which technology is used to show pictures or videos is wasteful. Teachers have to adapt to technological innovations but more importantly, learners need to be taught how to use these innovations:

...to learn on their own – from the Internet with almost all the information, to search and research tools to sort out what is true and relevant, to analysis tools to help make sense of it, to creation tools to present one’s findings in a variety of media, to social tools to network and collaborate with people around the world. (Prensky, 2008, p. 2)

The researcher finds these arguments compelling and holds that ICT integration in learning should be focused on both the teacher and the learner, with the teacher playing a supporting role. The FCA as model appears largely to fulfil this important requirement of ICT integration in learning by catering to the needs of the learner. On the part of the learner, Soparat, Arnold and Klaysom, (2015) suggest that ICT competency should include:

- Communication competence through speech and writing so as to share information with others.
- Critical thinking and problem-solving that starts with the identification of a problem followed by effective decision making on best tools and culminates in a reasonable solution and reflection.
- Capacity for applying life skills, especially through cooperative interaction. Learner should be able to overcome difficulties, muster self-confidence and engage in lifelong learning. This applies when using digital social networks.

From the above, learners should acquire knowledge and skills in word-processing (official languages), spread-sheets, databases, presentation software and internet (use and risks). They should also have some proficiency in hardware maintenance.

How should teachers select ICT for use by learners in the FCA?
2.10 Preparing the Learner for Computer Mediated Instruction

In utilising the insights of the ASSURE model as suggested by Molenda et al. (2002), the teacher should select learning media systematically before deciding to flip a lesson. This is achieved through:

i) Analysing the learners

ii) Stating the objectives

iii) Selecting the methods, media, and materials

iv) Utilizing the media and materials

v) Requiring learner participation

vi) Evaluating and revising the learning outcomes

At KIST, all the trainees have met minimum entry requirements for various courses. What tutors do is implement the syllabi for these courses using varying approaches, none of which is similar to the FCA. The researcher opines that, if the FCA is adopted at KIST by utilizing the available physical and ICT resources, there will be more time for trainee participation in the learning process. More participation leads to better retention of content and performance. This argument is supported by Dale, (1969), who conceived the Cone of Experience. This is illustrated in Figure 2.1 which depicts how media impacts on the retention of content.
The FCA can be applied for all levels indicated in the Cone by utilizing textual, audio and audiovisual material. At KIST, practical skills require “doing the real thing” and the FCA, when effectively utilized, can increase the time for practical work since theory will be learnt outside the timetable. As suggested earlier in this chapter, trainees could be encouraged to use social media and mobile technology for learning.

2.11 Involving the Learner in Developing Lesson Content

The FCA has constructivist potential in the sense that learners can be put in the “driving seat” with regard to the learning process. Constructivism as a philosophy is premised on a person’s ability to reflect on past experiences.

This enables a person to construct a personal or individualised understanding of the world based on these reflections. Each person creates unique systems or models by which one is able interpret new experiences. Without these systems, one is incapable of making sense of the new experiences.
Learning, therefore, is the process by which one adjusts the existing mental models to accommodate new experiences. Because of its strong emphasis on individual interpretation of the environment, constructivism can hardly work within a standardized curriculum. Instead, it promotes using curricula customized to the students' prior knowledge and hands-on problem solving approaches.

Jonassen's (1994) proposed eight characteristics that define constructivist learning environments:

- They provide multiple representations of reality.
- These multiple representations avoid oversimplification and represent the complexities found in the real world.
- They are based on real-world issues or cases and not predetermined sequences of instruction.
- They accentuate knowledge construction instead of knowledge reproduction.
- They enable context- and content-dependent knowledge construction.
- They require authentic tasks in a meaningful context rather than abstractions.
- They inspire reflection on past and new experiences.
- They support collaborative learning through social negotiation and eschew competition.

Arising from the foregoing discussion on constructivism, digital technology provides a means for creating effective learning environments.

As demonstrated by Buru Buru Girls Secondary school in Nairobi County, Kenya, conventional video cameras can be placed in the learners' hands and used effectively. These learners at a relatively low-cost school use video cameras to make clips of lessons and field trips. Their teachers assist them in this exercise during editing.
The fact that the presentations are done by people the “students can relate with” makes learning interesting for the students (Ndirangu, 2013, p.31).

Since practically all learners with smartphones participate in the so-called social media interactions such as Facebook®, Twitter® and Whatsapp®, one can involve them in learning the required content by individualizing the conventional curriculum. By harnessing the power of these media, an instructor can enrich lesson content by requiring the learners to contribute via photographs or videos. Even a simple chat via short message service (SMS) text can aid in the delivery of required content.

The foreseeable drawback with this intervention is that some learners might resent the idea of having “the classroom” intrudes in their social lives. Yet others may not afford the smartphones, making them be left out of the “conversation”. The advantages of having learners contribute to the lesson content, however, are likely to far outweigh the limitations.

2.12 Environmental Factors Affecting Learning

Learning spaces have an important bearing on the relationship and social practices of teaching and learning. They are only one factor among many in the complex relationships of teaching impact on learning outcomes (Oblinger 2006). Major environmental factors that have an impact on learning include lighting (quantity and quality), acoustics (clarity), thermal control and seating arrangements.

They should be carefully assessed so as to enhance the learning experience, especially when media are in use. If these factors are ignored, media use may well be viewed by the learners as either a welcome or bothersome distraction. The physical environment outlined in the foregoing requires additional consideration in terms of access, comfort and safety where ICT is being used. At KIST, it is sometimes necessary to use
workshop facilities for theory lessons, which is not conducive to learning. Some classrooms also lack power outlet points, thus presenting a major challenge in the use of electronic equipment.

2.13 Challenges of Teaching Technical Drawing

According to Urdarevik (2013), one of the biggest problems engineering students are facing is visualization. He proposes extensive use of models to overcome this difficulty. A key aspect of using models is having to talk or lecture less by allowing the learners to interact with the model before coming up with the drawings. The FCA can be adapted to use models, possibly by making the models first with learner participation.

The official syllabus for Technical Drawing subject was developed by the Kenya Institute of Education (KIE), which is now known as the Kenya Institute of Curriculum Development (KICD).

Teaching Technical Drawing at KIST is taught at times in classes having 30 or more trainees. The particular class that was used for the study comprised 27 trainees.

By comparison, a technical and vocational class size should be limited to 16-20 trainees (Anane & Okwabi, 2014). This makes individual facilitation harder for the tutor at KIST. Trainees who would require more attention from the tutor are left to cope on their own, oftentimes unsuccessfully. This situation calls for more effective interventions such as the FCA.

2.14 Performance Trend of Trainees in KNEC Examinations

The findings by Gatundu (2014) show that for KIST, trainees who sat for the KNEC examination passed poorly. In Building Technology, where Technical Drawing was examined, 21.4 per cent the number of students passed in 2008, 29.5 per cent in 2009, 34.9 per cent in 2010 and 35.1 per cent in 2011. He also reports that at the Rift Valley Institute of Science and Technology, those who passed in the same course were 14.3
per cent in 2008, 27.3 per cent in 2009, 19.2 per cent in 2010 and 31.6 per cent in 2011. Among the causes for these results was lack of adequate laboratory apparatus reported by 89 per cent of the trainees in his study. Additionally, 88 per cent of the trainees felt that the time allocated to them to conduct practicals was not enough.

2.15 Summary of Chapter Two

This chapter has presented the development of the FCA by citing examples mainly from the USA where the concept originated. At present, there is no research on the FCA that has been undertaken in Kenya. Unsatisfactory passing rates in KNEC examinations are partially attributable to lack of sufficient time to conduct practical tasks. The advantages as well as the limitations of adopting the FCA have been discussed and it was the researcher's considered opinion that the FCA should be introduced in teaching at KIST, a TVET institution. This would make the trainees have more control and accountability in the learning process and it was hoped that this would then contribute in raising the level academic performance. There was a probability of challenges that would be experienced by tutors and trainees which needed to be determined and dealt with so as to enhance the effectiveness of the FCA. These challenges also constituted a significant research gap that the study sought to fill.

Chapter Three outlines the methodological aspects of flipping the classroom in Technical Drawing subject at KIST.
CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter outlines how the case study was conducted. It explains the choice of the research design and location of the study. Details of the target population, sample size, research instruments, data collection procedures, data analysis are presented. The issue of logistical and ethical considerations is also tackled.

3.2 Research Design

The research took the form of a descriptive survey while adopting a case study approach at KIST. A case study approach was necessary because the phenomenon being investigated of the FCA could not be investigated elsewhere without a considerable amount of time being spent to set it up. A descriptive survey involves collecting information by interviewing or administering questionnaires to a sample of individuals (Orodho, 2002). The researcher was employed at KIST and was, therefore, an insider at KIST. In order to preserve objectivity, it was necessary to adopt a non-participatory role in the collection of some of the data. This was achieved by using a competent cooperating tutor whose specific role was to collect data related to teaching a topic in Technical Drawing with the FCA. Bonner and Tolhurst (2002) have opined that an insider-researcher has a greater understanding of the culture being studied. In addition, the insider researcher will not alter the observed interactions unnaturally and can use the intimate knowledge of the institution to judge the facts. Being familiar with the politics of the institution also allows the insider researcher to approach people and obtain knowledge which takes an outsider a longer time to acquire (Smyth & Holian, 2008). These advantages were additional reasons for the case study approach at KIST.

The study aimed at obtaining baseline data from trainees, the cooperating tutor and the researcher.
There are known weaknesses associated with case studies, which include having a limited ability to test a theory, inability to directly address causal relationships between variables and to make scientific generalizations (Gable, 1994). The three research objectives of this study did not engender a situation in which these weaknesses would come into play. There was no theory being tested, neither was a causal relationship between variables being investigated, nor scientific generalizations being pursued.

3.3 Variables

The variables being investigated were, as depicted in the conceptualized research model (Figure 1.1), independent, intervening and dependent.

3.3.1 The Independent Variables

The independent variables being investigated were:

a) Capacity of the ICT resources at KIST to support the teaching of Technical Drawing, a subject in the diploma curriculum, using the FCA. This included the physical resources such as computer laboratories, the ICT infrastructure and human resources.

b) Challenges that trainees encountered while learning Technical Drawing using the FCA. These included the ICT competence of trainees and the ease with which the trainee could access the ICT resources.

c) Challenges that the cooperating tutor encountered while teaching Technical Drawing in the diploma curriculum using the FCA at KIST. They encompassed the level of competence of the cooperating tutor in ICT and organizational hurdles encountered while teaching using the FCA.

The study included only two observable factors based on the cooperating tutor’s personality, namely his motivation and attitude towards the FCA.
3.3.2 The Intervening Variables

The intervening variables were teaching methods and learning styles.

3.3.3 Dependent Variable

The dependent variable under investigation was flipping a given lesson in Technical Drawing at KIST, that is, the utilization of the FCA in teaching the topic.

3.4 Location of the Study

The case study was carried out at Kiambu Institute of Science & Technology (KIST) in Kiambu County, republic of Kenya. It is situated 14 kilometres from the capital city, Nairobi.

3.5 Target Population

KIST had a trainee population of 1793 as of January 2015. Of the total population, males trainees at KIST represented 70 per cent and female trainees 30 per cent, (KIST Registrar, official communication, May 11, 2015). The Building and Civil Engineering department had the largest population with 522 trainees. The target population was the entire second year DQS1209B class of 27 trainees pursuing a diploma course in Quantity Surveying in the Building and Civil engineering department of KIST, Kiambu. In addition, 10 trainees from the DQS1209A class were used by the researcher for piloting the trainee questionnaire only.

3.6 Sampling Procedures and Sample Size

Purposive sampling was carried out to meet the study parameters and the DQS1209B class taught by the cooperating tutor had been identified for the research. There were 27 trainees in the target class and all the trainees were expected to be involved in the study. They were learning Technical Drawing amongst other subjects. A first year
class was not chosen because the FCA tends to work better with learners who are conversant with the subject matter in comparison to beginners (Chipps, 2012).

Table 3.1: Sample Size

<table>
<thead>
<tr>
<th>Gender</th>
<th>Total No.</th>
<th>No. sampled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>04</td>
<td>04</td>
</tr>
<tr>
<td>Male</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
<td>27</td>
</tr>
</tbody>
</table>

(Source: Study 2015)

3.7 Research Instruments

The research instruments used in the study were:

a) Content Analysis of Stage 1 and 2 Technical Drawing Syllabus by KICD. The analysis was done by the researcher, whereas the cooperating tutor prepared a lesson plan for a chosen topic identified in the analysis of content suitable for using the FCA.

b) Questionnaire for the trainees

This instrument captured data on the trainees’ ability and ease to access ICT resources required for the FCA to be effectively utilized. The design of the questionnaire was kept simple to afford the respondent an average time of 10 minutes to fill it. This was verified during the piloting. This resulted in a one-page document having Part A with three questions on computer ownership. Part B had five questions on the actual experience with the FCA and the perception of the trainee with regard to this approach.

c) Checklist of ICT resources at KIST.

The checklist was designed to evaluate the physical aspect of the environmental factors as contemplated in the conceptualized research model (Fig 1.1).
With the aid of this checklist, the researcher carried out an audit of the physical and ICT infrastructure on the 25th of May, 2015. The technicians in the e-learning center assisted the researcher in filling out the checklist. It is the completed checklist that the researcher used to evaluate the capacity of KIST to support the FCA in Technical Drawing.

In Part A of the checklist, the researcher assessed the hardware resources available at KIST that could support the FCA. Part B of the checklist highlighted the availability of different software, whereas Part C provided data on network and internet connectivity. Part D surveyed the human resources associated with the ICT use at KIST.

d) Observation schedule for the cooperating tutor

The cooperating tutor filled a schedule on his experience on utilizing the FCA Technical Drawing. The observation schedule was filled by the cooperating tutor at different times. These were before, during and after the FCA had been utilized with the target class. Details included the professional and academic qualifications of the cooperating tutor, competence and experience in the use of ICT as well as the actual experience gained from using the FCA in the study class.

3.8 Pretesting

All the instruments were piloted for their suitability in this study.

3.8.1 Instrumentation: Validity

Instrument validity is an indication of how germane the responses that have been obtained are in relation to the study objectives.

In this regard, the research instruments were pretested as follows:

a) Content of the lessons taught using the FCA was compared with the official Technical Drawing diploma syllabus developed by the KICD.

The content corresponded 100 per cent.
b) The ICT checklist provided an inventory of what resources were available at KIST. The researcher consulted with the ICT personnel to ascertain that the checklist was comprehensive for the intended purpose. These included, but were not limited to:

- Workstations
- Laptops
- Networks
- Internet connectivity
- Website
- Digital cameras
- Power supply
- Technical Support staff

c) The trainee questionnaire was administered to 10 trainees chosen at random in the DQS1209A class. The researcher confirmed that:

- Only responses relevant to the utilization of the FCA in the Technical Drawing lesson at KIST were elicited.
- Conclusions on the utilization of the FCA in Technical Drawing at KIST could be made.
- The respondents took an average of 10 minutes to fill their answers.

d) The cooperating tutor was professionally helpful in clarifying items on the observation schedule. As a colleague, it was reasonably expected that he would remain truthful and objective when reporting on his experiences with the FCA. In general, feedback from all those involved in the study helped in modifying the instruments to improve validity.
3.8.2 Instrumentation: Reliability

Mugenda and Mugenda (1999) define reliability as a measure of the degree to which a research instrument yields consistent results or data after repeated trials. Hence, the instrument should have the capacity to consistently measure what it is designed to measure. Before the actual study, the instruments were tested for reliability as follows:

a) The format of the lesson content was compared with the syllabus and both the researcher and the cooperating tutor were in agreement that there was no deviation.

b) The checklist was compiled with the assistance of the ICT personnel at KIST. It was deemed consistent in what it sought to capture.

c) The questionnaire was tested for reliability by getting responses on the first presentations provided to 10 trainees chosen at random from the sister class. By examining the responses, the researcher resolved cases of ambiguity, vagueness and confusion.

d) The researcher and the cooperating tutor came to an understanding that objectivity would be pursued as a matter of professional obligation. The researcher also included suggestions provided by the cooperating tutor to enhance the observation schedule.

3.9 Data Collection Techniques

Primary data was collected by:

a) Analyzing the Technical Drawing syllabus content for Stage 2 diploma course in Quantity Surveying using the designed content analysis checklist.

b) Processing the checklist evaluating the physical and ICT resources at KIST relevant to Technical Drawing.
c) Filling out of a questionnaire by trainees to identify the main challenges while participating in the FCA.

d) Reporting on observations by the cooperating tutor on the experience of using the FCA to teach 2-Point perspective drawing.

e) Taking note by the researcher of relevant observations that were not captured by other instruments.

3.10 Data Analysis

Data, which was quantitative in this study, was analyzed by using MS Excel software to generate simple descriptive statistics and then tabulating the results. Although this software is not meant for professional statistical analysis, it does well for simple descriptive statistics when used judiciously. It can be utilized to analyze qualitative data both qualitatively and quantitatively (Scandlyn, 2013).

Results were in form of frequency and percentage charts.

The ASSURE model (Gagne, Briggs, Wager, 1992) provided a procedure for flipping the lesson from which the study data was obtained. This model assists the teacher in selecting the most appropriate media or material and methods to use in a particular lesson. In this study, ICT resources were required by the cooperating tutor use the FCA. The following six stages representing the acronym were followed:

a) Analyzing the trainees characteristics. This was done by the researcher and the cooperating tutor.

b) Stating the learning objectives for a 2-Point perspective drawing lesson. This was done by the cooperating tutor.

c) Selecting the methods, media and materials (PowerPoint slides via email and offline on CDs). This was done by the cooperating tutor with the help of the researcher.
d) Utilizing the selected methods, media and materials was done by the cooperating tutor.

e) Requiring the trainees to watch the PPPs, sketch and draw using instruments was done by the cooperating tutor.

f) Evaluating the degree of success of the FCA and identifying challenges were carried out by the researcher.

**Table 3.2: Timetable for the ASSURE activities in the Study**

<table>
<thead>
<tr>
<th>Term 1, 2015 Activities</th>
<th>March 01st -15th: Analysing</th>
<th>March 16th -31st: Analysing</th>
<th>May 01st -31st: Stating &amp; Selecting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lesson Preparation &amp; Delivery</td>
<td>1. Lesson Preparation &amp; Delivery</td>
<td>1. Training of Cooperating tutor in the FCA</td>
<td></td>
</tr>
<tr>
<td>2. Compilation of Trainee Email addresses</td>
<td>2. Validation of Email addresses</td>
<td>2. Piloting the Tutor Observation Schedule and Trainee Questionnaire</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Term 2, 2015 Activities</th>
<th>June 01st -30th: Utilizing &amp; Requiring</th>
<th>June 01st -30th: Evaluating</th>
<th>July 01st -30th: Evaluating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching with the FCA</td>
<td>Cooperating tutor's Report, Filling of Questionnaire by Trainees</td>
<td>Preliminary data analysis</td>
<td></td>
</tr>
</tbody>
</table>

(Source: Study 2015)

The timetable excluded the month of April 2015 as the institute was closed and trainees were away on holiday.

The following subsections present the particular methodological processes that took place based on the ASSURE model.

**3.10.1 Technical Drawing Subject Content Analysis**

Using a self-designed weighting table, the researcher analyzed the Technical Drawing topics for Stage 2 in Diploma in Quantity Surveying course for suitability of utilization of the FCA for Term 2, 2015.
This analysis followed a simple criterion decided on by the researcher, which was a scale that took into account the degree of manipulative skills being taught. A weight of 3 points meant that a topic consisted of very manipulative hand-on skills, 2 points = limited manipulative skills and 1 point = no manipulative skills which were possibly cognitive or attitudinal learning outcomes.

3.10.2 Preparation of the Cooperating Tutor

Being an insider-researcher conducting a case study, gathering of data relating to teaching with the FCA was done with the help of the cooperating tutor. It was initially a big challenge identifying a suitable cooperating tutor. This was because the researcher needed a person who would be enthusiastic about trying a new teaching approach and who also possessed basic computer skills. After consulting with several colleagues over some time, the researcher came to an understanding with the cooperating tutor who had previously taught the DQS1209B target class but in a different subject. The understanding was that the researcher would provide guidelines on the FCA and a laptop. The cooperating tutor agreed to teach a Technical Drawing topic chosen from the term's course outline and make his observations in the schedule provided. He was helpful in improving the observation schedule before its use.

In particular, it was the cooperating tutor who:

a) Chose the topic to teach using the FCA from the available topics.

b) Prepared the lesson plans and materials needed for the lesson with help from the researcher.

c) Filled the observation schedule provided by the researcher on the lesson taught using the FCA.

This arrangement allowed the researcher to focus on the academic (research) role while the cooperating tutor assumed the professional role in the study.
After the flipped lesson, researcher and the cooperating tutor discussed at different instances on the follow-up to the lesson. Information that was deemed as being personal or private for the cooperating tutor has been omitted from the study findings.

3.10.3 Preparation of the Trainees

In order to avoid or mitigate the Hawthorne effect in which study subjects do not exhibit authentic behavior if they know they are under scrutiny (Macefield, 2007), the researcher had already introduced to the DQS1209B class the concept of receiving information on lessons via email correspondence. Included were the course outline and solutions to given exercises sent in Term 1, 2015 as per the timetable (Table 3.1).

Prior to this, the trainees had already updated their email accounts and mobile telephone details for classroom use. It was made clear to the trainees that the contact details would be used for classroom research whereby they indicated whether or not to participate in the educational research.

This preliminary information was compiled by the end of the Term 1, 2015. Thereafter, the course outline for 12 weeks in Term 2, 2015 was sent as a portable document file (PDF) attachment before Term 2 began. During the first week of Term 2, 2015, the course outline was discussed in class by the cooperating tutor and trainees. By the end of the second week, all email accounts had been verified by the cooperating tutor.

3.10.4 Physical and ICT Resources

Although the researcher was familiar with the facilities available at KIST, the study required exact data on available resources.

This was done with the aid of the prepared checklist on 25th of May, 2015.

3.10.5 Lesson Preparation and Presentation

A lesson plan derived from the approved scheme of work as used at KIST was prepared by the cooperating tutor for use in the study. The cooperating tutor and the
researcher agreed to allow the trainees to have access to the content on the topic before a face-to-face classroom session. Because the cooperating tutor was not familiar with video tutorials and that fact that uploading a video was not viable, he and the researcher settled on a number of PowerPoint presentations (PPP) and PDF files on perspective drawing. They were sent via email in the course of the third and fourth week of June 2015. In the fourth week of the term, one of the presentations dealing with 2-point perspective drawing was used for the study.

3.10.6 Additional Data

Being a case study, the researcher also made additional relevant observations that materialized but were not captured in the research instruments during the study period. These included the motivation and attitude of the cooperating tutor.

3.11 Logistical and Ethical Considerations

The study was confined to only the DQS1209B and DQS1209A class at KIST. This made it very easy for the researcher and the cooperating tutor, being members of teaching staff, to access the respondents. Classrooms were at a walking distance and the trainees could be contacted most of the time.

Apart from the research perspective, the researcher and the cooperating tutor were performing normal professional duties. Teaching using the FCA was not interfering with these duties. Indeed, they exchanged useful professional ideas during the undertaking and remained transparent in their activities. The trainees participated in the study freely and data obtained was treated confidentially.

The researcher got necessary administrative assistance from the management of KIST during the study and was encouraged to share his experience and findings on the educational research.
CHAPTER FOUR

PRESENTATION OF FINDINGS, INTERPRETATION AND DISCUSSION

4.0 Introduction

The results of the analysis, interpretation and discussions of the data gathered in the study are presented in this chapter. The research objectives of the study aimed at establishing the extent to which the FCA, as an additional intervention in curriculum implementation, could be utilized to teach Technical Drawing at Kiambu Institute of Science and Technology (KIST), Kenya and the concomitant challenges. This chapter is organized into five sections. The first section and subsections deal with the results of the analysis of the Technical Drawing subject content of the Diploma in Quantity Surveying syllabus. The second section and subsections relate to the availability of ICT and access to resources at KIST. The third section and subsection present findings on participation by trainees in the flipped classroom. The fourth section and subsections deal with the cooperating tutor’s and researcher’s involvement in flipping the Technical Drawing classroom. The findings of the study are discussed in the fifth section

4.1 Rationale of Teaching Technical Drawing

According to the design of the syllabus for Technical Drawing, the subject should “equip the trainee with knowledge and skills so as to be able to draw and interpret working drawings.” (KIE, 1990). The trainees undertaking any building related courses have to acquire drawing skills so as to communicate their ideas graphically.

The general objectives of the course unit (subject) are:

a) To be able to produce drawings in orthographic and perspective projections
b) To able to produce freehand sketches and scaled drawings as used in construction.
c) To be able to produce, read and interpret working drawings for construction works
(KIE, 1990). It can be seen from the rationale and objectives that the subject envisages acquisition of knowledge and skills.

4.1.1. Content Analysis of the Technical Drawing Syllabus in the Diploma in Quantity Surveying

The syllabus was analyzed with the designed tool to assess the suitability of the FCA in teaching the subject at KIST.

4.1.2 Topics and Sub-topics in Technical Drawing

There were eight (8) topics broken down into fourteen (14) subtopics in Stage 1 and three (3) topics broken down into five (5) subtopics in Stage 2. A stage is the period of three academic terms of twelve (12) weeks each. Each topic is subdivided into subtopics and time allocated in hours as the content coverage requires.

Hours have been allocated for teaching each topic whereby more hours in a topic indicate a practical component. In analyzing the topics for the content, weighting was done. A weight of 3 points indicates a very strong practical component in the topic or subtopic which would make the FCA a good choice in the delivery of the content. A weight of 2 points and 1 point show decreasing practical components, but it would still be possible to use the FCA. The maximum points that could be awarded for Stage 1 topics and subtopics were forty-two (42) and fourteen (14) was the minimum number of points. Table 4.1 shows the analysis of the syllabus and the weighting that indicates the suitability of the FCA in teaching the topic. From the total number of points attained by the topics in Stage 1, a score of 92 per cent indicated that most topics or subtopics had learning outcomes that are manipulative and a demonstrable manual skill has to be learnt. If one prepares learning videos and presentations for the FCA, it could be utilized very frequently in teaching the topics and subtopics for Stage 1 in Technical Drawing. A similar analysis for Stage 2 presented a score of 86 per cent.
Table 4.1: Content Analysis for Stage 1 and 2 in Technical Drawing Syllabus

<table>
<thead>
<tr>
<th>CODE</th>
<th>STAGE 1 TOPICS</th>
<th>SUB-TOPICS</th>
<th>HOURS</th>
<th>FCA WEIGHT</th>
<th>FCA UTILIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.1.1S</td>
<td>Instruments and Materials</td>
<td>Instruments, Paper sizes</td>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Layout, Storage, Reproduction of Drgs</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>13.1.2S</td>
<td>Plane Geometry</td>
<td>Conic Sections, Loci, Lines in Space, Orthographic Views</td>
<td>22</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>13.1.3S</td>
<td>Solid Geometry</td>
<td>Sections of Solids, Aux. Views</td>
<td>20</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>13.1.4S</td>
<td>Freehand Sketching</td>
<td>Three Dim. Sketching</td>
<td>5</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>13.1.5S</td>
<td>Orthographic Projection</td>
<td>1st and 3rd angle Projection, Conversion to Pictorial Views, Exploded Views</td>
<td>22</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>13.1.6S</td>
<td>Perspective Drg</td>
<td>1-Point &amp; 2-Point Proj’n</td>
<td>6</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>13.1.7S</td>
<td>Design</td>
<td>Principles of Design</td>
<td>8</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>13.1.8S</td>
<td>Building Drg</td>
<td>Working and Detail Drgs</td>
<td>14</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>TOTALS</strong></td>
<td></td>
<td><strong>99</strong></td>
<td><strong>1</strong></td>
<td><strong>2.6</strong></td>
</tr>
<tr>
<td></td>
<td><strong>%</strong></td>
<td></td>
<td><strong>100</strong></td>
<td><strong>2.6</strong></td>
<td><strong>92.3</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CODE</th>
<th>STAGE 2 TOPICS</th>
<th>SUB-TOPICS</th>
<th>HOURS</th>
<th>FCA WEIGHT</th>
<th>FCA UTILIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.2.1S</td>
<td>Building Services Drg</td>
<td>Working Drgs</td>
<td>12</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>13.2.2S</td>
<td>Structural Drg</td>
<td>Presentation of Struct. Drgs, Reinforced Concrete Detailing, Structural Work Det.</td>
<td>8</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>13.2.3S</td>
<td>Civil Eng. Working Drgs</td>
<td>Scales, Working Drgs</td>
<td>16</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>TOTALS</strong></td>
<td></td>
<td><strong>44</strong></td>
<td><strong>2</strong></td>
<td><strong>14.3</strong></td>
</tr>
<tr>
<td></td>
<td><strong>%</strong></td>
<td></td>
<td><strong>100</strong></td>
<td><strong>14.3</strong></td>
<td><strong>85.7</strong></td>
</tr>
</tbody>
</table>

(Source: Study 2015)
4.2 ICT Resources at KIST

A checklist designed for this study was used to assess the capacity of the ICT infrastructure to support the FCA. It comprised four (4) parts as follows:

- Part A dealing with hardware and accessories
- Part B on software.
- Part C on connectivity
- Part D on personnel

The completed ICT checklist for this study is shown in Table 4.2.
Table 4.2: Completed ICT Checklist

<table>
<thead>
<tr>
<th>CHECKLIST ON ICT RESOURCES AT KIST</th>
<th>As of 25th May 2015</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. COMPUTER HARDWARE AND ACCESSORIES</strong></td>
<td>YES NO</td>
<td></td>
</tr>
<tr>
<td>01 System Unit, Monitor, Keyboard, Mouse and UPS</td>
<td>X</td>
<td>approx 200 in 5 labs</td>
</tr>
<tr>
<td>02 Laptops with Webcam</td>
<td>X</td>
<td>01 per dept., HoD’s custody, rarely for teaching.</td>
</tr>
<tr>
<td>03 Multimedia Headset (Mic and Headphone)</td>
<td>X</td>
<td>not available</td>
</tr>
<tr>
<td>04 Digital Camera</td>
<td>X</td>
<td>03 No. 12 megapixels</td>
</tr>
<tr>
<td>05 Scanner</td>
<td>X</td>
<td>04 No. only for administrative use.</td>
</tr>
<tr>
<td>06 LCD/ Data Projector, Interactive Whiteboard (IWB)</td>
<td>X</td>
<td>01 Project per dept, no IWB</td>
</tr>
<tr>
<td>07 Printers</td>
<td>X</td>
<td>03 No (A4 size only), not networked</td>
</tr>
<tr>
<td>08 External Storage/Memory</td>
<td>X</td>
<td>06 No. 500 Gb, only for administrative use.</td>
</tr>
</tbody>
</table>

| **B. COMPUTER SOFTWARE** | YES NO | |
| 07 IMIS | X | ABN, vendor serviced |
| 08 MS OFFICE | X | On all stations |
| 09 CAD | X | Not available |

| **C. INTRANET & INTERNET** | YES NO | |
| 07 Wi-fi hotspots | X | 05 No. radius 100m |
| 08 Data Speed | X | Bandwidth (2Mbs), 5 Mbs or more preferred |
| 09 LAN-Network | X | Labs, offices |
| 10 Website | X | Mail server, Hosting website externally procured |

| **D. PERSONNEL** | YES NO | |
| 10 ICT Teaching Staff | X | approx 17 |
| 11 System Administrator | X | available |
| 12 ICT Technician | X | 01 available, 02 ideal |

(Source: Study 2015)
4.2.1 Availability of and Access to Hardware and Accessories

From the checklist processed by the researcher, there were 200 workstations (System Unit, Monitor, Keyboard, Mouse and UPS) spread over five (05) computer laboratories at KIST. These were adequate for ICT training and the utilization of the FCA provided that classes are spread out in the day. KIST provided the Building and Civil Engineering department with one (01) laptop without a webcam or multimedia headsets (mic and headphone). This meant making videos would be a challenge. Also provided was one (01) LCD/Data projector, one (01) desktop computer and two (02) printers in the department. There are no interactive whiteboards (IWB) at KIST. Only three (03) digital cameras were available and a scanner was provided for centralized use at the Registrar’s office. External storage/memory devices were provided for administrative use only. Arising from this reality, the only option was for the researcher and the cooperating tutor to create presentations by supplementing what was available with personal equipment and materials (laptop and CDs). The researcher decided against using videos due to time constraints of shooting and editing a video.

4.2.2 Availability of Standard Productivity Software

Productivity software, also known as application software allows the user to perform specific tasks efficiently. KIST had MS Office installed on all workstations and computer aided drafting (CAD) software was limited to two (02) computer laboratories.

Files of different formats could, therefore, be created and run on the workstations. There existed an integrated management and information system (IMIS) which was used for most operations at KIST such as examination records. Being of a modular design, it could potentially be used to support teaching and learning by procuring the teaching and learning support module from its vendor.
This would require appraising the vendor of the software to the specific needs of KIST to also include FCA support.

4.2.3 Data Speeds and Connectivity

There were two (02) internet service providers (ISP). One of the ISP was contracted by the Kenya Government on the basis of Vision 2030 and delivered data speeds of up to 10 megabytes per second (Mbs) but was frequently down, hence not very reliable.

The second ISP was contracted by KIST but delivered slower speeds of up to two (2) Mbs. One of the problems of utilizing the FCA arose from low network speeds which prevented downloading of files by trainees to take place effectively.

In terms of Wi-Fi connectivity, there were five (05) hotspots with a reach of 100 metres radius. All departmental offices and laboratories had Local Area Networking (LAN) connections. There was a website for the institute but it was not designed nor hosted by the institute. This could hinder integrating the website for the purposes of the FCA.

4.2.4 ICT Personnel

The human resource at KIST that handles ICT matters was fairly adequate, having a teaching force of 17 tutors and a systems administrator. One ICT technician was available although two (02) more would be ideal. The technicians were also assisted by trainee technicians placed on internship at the institute.

4.3 Trainee Characteristics at KIST

All KIST trainees were eighteen (18) years and above in age. They were admitted subject to the entry requirements for various courses. The minimum academic requirement for the Diploma in Quantity Surveying was a mean grade of C minus (C-) from the Kenya Certificate of Secondary Education (KCSE) administered by the KNEC. Trainees with physical disabilities were rarely admitted and no special needs programme was in place.
4.3.1 Ownership of Computing Devices and Access to Computers by Trainees

The questionnaire designed for trainees in the study had eight (8) questions. Questions 1 and 3 addressed ownership of computing devices which could potentially enhance the FCA intervention. It was coded for anonymity of trainees, then administered on the sample.

Out of 27 respondents, 26 filled the questionnaire completely after interacting with the presentation prepared for 2-point perspective projection. One respondent had not reported for the term 2 at the time of the study.

Table 4.3 shows the responses for Questions 1 and 3.

<table>
<thead>
<tr>
<th>Question No.</th>
<th>01 Do you own a personal computer or laptop?</th>
<th>03 Do you own a smartphone, that is, a phone that can run applications?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of positive responses (YES)</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Percentage</td>
<td>11.5</td>
<td>30.8</td>
</tr>
<tr>
<td>No. of negative responses (NO)</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>Percentage</td>
<td>88.5</td>
<td>69.2</td>
</tr>
<tr>
<td>Total responses</td>
<td>26</td>
<td>26</td>
</tr>
</tbody>
</table>

(Source: Study 2015)

From the responses obtained, 88 per cent of the trainees did not own a computer and 69 per cent did not have a smartphone. This implies that the trainees were dependent on computing devices owned by third parties or external providers. These external providers included cybercafés and the KIST computer laboratories. The access to these resources was captured by Question 2 in the questionnaire. Figure 4.1 shows access to ICT resources by trainees outside KIST.
From the responses, 73 per cent claimed to have no access to a computer away from KIST.

Compared with the number of trainees that did not own a computing device (88 per cent, Table 4.2), it meant 12 per cent of the trainees could access their own computer. The number of trainees that could access either their own computer or a computer owned by relatives and friends is 27 per cent. These results suggest that utilization of the FCA would largely depend on the ICT resources available at KIST.

4.3.2 ICT Competence of Trainees

On the issue of competence by trainees in ICT, Questions 1, 2, 3, 4 and 8 can give an indication of competence, either implicitly or directly. It was probable that ownership and competence were directly related, in which case a figure of 12 per cent was obtained. Question 8 directly elicited a response on competence when using MS PowerPoint. Figure 4.2 shows the competence of trainees in MS PowerPoint.
The responses in Figure 4.2 imply that only 15 per cent of the trainees could create a PowerPoint presentation. It suggests that the majority of trainees might have possessed only basic or quite limited ICT competence. This could significantly affect the learning outcomes in a lesson taught using the FCA based on ICT resources.

4.3.3 Trainee Participation and Experience in the Study Lesson

Questions 4 and 5 in the trainee questionnaire sought to get responses on a lesson taught using the FCA. Access and adequacy of the presentation for the lesson were addressed. The results are shown in Table 4.4.
Table 4.4: Access to and Adequacy of the Lesson Presentation

<table>
<thead>
<tr>
<th>Question No.</th>
<th>04</th>
<th>Did you access the PRESENTATION easily?</th>
<th>05</th>
<th>Did the PRESENTATION guide you adequately on the topic?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. of positive responses (YES)</td>
<td></td>
<td>No. of negative responses (NO)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percentage</td>
<td></td>
<td>Percentage</td>
</tr>
<tr>
<td>04</td>
<td>9</td>
<td>34.6</td>
<td>4</td>
<td>15.4</td>
</tr>
<tr>
<td>05</td>
<td>4</td>
<td></td>
<td>22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>65.4</td>
<td>22</td>
<td>84.6</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>Total responses</td>
<td>26</td>
<td>Total responses</td>
</tr>
</tbody>
</table>

(Source: Study 2015)

The respondents that found the presentation easily accessible was 35 per cent, but only 15 per cent found it adequate for the lesson content. This indicates that the majority of trainees found the presentation hard to access and the content challenging to grasp.

Four main explanations were cited by trainees as to why this was the case. These are illustrated in Figure 4.3 below.

Figure 4.3: Summary of Trainees’ Challenges

![Reasons for not being able to Access Lesson](image)

(Source: Study 2015)

It appears that the most common challenge was a slow network connection with 47 per cent of the respondent being unable to get the lesson content easily. The second reason given was that the time available was not adequate.
This might be related to the first reason since the slow network connections eroded the time available for working on the web-based (email) assignment.

4.3.4 Attitude of the Trainees Towards the FCA

To gain an insight on the willingness of the trainees to continue participating in lesson taught utilizing the FCA, Question 6 and 7 in the trainee questionnaire required a response in the affirmative or in the negative. Table 4.5 shows the results.

Table 4.5: Disposition of the Trainees Towards the FCA

<table>
<thead>
<tr>
<th>Question No.</th>
<th>06 Are you willing to watch similar PRESENTATIONS in Technical Drawing?</th>
<th>07 Are you willing to watch similar PRESENTATIONS in other subjects?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of positive responses (YES)</td>
<td>No. of negative responses (NO)</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Percentage 34.6</td>
<td>Percentage 65.4</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Percentage 38.5</td>
<td>Percentage 61.5</td>
</tr>
<tr>
<td></td>
<td>Total responses 26</td>
<td>Total responses 26</td>
</tr>
</tbody>
</table>

(Source: Study 2015)

Only slightly over one third (35 per cent) of the respondents wanted to have a similar presentation in Technical Drawing and (38 per cent) were willing to use the same for other subjects. Those trainees having this positive disposition towards the FCA could increase if the challenges identified in this study were addressed adequately.

4.4 Utilizing the FCA to Teach Technical Drawing at KIST

The cooperating tutor filled the observation schedule that captured the information at three instances of time. The following subsections outline the events before, during and after teaching the study lesson while utilizing the FCA in Technical Drawing.

4.4.1 Qualifications of the Cooperating tutor

The cooperating tutor filled the first part of the observation schedule on his qualifications and experience.
He was professionally trained, having a Diploma in Architecture and a Diploma in Technical Education from Kenya Technical Teachers’ Training College. In terms of teaching experience, he had taught for six years at KIST. Subjects taught were Architecture Studio and Building Construction. On a number of occasions, he had participated as a head of section in curriculum implementation work at KIST. He had experience in using ICT such as using MS Office without difficulty as well as competent use of CAD software, installation of standard hardware and general computer maintenance. Based on these facts, the researcher was satisfied that the cooperating tutor was suitable for purposes of the study. Indeed, the cooperating tutor’s keenness in trying out a new teaching approach was a fact the researcher appreciated and commended.

4.4.2 Preparing for the Study Lesson

The researcher had discussed with the cooperating tutor how to prepare the trainees. At the end of term 1 (March 2015), the contact details for trainees had already been obtained by having the trainees fill a form in which they indicated their email addresses and telephone numbers. Those who did not wish these details to be used for educational research in Term 2 of 2015 were asked to indicate this on the form, but none declined. In April 2015, the tutor and the cooperating tutor prepared the scheme of work for Technical Drawing as well as a course outline for the trainees. From the topics of the term 2 (11-May to 24-July 2015), the cooperating tutor chose the topic Perspective Projection to deliver using the FCA.

He then prepared a lesson plan, a PPP and PDF versions and sent them via email to the trainees.
4.4.3 Delivering the Study Lesson

Using the trainee email contact details, the cooperating tutor sent viewing instructions together with the PPP and PDF files as attachments in Week 4 (2-June to 5 to June, 2015) of term 2. This was two weeks before the actual class lesson. The task in the PPP required the trainees to watch in pairs and then do freehand sketches of the presented object. It was expected the trainees would gain access, view the PPP and do the freehand sketches cooperatively by assisting each other mutually.

The PPP and PDF files were accessed mainly from the two computer laboratories at KIST before drawing using instruments in the class lesson.

In Week 6 (15-June to 19-June, 2015), the cooperating tutor presented the class exercise based on the PPP. He facilitated the trainees individually in the class exercise. In this session, the trainees were to convert their freehand sketches to scaled drawings using appropriate instruments. In the course of the interaction, it was observed by the tutor that the trainees had not yet mastered the steps involved in 2-Point perspective projection. He administered the trainee questionnaire immediately at the end of the lesson.

4.4.4 Follow-up of the Study Lesson and Observations Schedule

Immediately after the study lesson, the researcher and the cooperating tutor analyzed the trainee questionnaire to ascertain what challenges the trainees had encountered in accessing the PPP online.

From the feedback obtained, a majority of trainee had difficulties in accessing the PPP online. Therefore, the researcher suggested a change of delivering the PPP from online to offline mode. The cooperating tutor subsequently prepared a resource CD from which trainees could make their own copy the content.
He also directed the trainees to a reference folder having the PPP posted in two computer laboratories for them to access at their own time.

In the follow-up lesson, the cooperating tutor discussed with the class whether the offline mode of access to lesson content was convenient. He received positive responses from the trainees, some of whom requested for hard copies of the PPP and others offered their own CDs and DVDs for writing.

He captured his observations as depicted in the Table 4.6.
Table 4.6: Cooperating Tutor’s Observations Schedule

**OBSERVATION SCHEDULE FOR THE COOPERATING TUTOR**

<table>
<thead>
<tr>
<th>A. PROFESSIONAL AND ACADEMIC QUALIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Highest academic qualification</td>
</tr>
<tr>
<td><em>Diploma in Architecture, KNEC</em></td>
</tr>
<tr>
<td>02 Highest professional qualification</td>
</tr>
<tr>
<td><em>Diploma in Technical Teacher Education, Kenya Technical Teachers’ Training College</em></td>
</tr>
<tr>
<td>03 Additional qualifications</td>
</tr>
<tr>
<td><em>Trained in the use ArchiCAD</em></td>
</tr>
<tr>
<td>04 Experience in Teaching Technical Drawing in Years</td>
</tr>
<tr>
<td><em>Six years.</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. SELF-EVALUATION ON TEACHING TECHNICAL DRAWING</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Subject Mastery (Select One Only)</td>
</tr>
<tr>
<td>Excellent □</td>
</tr>
<tr>
<td>Very Good □</td>
</tr>
<tr>
<td>Good □</td>
</tr>
<tr>
<td>Average □</td>
</tr>
<tr>
<td>Below Average □</td>
</tr>
<tr>
<td>02 Explain briefly your choice in 01 above</td>
</tr>
<tr>
<td><em>(I have keen interest in the subject and I have participated in curriculum development in the subject area. I also examine the subject nationally.)</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. SELF-EVALUATION ON ICT COMPETENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>03 Ability to Use diverse Hardware and Software (Select One Only)</td>
</tr>
<tr>
<td>Excellent □</td>
</tr>
<tr>
<td>Very Good □</td>
</tr>
<tr>
<td>Good □</td>
</tr>
<tr>
<td>Average □</td>
</tr>
<tr>
<td>Below Average □</td>
</tr>
<tr>
<td>04 Explain briefly your choice in 03 above</td>
</tr>
<tr>
<td><em>(I can use MS Office without difficulty. I am competent in the use of CAD software, installation of standard hardware and general computer maintenance.)</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D. OBSERVATIONS ON PREPARING TO USE THE FCA IN TECHNICAL DRAWING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use separate sheet(s) as may be necessary.</td>
</tr>
<tr>
<td><em>From the scheme of work, I chose the topic 2-Point Perspective Projection and wrote a lesson plan. Adapting content for the FCA was done using PowerPoint slides. The trainees were required to watch the slides and do freehand sketches of the object. I then sent the PPP as an attachment to all trainees via email 1 week before class lesson.</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>E. OBSERVATIONS DURING THE USE OF FCA IN TECHNICAL DRAWING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use separate sheet(s) as may be necessary.</td>
</tr>
<tr>
<td><em>Some trainees had already accessed the prepared PPP, but most had not. I modified the class exercise based on the PPP and facilitated trainees practically in the class exercise. The trainee questionnaire was administered at the end of the lesson.</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F. OBSERVATIONS AFTER THE USE OF FCA IN TECHNICAL DRAWING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use separate sheet(s) as may be necessary.</td>
</tr>
<tr>
<td><em>From the feedback obtained in the trainee questionnaire, it was necessary to change the delivery mode from online to offline viewing of the PPP. I prepared a folder and posted it in Lab 20 and 22 for trainees to access at their own time. I also made 2 CDs. This worked better. In my opinion, this method will help me and the trainees in future. The topics can be handled better if all resources were available, it can help a lot. The department should provide at least the CDs.</em></td>
</tr>
</tbody>
</table>

(Source: Study 2015)
4.5 Discussion of Findings

The findings from the data analysed in the study relate to the extent to which flipping the classroom succeeded while teaching Technical Drawing at KIST. The following subsections present a discussion of the findings, dwelling on the capacity of ICT resources at KIST to support FCA, the challenges faced by trainees and the cooperating tutor.

4.5.1 ICT Resources for the FCA at KIST

The ICT resources at KIST were adequate for the FCA with 200 workstations in five (05) computer laboratories being available. Nevertheless, there existed a challenge since 88 per cent of the trainees had no alternative access to ICT resources outside of KIST. The trainees depended heavily on the resources at KIST for the FCA to work well. The internet could not be used to post lesson content and achieve spatial independence. The initial hindrance was the data connection speed which proved too slow for online delivery of content. However, this challenge was surmounted by offline delivery through use of CDs and DVDs. These obviated the need for an internet connection, but the trainees still had to use KIST facilities.

On the side of the cooperating tutor and the researcher, personal resources (laptop and CDs) were utilized to prepare for the flipped lessons. Availability of institutional laptops for tutors could greatly encourage flipping of lessons in Technical Drawing and other subjects. From the trainee and cooperating tutor perspectives, flipping a lesson was not very easy since they were dependent on the ICT resources located at KIST.

4.5.2 ICT Competence of Trainees in at KIST

The ability to use PowerPoint was used as a gauge of ICT competence, though it was not the only way. Based on this, the competence of the trainees in ICT was quite limited with only 15 per cent of the trainees being able to use PowerPoint. Since the
FCA requires frequent interaction with ICT, this was deemed a challenge in flipping a Technical Drawing lesson successfully.

4.5.3 Tutor Requirements for Utilizing the FCA to Teach Technical Drawing

There is substantial research that supports the contention that learners get a better education when they have "better" teachers (Morsund, 2005). This observation applies to the cooperating tutor in the study who applied himself to the set tasks with a lot of dedication. He demonstrated practically that he desired to be a better teacher by participating in educational research. The study had created a new challenge for him and he had accepted it very enthusiastically. With newly acquired knowledge on the FCA, he exhibited a lot of motivation in using it to teach Technical Drawing. His interest in the subject and ICT was very evident. Throughout his participation in the study, the cooperating tutor and the researcher exchanged ideas on subject matter, issues regarding ICT and specific teaching points.

4.6 Summary of Chapter Four

The majority of Technical Drawing topics can be flipped as demonstrated by the analysis of the syllabus content undertaken in the study. It is the researcher's informed view that flipping a classroom works most effectively by integrating ICT, whether by use of online or offline resources. The findings suggest that the trainees in Quantity Surveying class used in the study did not have adequate ICT competence. Their attitude and feedback, however, indicated that they would welcome flipping of lessons in future. ICT resource provided by KIST were not sufficient for flipping classrooms via online delivery because of low internet connection speeds, but offline delivery seemed to work. The challenges that the cooperating tutor encountered included having to vary online delivery to offline delivery of the content. He also had to obtain resources through personal financial expense due to procurement procedures at KIST.
He possessed qualities that might not be typical of all Technical Drawing tutors, such as a willingness to try something new and being flexible in the face of instructional challenges.

Chapter Five concludes the study by giving recommendations and suggestions for further research on flipping the class in Technical Drawing and other subjects.
CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents key findings from the study. It includes the conclusions drawn and recommendations arising from the purpose of this study. The study also established the main challenges that faced the trainees and the cooperating tutor in the use of the FCA.

5.1 Summary of the Study

The purpose of this study was to adopt the FCA as an additional teaching intervention with a view to increasing class contact time and potentially improving performance in external examinations in the Technical Drawing subject at KIST. Only scant local research literature was available and a case study approach was deemed necessary to achieve the study objectives.

The following sub-sections summarize the findings in relation to the objectives of the study. They address the degree of success in flipping a lesson in Technical Drawing at KIST, challenges faced by trainees and cooperating tutor while participating in a lesson taught using the FCA.

5.1.1 Challenges of Flipping the Class in Technical Drawing

The Technical Drawing subject and the content analysis of the Diploma in Quantity Surveying syllabus showed that 92 per cent (Stage 1) and 86 per cent (Stage 2) of topics and subtopics were practice-oriented. Hence, they were an excellent opportunity for utilizing the FCA in content delivery. The lesson that was taught using the FCA had a moderate degree of success with 35 per cent of the respondents being able to easily access the content via PPPs and attempt the tasks specified therein. With additional interventions such as raising ICT awareness and competence, infrastructural
improvements as well as enhanced data speeds, it is possible to make the FCA an everyday reality in teaching Technical Drawing at KIST.

5.1.2 Challenges the Trainees Faced

The second objective of the study was to investigate challenges trainees faced in participating in a flipped classroom environment at KIST. The study results show that 88 per cent had no access to a computer outside of KIST whereas 85 per cent of the trainees could not use PowerPoint presentations to learn thus suggesting a low level of ICT competence. Another common challenge was the frustratingly low data connection speeds available at KIST. These findings partially concur with those of a study by Davidson and Santorelli (2010) on the impact of broadband on education. They suggest that public-private funding could help schools have better internet connections so that the schools add value and digital equity to learning.

5.1.3 Challenges the Cooperating Tutor Faced

The ICT resources available at KIST for the cooperating tutor had a limiting effect. The departmental laptop was mostly restricted to administrative use. It appears that the positive attitude of the cooperating tutor and the motivation for self-improvement made him surmount the challenges that arose. Even though the FCA was introduced to him for an academic purpose, the cooperating tutor felt that he had learnt a lot through his participation and that he would keep applying the knowledge gained in future. The findings of the study suggest that tutor who is motivated could try new instructional interventions such as flipping his or her classroom. He or she could be willing to seek assistance of a material kind (such as borrowing a laptop) as well as professional cooperation.
5.2 Conclusions of the Study

This study has resulted into three main conclusions as follows:

a) The FCA could be an excellent instructional mode for over 85 per cent of the Technical Drawing topics. However, there was a limited degree of success in the study lesson utilizing the FCA at KIST because of ICT related reasons. Online delivery of lesson content was not as effective as the offline mode.

b) The majority of trainees did not have access to computing devices of their own which made them entirely dependent on ICT resources at KIST. They also lacked sufficient skills in ICT to follow through the content delivered via the FCA. This challenge should be addressed for the FCA to be more effective.

c) Academic and professional qualifications of the cooperating tutor necessary for flipping the Technical Drawing class included ICT proficiency. It was observed that a positive attitude towards new teaching interventions helped in overcoming challenges that arose. It was also noted that there were cost implications for the tutor who provided some of the resource CDs for the class. Unless administrative support is provided, this could be a challenge in the long term.

5.3 Recommendations

The following recommendations could be made to TVET institutions that wish to adopt the FCA in teaching Technical Drawing and other subjects:

a) Going by the global trend, the FCA could be used most effectively through integration of ICT resources. Even providing trainees with simple photocopies for a drawing exercise would require use of an ICT device. As a matter of urgency, TVET institutions should develop an ICT policy dealing with integration in learning and teaching, among other areas. Its implementation
would deal with the availability and access to ICT resources for teaching and learning through BL modes such as the FCA.

b) The competence of trainees in ICT should be given high priority during training so that, in the case of a flipped classroom, trainees do not get frustrated by lack of skills and knowledge on how to access the content being delivered.

c) The FCA is one of the relatively new instructional approaches.

By providing regular in-service training and further training opportunities for tutors, they could be motivated to take up new instructional modes as the evolve.

Some of the more experienced tutors could mentor the others.

Also to be noted is that, without institutional support, even the most enthusiastic teacher may not cope if they have to personally provide the training and material needs that arise from such innovations. The FCA could contribute towards attainment of training goals as established by the State Department of Education and the State Department of Science & Technology in the Ministry of Education Science and Technology, Kenya.

Despite the endeavours to integrate ICTs in education, training and research, a number of issues have remained as barriers to full attainment of the desired goals. These include; Access, funding, inadequate ICT facilities, high cost of development of interactive e-learning content, ICT not embraced as medium of instruction and management tool, inadequate capacity for teachers, absence of ICT Curriculum at ECD and primary levels, dynamic nature of ICT technology, inadequate capacity for maintaining ICT equipment... (MoEST, 2013,p.34).

New media continue to evolve that can enhance learning in Kenya. The Government’s intention to adopt mobile learning technology at primary school level is a welcome development because it provides an effective means of flipping classrooms.

Indeed, digital curriculum implementation at all levels is a necessity that can no longer be ignored.
5.4 Suggestions for Further Study

It was the purpose of this study to determine the challenges of flipping a Technical Drawing class at KIST. Based on the findings, the researcher concludes this study by suggesting that:

a) The study be replicated at other TVET institutions in Technical Drawing or other subjects to investigate the challenges of flipping the classroom.

b) Investigation of the impact on academic performance from flipping the classroom in Technical Drawing and others subjects be undertaken.

c) Investigation of the perception of tutors regarding subject teaching methods and approaches in Technical Drawing at TVET institutions be carried out.
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## RESEARCH INSTRUMENTS

### Manipulative Skills Content Analysis

<table>
<thead>
<tr>
<th>CODE</th>
<th>STAGE 1 TOPICS</th>
<th>SUB-TOPICS</th>
<th>HOURS</th>
<th>FCA UTILIZATION WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.1.1S</td>
<td>Instruments and Materials</td>
<td>Instruments, Paper sizes, Layout, Storage Reproduction of Drawings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.1.2S</td>
<td>Plane Geometry</td>
<td>Conic Sections, Loci Lines in Space Orthographic Views</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.1.3S</td>
<td>Solid Geometry</td>
<td>Sections of Solids, Aux. Views</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.1.4S</td>
<td>Freehand Sketching</td>
<td>Three Dim. Sketching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.1.5S</td>
<td>Orthographic Projection</td>
<td>1st and 3rd angle Projection Conversion to Pictorial Views Exploded Views</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.1.6S</td>
<td>Perspective Drawing</td>
<td>1-Point Proj'n, 2-Point Proj'n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.1.7S</td>
<td>Design</td>
<td>Principles of Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.1.8S</td>
<td>Building Drawing</td>
<td>Working and Detail Drawings</td>
<td></td>
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</tr>
</tbody>
</table>

**TOTALS**

<table>
<thead>
<tr>
<th>CODE</th>
<th>STAGE 2 TOPICS</th>
<th>SUB-TOPICS</th>
<th>HOURS</th>
<th>FCA UTILIZATION WEIGHT</th>
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</thead>
<tbody>
<tr>
<td>13.2.1S</td>
<td>Building Services Drawing</td>
<td>Working Drawings</td>
<td></td>
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<tr>
<td>13.2.2S</td>
<td>Structural Drawing</td>
<td>Presentation of Struct. Drawings Reinforced Concrete Detailing Structural Work Detailing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.2.3S</td>
<td>Civil Engineering Working Drawings</td>
<td>Scales, Working Drawings</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTALS**
## ICT Checklist

### A. COMPUTER HARDWARE AND ACCESSORIES

<table>
<thead>
<tr>
<th>No.</th>
<th>Item Description</th>
<th>Adequate?</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>System Unit, Monitor, Keyboard, Mouse and UPS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>Laptops with Webcam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>Multimedia Headset (Mic and Headphone)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>Digital Camera</td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>Scanner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>LCD/ Data Projector, Interactive Whiteboard (IWB)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>Printers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>External Storage/Memory</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### B. COMPUTER SOFTWARE

<table>
<thead>
<tr>
<th>No.</th>
<th>Software Description</th>
<th>Adequate?</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>07</td>
<td>IMIS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>MS OFFICE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>09</td>
<td>CAD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### C. INTRANET & INTERNET

<table>
<thead>
<tr>
<th>No.</th>
<th>Service Description</th>
<th>Adequate?</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>07</td>
<td>WI-FI Hotspots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>Connectivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>09</td>
<td>LAN-Network</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Website</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### D. PERSONNEL

<table>
<thead>
<tr>
<th>No.</th>
<th>Position Description</th>
<th>Adequate?</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>ICT Teaching Staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>System Administrator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>ICT Technician</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

END
Questionnaire for the Trainee

**QUESTIONNAIRE FOR THE TRAINEE**

<table>
<thead>
<tr>
<th>Q. No.</th>
<th>Question</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Do you own a personal computer or laptop?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>If NO to No.01, do you have access to a computer away from KIST?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>Do you own a smartphone, that is, a phone that can run applications?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**B. PLEASE WATCH THE PRESENTATION "2-POINT PERSPECTIVE PROCEDURE" SENT TO YOUR EMAIL ACCOUNT AND RESPOND TO QUESTIONS 4-7 BELOW**

<table>
<thead>
<tr>
<th>Q. No.</th>
<th>Question</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>Did you access the PRESENTATION easily?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>If NO, state the main problem(s):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>Did the PRESENTATION guide you adequately on the topic?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>If NO, state the main reason(s):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>Are you willing to watch similar PRESENTATIONS in Technical Drawing?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>Are you willing to watch similar PRESENTATIONS in other subjects?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>Can you create a presentation using PowerPoint?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THANK YOU FOR YOUR TIME!
Observation Schedule for the Cooperating Tutor

OBSERVATION SCHEDULE FOR THE COOPERATING TUTOR

A. PROFESSIONAL AND ACADEMIC QUALIFICATIONS

01 Highest academic qualification

02 Highest professional qualification

03 Additional qualifications

04 Experience in Teaching Technical Drawing in Years

B. SELF-EVALUATION ON TEACHING TECHNICAL DRAWING

01 Subject Mastery (Choose One Only)
Excellent □ Very Good □ Good □ Average □ Below Average □

02 Explain briefly your choice in 01 above

C. SELF-EVALUATION ON ICT COMPETENCE

03 Ability to Use diverse Hardware and Software (Choose One Only)
Excellent □ Very Good □ Good □ Average □ Below Average □

04 Explain briefly your choice in 03 above

D. OBSERVATIONS ON PREPARING TO USE THE FCA IN TECHNICAL DRAWING
Use separate sheet(s) as may be necessary.

E. OBSERVATIONS DURING THE USE OF FCA IN TECHNICAL DRAWING
Use separate sheet(s) as may be necessary.

F. OBSERVATIONS AFTER THE USE OF FCA IN TECHNICAL DRAWING
Use separate sheet(s) as may be necessary.

END
RESEARCH AUTHORIZATION

Research Authorization by NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471, 2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacostt.go.ke
Website: www.nacostt.go.ke
When replying please quote Ref. No.

Date: 27th May, 2015

NACOSTI/P/15/1259/5909

Peter Gacheru
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "Flipping the classroom in technical drawing subject: A case study of Kiambu Institute of Science and Technology, Kenya," I am pleased to inform you that you have been authorized to undertake research in Kiambu County for a period ending 31st December, 2015.

You are advised to report to the Principal, Kiambu Institute of Science and Technology, the County Commissioner and the County Director of Education, Kiambu County before embarking on the research project.

On completion of the research, you are expected to submit two hard copies and one soft copy in pdf of the research report/thesis to our office.

DR. S. K. LAGAT, OGW
FOR: DIRECTOR GENERAL/CEO

Copy to:

The Principal
Kiambu Institute of Science and Technology.

The County Commissioner
Kiambu County.

THIS IS TO CERTIFY THAT:

MR. PETER GACHERU -

of KENYATTA UNIVERSITY, 0-100

Nairobi, has been permitted to conduct

research in Kiambu County

on the topic: FLIPPING THE

CLASSROOM IN TECHNICAL DRAWING

SUBJECT: A CASE STUDY OF KIAMBU

INSTITUTE OF SCIENCE AND

TECHNOLOGY, KENYA

for the period ending:
31st December, 2015

Signature

Applicant's

Permit No: NACOSTI/P/15/1259/5909
Date Of Issue: 27th May, 2015
Fee Received: Ksh 1,000

Director General
National Commission for Science, Technology & Innovation

85
RE: RESEARCH AUTHORIZATION


You have been authorized to conduct research on "Flipping the classroom in technical drawing subject: A case study of Kiambu Institute of Science and Technology, Kenya" in Kiambu County for a period ending 30th December, 2015.

You are requested to share your findings with the County Director of Education upon completion of your research.

Esther Maina
County Commissioner
Kiambu County

Cc County Director of Education
Kiambu County
RESEARCH AUTHORIZATION


This is to inform you that the above named has been authorized to carry out research on "FLIPPING THE CLASSROOM IN TECHNICAL DRAWING SUBJECT: A CASE STUDY OF KIAMBU INSTITUTE OF SCIENCE AND TECHNOLOGY, KENYA," for a period ending 31st December, 2015.

Wish you success.

BONIFACE N. GITAU
FOR COUNTY DIRECTOR OF EDUCATION
KIAMBU COUNTY