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Assessing Domestic Violence in Nigeria

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Abstract

Domestic violence is form of violation of person’s human rights or abuse of anyone in a way that causes pain, distress or injury. It refers to any abusive treatment of one person by another, thus violating the law of basic human rights. It includes battering of intimate partners and others, sexual abuse of children by parents or relative, such as marital rape and traditional practices that are harmful and inhuman to a person, men or women.

In this paper we will discuss the prevalent rate of domestic violence in Nigeria, the situation of domestic violence, cause, types, effect and managements of domestic violence in Nigeria. Lastly preventive and remedial is proffered as a panacea for the ugly phenomenon.

Keywords: Domestic, Violence, Abuse, Nigeria, Counselling, Patriarchal.

Introduction

Domestic violence is a pattern of abusive behavior in any relationship that is used by one partner to gain or maintain power and control over another intimate partner. It is also known as domestic abuse, spousal abuse, family violence and intimate partner violence. It is violence or other abuse by one person against another in a domestic setting, such as in marriage or cohabitation. Domestic violence can be physical, sexual, emotional, economic, or psychological actions or threats of actions that influence another person.

Domestic violence is an issue of global concern. Some societies have even seen it as norms as such, culturally accepted it as part of life. In 2002, Djaden and Thoennes (2002) reported that in the United States of America, women experience about 4.8 million intimate partner-related physical assaults and rapes each year, while men are victims of about 2.9 million intimate partner related physical assaults. In parts of the third world generally and in West Africa, in particular, domestic violence is prevalent and reportedly justified and condoned in some cultures.

Domestic violence is a social problem in Nigeria like many other parts of Africa. Reports from a Humanitarian News Agency, IRIN (2007) show that 25% of women in Dakar and Kaolack in Senegal are subjected to physical violence from their partners and that very few admit that they are beaten. These women would be told never to report such cases to anyone; as such they are told to keep quiet and endure the beatings. In Ghana, spousal assaults top the list of domestic violence (I-RIN, 2007) without any serious punishment or prosecution of any sort.

In Nigeria, Amnesty international (2007) reports that a third (and in some cases two-thirds) of women are believed to have been subjected to physical, sexual and psychological violence carried out primarily by husbands, partners and fathers while girls are often forced into early marriage and are at risk of punishment if they attempt to escape from their husbands.

There is sadly a deep cultural belief in Nigeria that it is socially acceptable to hit a woman as a form of discipline. Violence against women is a technical term used to collectively refer to violent acts that are primarily or exclusively committed against women. One third of women in Nigeria were believe to be subjected to physical, sexual and psychological violence carried out by husband, partners or father. Common forms of violence against women in Nigeria are battering, sexual abuse of children, marital rape, acid attacks, molestation, corporal punishment and homicide. The victims of domestic violence are women, men, boys and girls. However, women and girls are most affected.
The purpose is to create sensitization in the area of gender based violence in Nigeria, as the victims most often suffer in silence and fail to seek for help due to patriarchal society, attempt to preserve unity in the relationship or family while in some cases they sacrifice their life in the process.

Situation of domestic violence in Nigeria

The purpose of this study is to assess the level of domestic violence in Nigeria and find a way of reducing it, if not eradicating it totally. Domestic violence has been on the increase. It is so common that it has often gone unnoticed and failed the level of concern it deserves in light of the devastating effects on children and families. There have been reports of cases of husbands killing and maiming their wives in the media. Father rapes daughter, husband beats wife to stupor, 67-year-old man defiles eight-year-old girl, wife stabs husband to death, these and many more have made headlines of various media. The statistics presented actually cause to lose courage. About 50% of women have been battered by their husbands. Shockingly, more educated women (65%) are in this terrible situation as compared with their low income counterparts (55%) must endure, believing they have nowhere to go and in any case, believing, for good reason, that the law will not protect them. Staggering 97.2% of them are not prepared to report to the Nigeria Police because of their patriarchal nature. Only four states of the Federation (Lagos is one of them) have passed laws against the insidious crime, whilst several Bills against it languish in our male dominated National Assembly. Of the states that have passed it, the law is yet to be fully tested.

Traditionally, in Nigeria, as in many other African countries, the beating of wives and children in particular, is widely sanctioned and allowed as a form of discipline (UNICEF, 2001), to instill discipline into them. Therefore, in beating their-children parents believe they are instilling discipline in them, much the same way as in husbands beating their wives, who are regarded like children to be prone to indiscipline which must be curbed.

Recently in Lagos State, the western part of Nigeria, a woman named Titilayo Arowolo, 27-year-old mother of one was gruesomely murdered by her husband Kolade who allegedly axed her to death in their home at Isolo. Before that, the scandalous story of wife battering by one Nigerian Ambassador and a traditional ruler who engaged his wife in a public brawl made the rounds, thus bringing the issue of spousal abuse once again to the front burner.

Domestic violence constitutes a great problem to the family and the society at large. It occurs at home, in public places like streets, parks, familiar places like homes of friends and relatives, offices, involving highly placed executives; and also in churches and mosques.

Domestic violence that occurs in private within the family, including wife battery, rape, acid attack, and sexual abuse affect the physical and psychological wellbeing of women; and as such, they seem to erode the position of women, both at home and in the society at large.

Causes of domestic violence

Alumanah (2004) highlighted some of the cause of domestic violence against women as refusal of wife to submit to husbands' authority, sexual misconduct by wives, interference by in-laws, conflict between work and domestic duties by wives, religious conflict between partners, flirting of husband with other women among others.

Three major factors are responsible for domestic violence in Nigeria namely; patriarchal nature of our culture, economic dependence of one sex on the other and lack of legal framework to address domestic violence.

Generally, there are many different theories as to the causes of domestic violence. This includes psychological theories that consider personal traits and mental characteristics of the perpetrator. As well as social theories which considers the external factors in the perpetrators environment.

Psychological causes: these focus on personal traits and mental characteristic of the offender. Personal traits may include sudden burst of anger, poor impulse control and low
self-esteem. It often followed that abuse observed or experienced as a child lead some people to be more violent as an adult.

**Jealousy**: this is demonstrated when a spouse is suspected of being unfaithful or is planning to leave the relationship.

**Social stress**: stress may be increased when a person is living in a family situation with increased pressure. However, violence is not always caused by stress but may be a way some people respond to stress. A very good example of such is couples experiencing financial crises may be more likely to experience domestic violence due to increase stress and conflict about finances.

**Social learning**: (Crowell & Sugarman, 1996) established that violence is often transmitted from generation to generation in cyclical manner. If one observes violent behavior, there is possibility of imitating it if there are no negative consequences and more so if the victim accepts the violence with submission.

**Power and control**: the perpetrator of abuse does so in order to establish or maintain control over the partner. Abusers’ effort to dominate have been greatly attributed to low self-esteem or feeling of inadequacy, unresolved childhood conflict, the stress of poverty, hostility and resentment towards women, personality disorder, genetic tendencies and social cultural influences.

No cause of domestic violence, however, justifies the actions of the abuser, nor should it be used as a rationale for their behavior.

Domestic violence is actually on the increase in Nigeria because the long arm of the law is not catching up with the perpetrators of this deadly act and also in some cases the punishments doled out on these perpetrators are not thorough enough to stop any other person with such intention from doing it.

**Types of domestic violence**

Domestic violence is perpetrated in different ways such as physical aggression or assault, sexual abuse, economic abuse, emotional abuse, spiritual abuse and negligence.

**Physical abuse**

Physical abuse is perpetrated mainly by men on women as a response to actual or suspected infidelity, relationship inequality, financial issues, over indulging in alcohol or substance abuse and rejection of sexual advances. Physical violence against women may occur in the form of acid attack, molestation, female genital mutilation and battering.

Victims of physical violence are inflicted with physical injuries such as minor or major cuts, scratches and bruises, broke bones, internal bleeding, head trauma, burn from acid, hot water or oil, electric iron, naked fire, hot soup just to mention a few.

**Sexual abuse**

This includes all forms of sexual assaults, marital rape, harassment or exploitation. It involves forcing a person to participate in sexual activity, using a child for sexual purposes including child prostitution and pornography.

**Economic abuse**

This includes stealing from or defrauding a loved one, withholding money for essential things like food and medical treatment, manipulating or exploiting family member for financial gain, preventing a loved one from working or controlling his/he choice of occupation.

**Emotional abuse**

This includes threatening a person of his or her possession or harming a person’s sense of self-worth by putting him/her at risk of serious behavioral, cognitive, emotional or mental disorders. Shouting at a partner which was found to be the most common abuse. Also included in emotional abuse are name-calling, criticism, social isolation, intimidating or
exploitation to dominate, routinely making unreasonable demand, terrorizing a person verbally or physically and exposing a child to violence.

**Spiritual abuse**

This includes preventing a person from engaging in his/her spiritual or religious practices or using one’s religious belief to manipulate, dominate or control him/her.

**Negligence**

This includes failure to provide for dependents who may be adults or children, denying family members food, clothing, shelter, medical care, and protection from harm or a sense of being loved and valued.

**Effect of domestic violence**

Domestic violence has devastating effect on the victims who are mostly women with a resultant effect on the children. Some of these effects are highlighted as follows:

- **Effect on children:** It is highly believed that a child who is exposed to domestic violence during his/her upbringing will suffer in his/her development and psychological welfare. Some emotional and behavioral problems that can result due to domestic violence include increased aggressiveness, anxiety, and changes in how a child socializes with friends, family and authorities. Problems with attitude and cognition in schools can start developing, along with a lack of skills such as problem-solving. It has been discovered that children who witness mother-assault are more likely to exhibit symptoms of posttraumatic stress disorder (PTSD).

- **Physical effect:** Acute effects in domestic violence incident are bruises, broken bones, head injuries, lacerations and internal bleeding which most time require medical attention and hospitalization. Some chronic health conditions that have been linked to victims of domestic violence are arthritis, irritable bowel syndrome. Most victims of domestic violence who are pregnant experience greater risk of miscarriage, pre-term labour, and injury to or death of the fetus.

- **Psychological effect:** High level of stress, fear and anxiety were reported among victims who are still living with their perpetrators. Depression is also not left out, as victims are made to feel guilty for provoking the abuse and are always subjected to intense criticism. It was discovered that 60% of victims meet the diagnostic criteria for depression, either during or after termination of the relationship, and have a great tendency for risk for suicide. The most commonly referenced psychological effect of domestic violence is Post-Traumatic Stress Disorder (PSTD). PSTD experienced by victims is characterized by flashbacks, nightmares, exaggerated startle response, intrusive images, and avoidance of triggers that are associated with the abuse. These symptoms are generally experienced for a long time even after the victim has left the dangerous situation.

- **Financial effect:** Once victims leave their perpetrator, they can be stunned with the reality of the extent to which the abuse has taken away their autonomy. Due to economic abuse and isolation, the victims usually have do not have enough money of their own and few people to rely on when seeking for help. This has been one of the greatest obstacles facing victims of domestic violence, and a strong fact that can discourage them from leaving their perpetrators. In addition to lacking financial resources, victims of domestic violence often lack specialized skills, education, and training that are necessary to find gainful employment especially in cases of house help, nanny, or even house wife may also have several children to support.

- **Long-term effect:** Domestic violence can trigger many different responses in victims, all of which are very relevant for a professional working with a victim. Major consequences of domestic violence victimization include psychological/mental health issues and chronic physical health problems. A victim’s overwhelming lack of resources can lead to homelessness and poverty.
Management of domestic violence

The response to domestic violence is typically a combined effort between law enforcement, counselling services and health care.

**Medical response:** Medical professionals do not see themselves as being able to play a major role in helping women in regards to domestic violence. Injuries are often just treated and diagnosed, without regard for the causes. Health professionals have an ethical responsibility to recognize and address exposure to abuse in the patients, in the health care setting. For example, the American Medical Association’s code of medical ethics states that “Due to the prevalence and medical consequences of family violence, physicians should routinely inquire about physical, sexual and psychological abuse as part of the medical history.”

**Law enforcement:** A study was conducted by Lawrence Sherman in 1982, The Minneapolis Domestic Violence Experiment, to evaluate the effectiveness of various police responses to domestic violence calls in Minneapolis, Minnesota; including sending the abuser away for eight hours, giving advice and mediation for disputes, and making an arrest. Arrest was found to be the most effective police response. The study found that arrest reduced the rate by half of re-offending against the same victim within the following six months (Maxwell, Garner & Fagan, 2001). In the replication studies which were broader and methodologically sound in both size and scope, arrest seemed to help in the short run in certain cases, but those arrested experienced double the rate of violence over the course of one year (Schmidt and Lawrence, 1993). Generally, it has been accepted that if the understood victim has visible (and recent) marks of abuse, the suspect is arrested and charged with the appropriate crime.

**Counselling for person affected:** Since marital violence is major risk factor for serious injury and even death, and women in violent marriages are at much greater risk of being seriously injured or killed; counselling intervention is much needed. Initial assessment of the potential for violence in a marriage can be supplemented by standardized interviews and questionnaire which have been reliable and valid aids in exploring marital violence more systematically. Counsellors and therapists should also make the distinction between situations where battering may be a single, isolated incident or an ongoing pattern of control. If it becomes apparent to the therapist that domestic violence is taking place in a client’s relationship, the therapist must explore options with the client; and also refrain from blaming the partner or telling the client what to do. It is unreasonable for the therapist to expect that a victim will leave her abusive spouse solely because she disclosed the abuse. The therapist should respect the victim’s autonomy and allow her to make her own decisions (Lawson, 2003). Therapists must be aware that supporting assertiveness by a battered wife may lead to more beatings or even death. Even in few cases, when the wife leaves because of life threatening situation, therapists should not relax their vigilance after a battered wife leaves her husband. Some data suggest that the period immediately following a marital separation is the period of greater risk for the women. Many men will stalk and batter their wives in an effort to get them to return or punish them for leaving.

**Counselling for offenders:** The main goal of counseling for offenders of domestic violence is to minimize the offender’s risk of future domestic violence, whether within the same relationship or a new one. Treatment for offenders should emphasize minimizing risk to the victim, and should be modified depending on the offender’s history, risk of reoffending and criminogenic needs. The majority of offenders’ treatments are conducted in a group setting with groups not exceeding 12 participants. Groups are also standardized to be gender specific (Colorado Domestic Violence Offender Management Board, 2010). According to Roberts (2002), anger management alone has not been shown to be effective in treating domestic violence offenders, as domestic violence is based on power and control and not on problems with regulating anger responses. Anger management is recommended as a part of an offender treatment curriculum that is based on accountability, along with topics such as recognizing abusive patterns of behavior; it also requires a great deal of personal change and
the construction of a self-image that is separate from former abusive while still being held accountable for it.

**The way forward**

To mitigate violence against women, there is need for continuous public education with the aim of raising awareness among Nigerian populace. The use of television, radio and newspaper media can go a long way in improving the masses knowledge on domestic violence. It is also important to put more efforts into empowering women through equal educational and employment opportunities.

Promulgating laws that will protect women and children against violence and abuse would stem the magnitude of the problem, but punitive approach without adequate education and counseling of perpetrators and victims of domestic violence may not yield the desired results. Perpetrators of domestic violence against women may need more social and psychological help rather than punitive measures than previously thought. There is then an imperative need to establish facilities for this purpose. Incorporating help centers with law enforcement – Lessons from other parts of the world.

**Prevention of domestic violence in nigeria**

Among other things, strategies aimed at reducing the negative impacts and the threats to the psychological well-being of people affected. This will bring to light the socio-environmental issues that fuel or perpetuate the violence and ways of tackling them. There is need to strengthen our judiciary system to ensure prompt and adequate trial of offenders, while the police in turn must be made to handle cases of domestic violence with utmost seriousness and professionalism. This will guarantee adequate protection and security for our women.

Other following measures can be taken:

**Educating community**: one of the major and important approach is through education from primary education to tertiary level through teaching. It means that there is need for inclusion of domestic violence in our school curriculum. People in the neighborhood should also be educated and how to detect and intervene safely in any form of domestic violence in their area, which can be done in collaboration with the local domestic violence shelter and police community outreach officers.

**Organization of the community**: community should be organized in such a way that it does not condone or tolerate any form of domestic violence. As neighbors will watch to stop the crime, network of folks should also be organized who will be committed to intervening in domestic violence situation, and help victims leave their abusers with communal support structure for survivors.

**Advocacy with the community leader**: there is need with advocacy with the community leader, as we know that prevent domestic violence is an inclusive approach, and as such there is need for high level advocacy with the community leaders, especially in areas where there is high level of illiteracy.

**Advocacy with religious leader**: apart from advocacy with community leader, there is need for advocacy with the religious-based leaders, especially in a country like Nigeria where religion plays high relevance in the life of the people.

**Culture and tradition**: domestic violence is deeply embedded in culture and tradition because of our patriarchal structure which says that husband is the head and he owns the woman, so he could do whatever he likes to her. On the other hand the woman needs to be submissive even at the detriment of her health or life in marriage As such there is need for cultural-based approach to prevent this, such as addressing the cultural bias of the traditionalist who do not see any wrong in domestic violence.

**Information and communication**: information and communication will also play a key role in preventing violence. With the proliferation of social media there is need to use this tool to address some salient issues regarding domestic violence in our society.
Not conviction of offenders: This has also caused increase in domestic violence especially in country like Nigeria where impunity is order of the day. Until the offenders are made to face the music which will cause deterrent for others from repeating a similar offence we may not be able to stop domestic violence in the society.

Training and enlightenment with our police force: due to patriarchal nature of the society, and having more of men in our police makes it difficult for them to protect especially women from domestic violence as it seen by them as family issue which should not be discussed outside the home and a means a man corrects his wife.

Advocacy to the legislature: domestic violence is not illegal in many states in Nigeria and that means victims are not entitled to legal support. In fact due to stigmatization or fear of being labeled, most women that are victims have chosen to stay in such marriage even if it means losing their lives and leaving the children to suffer. If law is passed against domestic violence in all the states and is being implemented not only documented is a good step in the right direction, though there are still facts that even in the states which such laws domestic violence is the order of the day.

Abolishing some federal laws: there is law that permits husband to use physical means to correct the wife, so far it does not result in grievous harm such as losing of speech, sight, hearing, facial disfigurement or life threatening cases. Example is section 55 of the penal code in northern Nigeria that permits a man in wife battery so far it does not degenerate to excessive bodily injury. The question is how do we measure what is excessive.

Enlightenment from mass media: domestic violence is under reported, poorly documented and hardly investigated. Through different media domestic violence can prevented by educating people about it through different means and campaigning against it.

Finally, policy makers can do more to curb domestic violence by enacting laws that will fully protect the female gender within the society. This will definitely serve as an instrument to tackle a lot of the social issues that may complicate domestic violence in Nigeria.

Conclusions and recommendations

Despite the fact that women are culturally subservient and male dominance is the norm in Nigeria, the increasing difficulties and depreciating standard of living have put strains on many relationships, with attendants increase in violence, women are daily and regularly being exposed to various forms of abuses. Therefore, there is needed to take cognizance of the physical and psychological well-being of these women who are expose to different domestic violence in our society.

The Nigerian Government through the Ministry of Women Affairs needs to pay more attention to issues of gender based violence. More research investigations are also needed in the area of gender based violence in Nigeria. This would help in policy formulation to prevent gender based domestic violence and protect women and children from attendant complications arising from gender based domestic violence. Routine screening of women for domestic violence in clinical facilities that attend to women and children’s health may help in early identification of victims and perpetrators and assessment of the magnitude of the problem in this environment.

References


Evaluation on Awareness and Application of Statistical Process Control (SPC) among Health Practitioners of Rural Tanzania Health Facilities

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Abstract

Background: Statistical process control (SPC) is a collection of tools that when used together can result in process stability and variance reduction in production and services. For effective and efficiency of quality performance, health practitioners must be fully aware of general concept of SPC, its components and how to apply it in their daily work. Health practitioners are the once who will shape the nature of quality of those components to fit the needs and demands of health seekers (customers) through proficient application of SPC in their daily practices. However, different studies reported that, general concept of SPC is unclear to many practitioners and its application does not gratify the needs and demands of those health seekers. The study was aimed at evaluating awareness and application of SPC among rural Tanzania health practitioner.

Method: This article was aimed at evaluating awareness and application of SPC among health practitioners of Rural Tanzania Health Facilities in their daily practices. Non-interventional of cross-sectional explorative method in nature where both quantitative and qualitative data was collected. Thirty five (35) health professionals were conveniently interviewed. Self-administered questionnaires were administered and data was systematically analyzed by excel programs in computer.

Result: The result revealed that, of 35 health parishioners interviewed, (47%) do not completely know the general concept of SPC. On other hand, all (100%) of health practitioners interviewed, had never applied at all SPC in their daily practices. About the tools of SPC, of the 280 required responses, only 22 (8%) indicated that they are aware with check sheet. Few respondents were poorly responded to other recommended tools of SPC. However, there are other forms of SPC tools used in the hospital for quality control. When practitioners were asked on their opinions to apply SPC as way forward to improve their practice in future, a great number (29, 83%) recommended the SPC to be incorporated in clinical practice to improve quality of work.

Conclusion: If properly considered, the result from this mini study will improve efficiencies and effectiveness of performance among health practitioners. The result will also be useful for health facility managers as they will use as a guide for decision making about where improvement and efforts of action to be focused in the first place. However, this study may not sufficiently reflect the real situation of Rural Tanzania Health Facilities as it took place in only one health facility with a very small sample size. For this reason, this study may be a good platform for further study with adequate sample size.

Keyword: Awareness of SPC, standard SPC tools, application of SPC

Introduction

SPC overview

Statistical Process Control (SPC) has been described in many ways by different authors. It is a statistical quality improvement endeavoring to reduce variability in processes and products. Deming W. E., (1950) defines APC as a study to understand different variations in processes and populations. He says, it is interactions among variables in processes and populations during operation that promote effective communication between people for mutual action to reduce these variations in process or population.
Statistical process control is a collection of tools that when used together can result in process stability and variance reduction. As per definition of AHRQ (2013), Dale H. B. et al, (2004) & Shridhara B. K, (2002) in TAU handouts, SPC is a set of statistical methods based on the theory of variation that can be used to make logic of any process or outcome measured over a series of time, normally with the aim of identifying improvement or sustaining a high level of performance. In their Journal of Quality & Safety in Health Care, Benneyan J.C et al (2003) explained SPC as “A philosophy, a strategy, and a set of methods for ongoing improvement of systems, processes and outcomes”. For the idea of this study, it is about data collection, analysis, process thinking, and prevention of defects, stratification, stability, capability, and prediction of outcome. In a different time, SPC was interchangeably used as “statistical quality control or Control Chart”. The control charts indicates both combination of an Upper Control Limit (UCL) and a Lower Control Limit (LCL), specifies the variability due to either natural variations or assignable variations (Russell R. & Taylor W. B., III, 2006).

**Contribution of SPC to the quality improvement**

The overall purposes of SPC depict on the system process control, identify problems in order to make improvements and to contribute in the Total Quality Management (TQM) goal of continuous improvement (Russell R. & Taylor W. B., III 2006). With this platform, the main purpose is to check the process variations and ultimately, to monitor and reduce its occurrence in production or service processes. As it was outline by Walter A. Shewhart in TAU handouts, variation can be due to two possible causes:

- **Common causes (natural variation);** referred to natural, inherent variation that can be reduced without making changes to the process such as improving equipment or using other machines. Such variation is often harmless and it may not need economical or technical efforts to reduce it. Such variation is normally said to be in-control (Marilyn K. H. & Hart R. F., (2007).
- **Special causes (Assignable Variations) in other hand refer to variation caused by external causes such as a broken part of a machine. Such type of causes usually leads to extra unnecessary variation and must therefore be detected and taken away as soon as possible. A process that is not in-control is said to be out-of-control (Madanhire I., Mbohwa C. 2016).

**Statement of problem**

The Statistical Process Control (SPC) as an element of Total Quality Management initiatives was actively pioneered globally in healthcare sectors in around early 1990s for the aim of controlling and managing some preventable hospital errors (Rodriguez N. R and Bucky R., 2010). As it was in other global views, Tanzanian societies define good quality of healthcare in outlook of different components of health facility like good infrastructure, positive practitioners’ approach and adequate availability of services (Russell R. & Taylor W. B., III, 2006). The choice of which health facility to attend is basically predetermined by the background knowledge of healthcare seekers on the quality of those components. On other hand, it is entirely the role of health practitioners to shape the nature of quality of those components to fit the needs and demands of those health seekers (customers) through proficient application of Statistical Process Control in their daily practices (Thor J. et al, 2007 and Madanhire I., Mbohwa C., 2016). However, it has significantly been noted that, in some circumstances and in other health facilities, the general concept of SPC is unclear to many practitioners and its application does not gratify the needs and demands of those health seekers (customers) (Russell R. & Taylor W. B., III, 2006). This situation amuses health seekers undergo through long distance, high costs and physical suffering looking for better quality health service from one facility to another facility. The aim of this article was to evaluation the degree to which health practitioners know and apply the Statistical Process Control in their daily practices in Rural Tanzania Health Facilities.
Significance of study

Statistical Process Control has wider range of significances in healthcare facilities. These studies will possibly going to improves efficiencies and effectiveness of performance in rural health facilities if practitioners would apply SPC as insisted in study by Thor J. et al (2007) and Madanhire I., Mbohwa C. (2016). Secondly, the results from this study may be used by healthcare providers and managers as guides for decision making about where improvement and efforts of action to be focused in the first place. Application of the result of this study would in place the use of SPC in practice by health faculties, and this will reduce in great extent the risks that may occur in hospitals and other healthcare facilities. In the economic view, if these facilities apply SPC, they will reduce unnecessary costs that the facilities may incur due to errors of healthcare practitioners (Thor J. et al 2007). The study also would contribute to the reduction of time required to produce the product or service within health facilities. Article writing is among the course requirement to fulfill my doctoral program.

The study general question

To what extent the health practitioners of Rural Tanzania Health Facilities use statistical process control in their daily practices?

Objectives

To assess an awareness of healthcare practitioners on the general concept of SPC
To identify the presence of standard SPC tools in health facilities of Rural Tanzania Healthcare Facilities
To review the application of SPC tools by the practitioners in Rural Tanzania Healthcare Facilities

Literature review

Statistical process control (SPC) is a compilation of tools that when used jointly can result in process constancy and variance reduction (Marilyn K. H. & Hart R. F., 2007). It is expected to improve outcome of performance in health facility by reducing variability in wider aspects areas. Russell R. & Taylor W. B., III (2006) and Benneyan J.C et al (2003) in their studies said, several hospitals use the database from SPC to classify unusual variability in staff and physician performance, cost of care, and prevent events that affect the outcome of a patients care. As shown in this article, SPC can afterward be used to identify variability due to special causes and hub further review to reduce this variability.

The presentation of Pearson Prentice Hall, (2008), outlined the special causes of variation occurring in processes as the one that can be traced to a specific reason and be corrected with a specific effort. The goal of employing SPC is to determine the assignable causes within a process and eliminate them by incorporate the good once.

Marilyn K. H. & Hart R. F., (2007) said, control charts are the important tools of SPC for continuous quality control. Control charts examine processes to prove how the process is performing and how the practice and abilities are exaggerated by changes to the process. This information is subsequently used to construct quality improvements (Xin D., Wardell D., Rohit V. 2006).

The benefits of SPC application in healthcare facilities are significantly noticed by many authors. Dale H. B. et al, (2004) in TAU handouts and Rodriguez N. R. and Bucky R., (2010), Benneyan J.C et al (2003) demonstrated that SPC has made proper utilization of scared resources within many organizations by reducing waste. The great impact has been observed in reduction of time required to produce the product or service.

Several authors have suggested different tools used in SPC to identify and control any process defect. Among these tools are pareto charts and analysis, cause-and-effect diagrams, frequency histograms, control charts, Scatter diagrams, check Sheet and Graph (Thor J. et al 2007, Madanhrire I., Mbohwa C. 2016, Dale H. B. et al, 2004 in TAU handouts, Rodriguez N. R. and Bucky R., 2010, Benneyan J.C et al, 2003). Many studies have recommended SPC as good device to improve quality

Methodology

The study type

The study design was a Non-interventional of cross-sectional explorative in nature where the extent of SPC general awareness and application has been scrutinized, and both quantitative and qualitative data will be collected.

The study area

One of the healthcare facility in Rural Tanzania was selected, preferably “Haydom Lutheran Hospital”. This is a second level referral regional hospital located in Northern Rural Tanzania with a bed state <500 and <600 staff. Of this number of staff, approximately 7% involves Professional Medical Doctors, 19% occupies Professional Nurses and the rest involves different technicians like Lab tech., Physiotherapists, Radiologists, Pharmacists, Medical Attendants and others. The hospital has all basic medical and nursing departments with its specialty of services.

The study population and sampling method

In this study, all professional staff was presumably supposed to use the SPC tools in their daily work and they were subjects to the study. Non-probability with convenient sampling was employed to approach the study. Nine (9) Medical Doctors, nineteen (19) Nurses, three (3) Lab Tech, two (3) Physiotherapists, two (2) Radiologists and one (1) Pharmacist have been involved in the study. However, availability of other supplementary SPC tools used in the hospital like charts, figures and diagrams was evaluated through interview and observation.

Sampling technique and tools

Self-administered questionnaires were offered for gathering data about general concept of SPC from professional practitioners. Face to face interview was deployed to assess the existing SPC tools. However, observation, photographing and recording have been done to collect data about SPC tools.

Ethical consideration

Permission was sough from Hospital Administration and Management through written letter. Consent has been obtained and the thorough explanation to the participants about the study and their roles in the study has been clearly made. Unethically related issues were debarred. The freedom to or not to participate in the study has been widely discussed to seek for consent. The personalized/identifying information gathered from the study was strictly protected and will remain anonymous.

Limitation to the study

Time Constrain has been experienced from the preparatory phase through the data collection to the presentation phase of the study. A financial limit has significantly impended. Low responsiveness of the participants due to unwillingness to the study was eminently noted.

Data analysis

Data has been analyzed systematically using manual and excel programs in computer. The master sheet has been contracted in the excel program and all data has been entered. The information gathered through quantitative review has manually been analyzed and presented in quantifiable way. Other data collected through observation and photographing has been incorporated though scanning and been presented into graphics and figures.
Results

Demographic data

This chapter summarizes the results of this mini study on the “Evaluation on Awareness and Application of Statistical Process Control (SPC) among Health Practitioners of Rural Tanzania Health Facilities”. The study took place in one of the health facility in Northern Rural Tanzania, and thirty five (35) Health Practitioners were interviewed. Of this number, 17th were nurses, 9 were medical doctors, 3 were lab technicians, 3 were radiology technicians, 2 were physiotherapists and 1 was pharmacist. The study considered various levels of education of participants where 2 of them were certificate, 12 were diploma, 18 were bachelor degree and 2 were masters. The different departments of the facility were involved to see if any of which is applying SPC. Figure 1, 2 and 3 represent the demographic data.

Figure 1. Profession of participants

Figure 2. Educational level of participants
Concept of statistical process control

The study interviewed the knowledge and awareness of health practitioners on the general concept of SPC and its application in their daily work. Of all number thirty five (35) participants who were involved in the study, at least 19 (53%) have ever heard the term SPC in their life. 13 (47%) said they did not completely heard the term SPC before. However, none of them (100%), both who heard and not heard had ever applied SPC in their daily work.

4.3: Source of knowledge on SPC

Participants were asked to sketch their origin of information about SPC. Of all respondent who heard the term SPC, 13 (37%), heard from the schools during their studies. 12 (34%) respondents did not responded to this question. Other respondents hear the term from other different sources as shown in figure 4.

Figure 3. Department involved

Figure 4. Sources for knowledge on SPC
**Tools used in SPC**

The different recommended tools for SPC which are used to control work performance in practices were intervened in this mini study. Check sheet, histogram, pareto chart, cause and effect, scattered diagram, control chart, and graph were assessed for their application. The respondents were given opportunity to respond to all tools as many as they have heard/seen or used in their daily work. There are possible 280 responds if at all they could have responded to all. Of all tools, check sheet was seen to be known to majority of respondents 22 (8%) compare to other tools. This was followed by histogram and graph. However, 194 responds were not attempted. In this study, other tools available in the hospital for controlling quality have been observed. Figure 4 below indicates this result.

![Figure 4](image.png)

**Figure 5.** Tools for SPC (Above)

Examples of other different tools used in the hospital for controlling quality (Below a-d)

![Annual statistic record sheet](image.png)

(a). Annual statistic record sheet.
How practitioners use SPC in their work

The study interviewed the practitioners on how SPC could be used in facility daily work. This question was approached differently by respondents. Some say, it is used in statistical control, others said it is used in controlling patients’ progress; others said it is used in controlling labor progress and few said; is used in controlling equipment and supplies. The figure below emphasis this finding.
Can SPC improve quality of work?

The finding from this question was impressing as majority of respondent responded to agree that SPC improves quality of work if applied promptly. Among 35 participants involved, 30 (86%) said, yes SPC improves quality of work if applied in daily work. Figure 6 indicates the result.

![SPC IMPROVES QUALITY OF WORK](chart.png)

**Figure 6.** The use of SPC

Opinions of Participants on application of SPC

Further dialogues were done to uncover out an opinions of participants on application of SPC as way forward to improve their practice in future. In this particular question, large number of respondents 29 (83%) agreed that SPC has to be commence in clinical practice to improve quality of work. Four (4) respondents among total said they are not sure if it can improve the quality, and the rest did not responded to the question. Figure 7 below indicates the result.

![SPC IMPROVES QUALITY OF WORK](chart.png)

**Figure 7.** Contribution of SPC in quality improvement
Discussion

Concept of statistical process control

The result of this mini study on this aspect of concept of Statistical Process Control shows that, significant number of health parishioners (47%) completely do not know the general concept of SPC. The study on other hand also indicates that all (100%), health practitioners said, they have never applied at all SPC in their daily practices. However, there are other different forms of SPC used by practitioners in the hospital that the practitioners used and they are not aware whether they are form of APC. These forms include partograph, patient treatment sheets, tally sheets, medicine dispensing and supply sheets, etc. However, some of these tools lack recommended standard displayed in SPC like having upper and lower limit. This finding is contrary to the study by Thor J. et al (2007) that says, effective application of SPC which may bring about improvement in quality of care depends on knowledgeable practitioners on SPC aspects. This study says, a knowledgeable practitioner could be able to identify the area of practice that needs to be improved.

Source of knowledge on SPC

After making inquiries on sources of information on SPC among those who have ever heard the SPC, the finding identified that majority 13 (37%), got information from the school they studied. This finding is inline with those of Chou C. S., (2002) that identified several valuable sources where health practitioner could obtain information about SPC. Of the sources, training institutions have been sited as a primary source, followed by working facilities, website and books. However, in this study, large number of respondents, 12 (34%) has not responded to this particular question, perhaps due to the fact that they do not have an idea on SPC.

Tools used in SPC

The study shown that, check sheet was known more by some practitioners compare to other tools. Of the 280 required responds in this study, only 22 (8%) indicated that they are aware of check sheet. Few respondents were poorly responded to other recommended tools of SPC. This responds are poor as different studies recommended in effective application of SPC. Several studies recommend about seven tools used in proper application of SPC which include check sheet, histogram, pareto chart, cause and effect diagram, scatter diagram, control chart and graph (Deming, W. Edward 1950, Rodriguez N. R and Bucky R. 2010, Rami H. F. & Adnan M., 2010, Russell R. & Taylor W. B., III 2006, Dale H. B. et al, 2004). However, when participants were asked to indicate other tools used in
the hospital instead, they specified partograph, patient treatment sheets, tally sheets, medicine dispensing and supply sheets, etc.

**How practitioners use SPC in their work**

When practitioners were asked on how they use SPC in their daily work, majority (25, 71%) responded differently. Some said they used in statistical control, others said it is used in controlling patients’ progress; others said it is used in controlling labor progress and few said; is used in controlling equipment and supplies. These responses are exactly what other studies recommend about the use of SPC in practices (Deming, W. Edward 1950, Rodriguez N. R and Bucky R. 2010, Rami H. F. & Adnan M., 2010, Russell R. & Taylor W. B., III 2006, Dale H. B. et al, 2004).

**Can SPC improves quality of work?**


5.6. Opinions of Participants on application of SPC

When more interviews were carry out to reveal opinions of participants on application of SPC as way forward to improve their practice in future, great number of respondents (29, 83%) recommended that SPC can improve quality of health care and must be incorporated in clinical practice to improve quality of work. This finding also has strongly supported adequate number of studies (Deming, W. Edward 1950, Rodriguez N. R and Bucky R. 2010, Rami H. F. & Adnan M., 2010, Russell R. & Taylor W. B., III 2006, Dale H. B. et al, 2004, Madanhire I., Mbohwa C. 2016, Thor J. et al 2007, Pearson Prentice Hall, 2008).

**Conclusion**

This article aimed at evaluating general knowledge and application of Statistical Process Control among health practitioners of Rural Tanzania Health Facilities in their daily practices. The result from this mini study will improve efficiencies and effectiveness of performance among health practitioners. The result will also be useful for health facility managers as they will use as a guide for decision making about where improvement and efforts of action to be focused in the first place. However, this study may not sufficiently reflect the real situation of Rural Tanzania Health Facilities as it took place in only one health facility with a very small sample size. For this reason, this study may be a good platform for further study with adequate sample size.

**Acknowledgement**

I would like to express my deepest appreciation to all those who in one way or another have contributed to the accomplishment of this article from the formulation of topic through data collection to the report writing. A special gratitude to my family through a lovely Wife H. Kaay for allocating grants and time to accomplish this work. Many thanks to staff and management of Haydom Lutheran Hospital and Haydom School of Nursing for their chivalrous responses during data collection.

Last but not least, the sincere thanks to all Faculties at TAU for their guidance and evaluation of this essay writing.

**References**


Objective: The aim of this study is to develop a model for measuring the impact of broadband on innovations at the institutions of higher learning in Kenya.

Background: Universities in Kenya are investing huge amounts of money on the provision of Broadband internet. However, the extent to which broadband is being utilised in these institutions to spur innovation is not certain. There is need therefore to measure the extend at which broadband internet influences innovations in these institutions in order to assess value for broadband investment.

Methods: The study adopts Porter's Diamond Model to develop the model. The model has four analytical dimensions that form the basis of designing the instruments of data collection. A descriptive study is adopted for the research. Data was collected from existing records, literature review and through interviews. A five-point Likert scale was designed and employed to assess the characteristics and behaviour of broadband consumer responses. Statistical methods were used to test the internal consistency reliability and construct validity of the study variables.

Results: The reliability and validity of the measures and measurement instruments were above the recommended level of 0.70 as an indicator of internal consistency.

Conclusion: Analysis of the structural model showed that the model performed well and was adequate for the study. Since this was a pilot study and the amount of data used was small, a more comprehensive study that incorporates all the 67 universities in Kenya is recommended.

Keywords: Broadband, Innovations, Internet, Education, metrics, model

Introduction

Current development of broadband Internet (BI) access market varies across different sectors and industry in a country. Broadband Internet penetration rates, usability levels and share of different broadband access technologies also vary. Broadband Internet continues to influence every aspect of life including education. Institutions of higher learning are increasingly becoming dependent on broadband Internet for their efficient and effective operation. The rapid deployment of broadband infrastructure is also changing the nature and variety of services and content delivery methods [2]. Broadband Internet access enable e-learning, research, marketing and collaboration. Due to its ability of global reach, the internet is providing people the opportunity to connect to other people with geographical limitations [3]. In essence, BI development affects technological innovation (TI) and competitiveness.

The capacity in which universities utilize BI for innovation is critical for national development and competitiveness. Comparative advanced deployment of broadband Internet in universities in Kenya make universities an important case study for assessing the possible environmental factors that have contributed to Kenya's broadband achievement.

This study assesses the role played by institutions of higher learning in innovation, discusses the factors that influence the development of internet in Kenya and then applies a modified Porter’s diamond model [4] to provide a comparison of broadband-related environmental determinants before finally developing a broadband-based innovation measurability model.
Problem statement

Broadband is an important ICT infrastructure that influences innovation and competitiveness, however, the measurability of these influence is less clear [1]. Although Kenya continues to invest in Broadband Internet (BI), the extent to which broadband is being utilised in institutions of higher learning in Kenya to spur development is not certain. It is therefore necessary to examine and ascertain the level of influence BI has on technological innovations by developing a broadband innovation model. In order to develop the model, it is important to identify the uses of BI for innovation and the extent at which it is used and thereafter determine the factors that influences its use for innovation in institutions of higher learning in Kenya.

Objectives of the research

This research adopts Porter's Diamond Model to assess innovation in higher education sector by analysing five environmental factors related to BI development.

1. To identify the uses of BI for innovation in universities
2. To determine the impact of competition conditions on the use of BI for innovation in universities
3. To determine the impact of advanced factor conditions on the use of BI for innovation in universities
4. To determine the impact of university policy on the use of BI for innovation in universities
5. To determine the impact of collaboration conditions on the use of BI for innovation in universities

Literature review

Assessment of the relationship between BI and Technological Innovation (TI) in institutions of higher learning in Kenya requires a review of several factors. Institutions of higher learning play an important role in TI and competitiveness of the country contributing to economic development. BI provides an important environment for innovation. An understanding of BI development in Kenya and the factors that influence its development is important. Analysis of the measurement model used to assess the relationship between BI and TI is critical.

The role of institutions of higher learning in innovation

Universities are the highest educational institutions that fulfil their mission of research and education to motivate the process of innovation. They are the sources of educated and skilled personnel and new ideas. Through teaching, they disseminate knowledge and improve the stock of human capital [5]. Through research, they extend knowledge and transfer it to the rest of society [6]. They also work with industry to bring about development [7]. Apart from their role in education and science and technology development, universities are expected to turn those scientific developments into useful innovations. There are numerous ways in which universities can be innovative through the use of BI. BI can be utilized in conducting research, education administration, planning and administrative tasks and online learning [8].

The rising interest in the university’s role in innovation is attributed to high profile examples of successful regional economies in which the university has made contribution. The Silicon Valley, the region around Cambridge in the UK and the Boston area are but just a few. The success of companies like Cisco, Google, and Yahoo (grew out of Stanford University research) is attributed to university research.

In the last few years Kenya has invested heavily in broadband internet and emerged as an ICT hub in innovative technologies particularly in the mobile sector. The implementation of mobile money transfer services put Kenya on the world map in technological innovations. The local ICT development groups such as ilab, iHub, nailab, University of Nairobi’s C4Dlab and infoDev’s mlabs set the stage for innovation of applications and information services
such as Drumnet, mfarm, Ushahidi, etc in many sectors of the economy. Over the years, Kenya has been home to multiple African Regional hubs including, IBM’s first African Research lab, Nokia’s Africa Headquarters and Google’s first Sub-Saharan Africa office (outside of South Africa). The Internet has also proven a dynamic tool for stimulating economic growth in developing countries, with the World Bank reporting that a 10% increase in broadband correlates to a 1.38% increase in GDP growth [9].

Factors influencing the development of the internet in Kenya

Before mid 2009, Kenya like the rest of the East African countries relied solely on satellite for internet connectivity and international communication. Through policy and government initiatives, subsequently, the country is connected to the international broadband highway through the SEACOM, TEAMS, EASSY and ILON undersea fibre cables.

Apart from the Government ICT infrastructure, operators in the private sector have been busy developing their own national ICT infrastructure. Particularly, the mobile and data sub-sector has resulted in extensive and aggressive deployment of infrastructure in most parts of the country by the giant telecommunications service providers (orange Telkom, safaricom, airtel and essar). Large data infrastructure operators, including Jamii Telecom, liquid Telcom, access Kenya Group, Wananchi Group, Kenya education network (KeneT), MTn, Internet solutions, amongst others are also busy developing infrastructure. This infrastructure deployment by many operators has resulted to competition leading to a relative reduction of tariffs and increased usage of mobile phones and internet access. By September 2013, there were 31.3 million mobile subscribers and mobile penetration of 76.9 per cent and at the same time, there were 25.1 million mobile money subscribers. The estimated internet users were 19.1 million with 47.1 per 100 inhabitants having access to internet services. International internet bandwidth available was 60,900Mbps of which 41.8 per cent was being utilised [10].

Technological innovation model

Porter’s diamond model is an analytical framework that has been used to study the innovative nature of an industry and its competitiveness while taking into consideration the influencing factors at the national-level [11]. This model has four analytic dimensions that have been applied in analyzing an industry, a cluster/sector, or a nation as a whole. The four dimensions are; advanced factor conditions, context for firm strategy and rivalry, related and supporting industries, and demand conditions. These dimensions are organized in such a way that the degree of interaction amongst them determines the magnitude of national innovativeness.

Evidence from numerous studies demonstrate the application of Porter's diamond to examine competitiveness of various industries. For instance, to determine British local economy’s competitiveness[12], evaluate research performance of various departments of higher education institutions in the UK[13], assess competitiveness of Armenia [14], explore competitive advantage of Irish software industry[15], investigate competitive advantage of Silicon Valley of USA [16] and Chinese automobile industry[17].

Advanced factor conditions

Advanced Factor Conditions (AFC) are resources specific for an industry that are important for its competitiveness. They normally include capital resources, human resources, physical, scientific, technological and infrastructure. Sometimes, an industry creates the factor conditions such human skills, technology, science and innovations. When nations and firms face a challenge such as high land costs, lack of natural resources or labour shortage they tend to innovate and upgrade in order to be competitive. A context for firm strategy and rivalry includes competition between local competitors, openness in business and free trade agreements. This leads to the formulation of the following hypothesis:

H1: Advanced Factor Conditions have a positive influence on BI use for technological innovation in the universities in Kenya
H2: Income, education and gender together influence TI in the universities in Kenya

**Related and supporting industries**

Related and Supporting Industries provide the access energy, communication, transport services, and collaboration. Universities rely heavily on telecommunication networks to deliver educational content and to administer student examinations. Lack of adequate funding is a barrier to adoption and utilization of broadband in education. Although computer availability and ownership rates have steadily increased over the past few years, a significant number of users remain without sufficient computer resources. As a result, many educators have yet to integrate technology into their curricula. Public-private partnership between participating institutions, national government, non-profit organizations may focus on digital literacy, computer manufacturers, and broadband service providers to increase broadband access and usage. Digital media literacy education such as online safety training, discounted desktop, laptop, or other computer devices that can access the internet and discounted home broadband service to institutions and households may help solve some of these problems. Through a national broadband plan, this can ensure that users are technologically literate regardless of their geographical location or disability. On this basis the following hypothesis was created:

H3: Collaboration conditions (COL) have a significant impact on BI use for TI in institutions of higher learning

**Consumer demand conditions**

Demand Conditions concern the demand for products and services that firms produce in the home market. Demand can create pressure to meet high standards, innovate, and respond to tough challenges.

There are numerous uses in which BI is utilized by universities to be innovative. Administrators use BI to deliver tools and services for use by students and educators. Course management platforms are used for the creation of online learning environments and facilitating the administration of education processes. Provision of open content on the Web enables access to educational information. Online learning is made possible through provision of BI. Mobile learning utilizes handheld devices for teaching and learning purposes. BI enables research through access to research material, publication journals and other data repositories. The table below summarises the uses and impacts of BI for innovation purpose.

<table>
<thead>
<tr>
<th>Users</th>
<th>Uses</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educators</td>
<td>Access critical curricular &amp; professional development resources, Participate in professional development, Planning, Web 2.0 tools</td>
<td>Enhanced curricula, Resource sharing, Increased effectiveness, More interactive classrooms</td>
</tr>
<tr>
<td>Administrative purposes</td>
<td>Streamline back office functions, Outsource data processes, Aggregate, store, and analyze student data</td>
<td>Enhanced efficiency in completing tasks, Cost savings by moving to cloud computing, More collaboration</td>
</tr>
<tr>
<td>Students</td>
<td>Gaming, Online learning, Blended learning, Mobile learning</td>
<td>Increased number of learning environments, Enhanced opportunities for disabled students, Personalized instruction, Enhanced learning outcomes and skill development</td>
</tr>
</tbody>
</table>

Source: Charles M. Davidson Michael J. Santorelli. A report to U.S Chamber of commerce 2010 on the impact of broadband on education
This lead to the formulation of the following hypothesis:
H4: Consumer demand conditions (CDC) influence BI use for TI in institutions of higher learning

**Competition conditions**

Competition is healthy in any business environment. It encourages adoption of more sophisticated methods of operation and service delivery in order to have a competitive edge from other business rivalries. Universities compete amongst themselves to increase enrolments in order to improve their capital base. They achieve this by increasing the number of programs they offer as well as improve the quality of services they provide. Competition also arises among technologies and among broadband Internet service providers. Technologies competing for BI provision in Kenya include; satellite, Digital Subscriber Line (DSL), cable mode provision and wireless. Broadband internet service providers operating in Kenya include safaricom, orange Telkom, airtel and essar. Others include Jamii Telecom, liquid Telcom, access Kenya Group, Kenya Education Network (KENET), Wananchi Group, Internet solutions and MTN. Competition brings down the costs of BI, improves BI penetration levels, improves the quality standards of services delivered and improves cooperative governance standards. This has the effect of encouraging foreign investments, better salaries and incentives as well as encourage intellectual property protection laws. This lead to formulation of the following hypothesis:

H5: Competition conditions (CCO) have an impact on BI use for TI in universities in Kenya

**Policy regulatory conditions**

Policy formulation and implementation on the use of BI is the responsibility of the regulatory authorities vested with powers to run institutions in consultation with the national government. Every institution is expected to have an ICT policy document which includes the use of BI for educational purposes. University authority is required to foresee the implementation of this policy to encourage innovation. These institutions can achieve this in many ways. They can improve BI infrastructure through increasing the number of computers, purchasing more broadband and constructing research and teaching laboratory facilities in order to provide access to BI for innovation. To encourage research by investing in research and development as well as provide training for all users. The following research hypothesis came up:

H6: Institution policy (IPO) on BI usability influences TI in institutions of higher learning in Kenya

**Research methodology and data collection**

This research uses a case study of universities in Kenya. The case study approach is appropriate for areas that are unique and require intensive and in-depth study as suggested by [18]. A modified Porter's Model is used to compare the determinants of innovation in education sector. University policy is included in the modified model as a determinant of innovation. University policy is important to support BI infrastructure development and encourage BI use at implementation level. In addition, changes in regulatory policy influences all the factors in Porter's diamond model and at the same time these factors may impact regulatory policy. The diamond model adopted uses education sector as a unit of analysis because firms within a sector practise innovative activities to survive under competitive pressure [19]. University collaborative nature and linkages with other industry players have a strong relationship with competition and innovation. Technological innovation can therefore be considered as a functional relationship between five interactive determinants namely: Consumer/Demand Conditions (CDC), Advanced Factor Conditions (AFC), Competition Conditions (CCO), Collaboration conditions (COL) and Policy regulatory conditions (IPO) at university level. A study conducted by [20], found out that Advanced Factor Conditions
(facilities for research, levels of education, and communication networks) determine sector dynamics to achieve high levels of innovation and competitiveness. BI infrastructure is an influential factor of the level of innovation. It contributes to business expansion, new product development and creativity [21] in addition the collaborative communication network formation provide platforms for exchanging ideas critical to innovation[22].

The Empirical model

To examine influential factors of technological innovation, this study employs a regression model. The study formulated the following regression model:

\[ \ln \text{TII}_i = \beta_0 + \beta_1 \text{CDC}_i + \beta_2 \text{AFC}_i + \beta_3 \text{CCO}_i + \beta_4 \text{IPO}_i + \beta_5 \text{COL}_i + \delta Z_i + \epsilon_i \]

In the model, dependent variable TII is technological innovation in university i in a particular year. Data transformation with logarithm was employed in this regression because the distribution of the dependent variable is rightly skewed. Independent variables used in the proposed research model were consumer demand conditions (CDC), advanced factor conditions (AFC), competition conditions (CCO), collaboration conditions (COL) and institution policy (IPO). \( \beta_0 \) is constant, \( Z_i \) represents university dummies, and \( \epsilon_i \) is the error term.

Measures of proposed determinants of the model

Consumer/Demand conditions

Consumer/demand conditions are determined by quantity and quality aspects of consumer demands[19]. In order to understand consumer demand of broadband internet for TI, this study will utilize BI consumer's characteristics and behaviour.

For this determinant, a survey was conducted to gather quantitative as well behavioural characteristics of BI users. A Likert scale was employed to analyse these categorical data. Principal component analysis was employed to reduce the user demands for BI and arrive at the items that had the greatest impact for this measure.
Advanced factor condition

BI infrastructure, skilled manpower and the number of e-learning programs are measures that can be used to represent advanced factor conditions [19]. BI infrastructure can be measured by finding the internet penetration level, the number of web sites/World Wide Web hosts and the ratio/number of broadband Internet connections among total Internet users. The amount of overall broadband available both fixed and mobile is an indicator that can be used to measure both the potential and extent of access to a wide array of online services. The number of Internet hosts can be used as an indicator to measure Internet infrastructure development[24]. BI literacy levels is an indicator that can be used to represent the level of Internet content development at the intuitional level[25].

Competition conditions

BI competition among broadband service providers at national level affects usability of internet within institutions of higher learning[26]. For this determinant, the study will review competition among competing technologies (mobile, DSL, cable etc) and the competition among broadband Internet service providers. The study will examine the pattern of broadband Internet market share of competing technologies and the top five firms’ ratios as is currently in the market. The study will also review the price of broadband Internet access.

Institutional policies

The study will examine ICT policy documents, government publications, press and marketing research reports to determine how BI related policies and regulation of telecommunication providers influence BI market. A survey study will be conducted among users to identify and determine how institutions encourage and promote the use of BI.

Measurement development

The items used for measurement in this research were either developed based on the literature review, adapted from previously validated measures or derived through consultation with ICT experts to ensure that they are valid and reliable. A five-point Likert scale arranged in order of magnitude was employed to assess responses. A representative sample was randomly chosen and used to conduct a pilot test of the measures. Partial least-squares (PLS) analysis technique was applied to test the measurement model to determine the internal consistency reliability and construct validity of the study variables. The technique was also used to test strength and direction of the relationships between variables used in the model[27] [28]. There are only 67 universities in Kenya which represents a small sample population. Therefore PLS was preferred for the research. PLS is applicable for testing and estimating small sample sizes as it converges quickly even for large models with many variables and constructs[27].

Validation of the measurement scale

In order to assess the reliability and validity of the measures before using them in the research model, the study applied a two-step approach as suggested by[29]. Analysis of the measurement model was conducted first before testing the structural relationships between latent constructs.

\[
\text{Composite Reliability} = \frac{(\sum_{i=1}^{n} x_i)^2}{(\sum_{i=1}^{n} x_i)^2 + (\sum_{i=1}^{n} y_i)} \text{............................................. 2}
\]

\[
\text{Average Variance Expected} = \frac{(\sum_{i=1}^{n} x_i^2)}{n} \text{................................................................. 3}
\]

Where \(x\) is the factor loading, \(y\) is error variance and \(n\) is the number of indicators.
Table 2. Constructs and their psychometric properties

<table>
<thead>
<tr>
<th>Construct</th>
<th>Metric Code</th>
<th>Loading</th>
<th>t-value</th>
<th>Composite reliability</th>
<th>Cronbach's alpha (α)</th>
<th>Average Variance (AV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. AFC</td>
<td>AFC1</td>
<td>0.712</td>
<td>43.824</td>
<td>0.921</td>
<td>0.938</td>
<td>0.671</td>
</tr>
<tr>
<td></td>
<td>AFC2</td>
<td>0.876</td>
<td>44.680</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AFC3</td>
<td>0.860</td>
<td>43.450</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. CDC</td>
<td>CDC1</td>
<td>0.912</td>
<td>32.102</td>
<td>0.985</td>
<td>0.849</td>
<td>0.721</td>
</tr>
<tr>
<td></td>
<td>CDC2</td>
<td>0.812</td>
<td>31.282</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CDC3</td>
<td>0.820</td>
<td>30.231</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. CCO</td>
<td>CCO1</td>
<td>0.850</td>
<td>54.780</td>
<td>0.875</td>
<td>0.875</td>
<td>0.739</td>
</tr>
<tr>
<td></td>
<td>CCO2</td>
<td>0.901</td>
<td>53.910</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CCO3</td>
<td>0.828</td>
<td>60.450</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. CSI</td>
<td>CSI1</td>
<td>0.760</td>
<td>55.940</td>
<td>0.872</td>
<td>0.850</td>
<td>0.715</td>
</tr>
<tr>
<td></td>
<td>CSI2</td>
<td>0.780</td>
<td>54.650</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CSI3</td>
<td>0.980</td>
<td>52.340</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. IPO</td>
<td>IPO1</td>
<td>0.870</td>
<td>44.780</td>
<td>0.880</td>
<td>0.920</td>
<td>0.613</td>
</tr>
<tr>
<td></td>
<td>IPO2</td>
<td>0.750</td>
<td>45.340</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IPO3</td>
<td>0.721</td>
<td>42.581</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2 shows reliability measures above the recommended level of 0.70 as an indicator for adequate internal consistency[30]. Convergent validity is adequate when constructs have an average variance extracted (AVE) of at least 0.5[28] or when items loading on their associated factors are above 0.5[30]. Furthermore, AVE from the construct should be greater than the variance shared between a particular construct and other constructs in the model[31]. Therefore, the constructs used in this study illustrated satisfactory convergent and discriminate validity. Table 3 illustrates the discriminate validity of constructs, with correlation among constructs and the square root of AVE on the diagonal.

Table 3. Constructs and their discriminate validity

<table>
<thead>
<tr>
<th>Constructs</th>
<th>AFC</th>
<th>CDC</th>
<th>CCO</th>
<th>SCI</th>
<th>IPO</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFC</td>
<td>0.819</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDC</td>
<td>0.811</td>
<td>0.849</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCO</td>
<td>0.794</td>
<td>0.493</td>
<td>0.859</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COL</td>
<td>0.668</td>
<td>0.188</td>
<td>0.805</td>
<td>0.846</td>
<td></td>
</tr>
<tr>
<td>IPO</td>
<td>0.802</td>
<td>0.760</td>
<td>0.391</td>
<td>0.322</td>
<td>0.783</td>
</tr>
</tbody>
</table>

Examination of research hypotheses

This section discusses the results of analysing the structural model and the hypotheses formed for each determinant factor. The structural model can be assessed by examining the path coefficients beta weight (β) which illustrates the strength of the relationships between the dependent and independent variables. The model also computes the ($R^2$) value. This value shows the amount of variance explained by each independent variable. Both of this measurement construct and the path coefficients indicate how well the model is performing. The $R^2$ value shows the predictive power of the model which should be interpreted in the same way as $R^2$ in any regression analysis[32] suggests that the path coefficients should be significant and consistent with expectations. Partial Least Squares technique was used to perform the assessment of the research model. Table 4 tabulates the results of statistical analysis of the research.
Table 4. Structural model assessment

<table>
<thead>
<tr>
<th>Hypothesis path</th>
<th>$R^2$</th>
<th>B</th>
<th>p-value</th>
<th>support</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFC $\rightarrow$ TI</td>
<td>0.325</td>
<td>0.425</td>
<td>0.000***</td>
<td>Yes</td>
</tr>
<tr>
<td>Gender $\rightarrow$ TI</td>
<td>0.008</td>
<td>-0.072</td>
<td>0.282</td>
<td>No</td>
</tr>
<tr>
<td>CDC $\rightarrow$ TI</td>
<td>0.053</td>
<td>0.651</td>
<td>0.000***</td>
<td>Yes</td>
</tr>
<tr>
<td>Income $\rightarrow$ TI</td>
<td>0.002</td>
<td>-0.003</td>
<td>0.132</td>
<td>No</td>
</tr>
<tr>
<td>COL $\rightarrow$ TI</td>
<td>0.128</td>
<td>0.753</td>
<td>0.000***</td>
<td>Yes</td>
</tr>
<tr>
<td>CCO $\rightarrow$ TI</td>
<td>0.216</td>
<td>0.352</td>
<td>0.000***</td>
<td>Yes</td>
</tr>
<tr>
<td>IPO $\rightarrow$ TI</td>
<td>0.531</td>
<td>0.426</td>
<td>0.000***</td>
<td>Yes</td>
</tr>
<tr>
<td>Education $\rightarrow$ TI</td>
<td>0.005</td>
<td>-0.082</td>
<td>0.120</td>
<td>no</td>
</tr>
</tbody>
</table>

***level of significance at <0.001

Five variables emerged with significant statistical support. Both AFC and IPO together explain 86% of the variance in TI. Both paths had positive effects, having coefficients of 0.325 and 0.531, respectively. The two determinants had the greatest influence on TI. CDC, COL and CCO had a coefficients of 0.053, 0.128 and 0.216 in that order respectively. The hypotheses that they have a positive impact on TI was also supported. Gender, income and education had negative coefficients and therefore no effect on TI. Hypotheses that income, education and gender influence TI were not supported according to the model.

Discussion of findings and recommendations

Generally, although the five independent variables influenced TI, the amount of variance explained by each individual variable was small. IPO had the greatest impact and explained 53% of TI variance. This shows the strength of policy implication in TI in Kenyan universities. Policies on BI use introduced in Kenyan universities play a very important role in university's capacity to innovate. Most of the universities investigated had ICT policy documents. Some universities had implemented online student results submission and had made it compulsory for all course providers to use this method. For those that did not, there was strong indication and intention to adapt the procedure. In the other determinants with positive impacts on IT, the capacity by which they explained the variance was small. This was an indication that there was a lot more room for improvement. For instance, more broadband was required because the demand outweighed supply. Universities require to purchase more BI to improve both download and upload speeds. The fact that income and level of education did not have any impact may have been as a result of the fact that many users are already literate in BI and the fact that BI purchase is the responsibility of the university. Users may purchase broadband (mostly mobile BI) from time to time depending on their personal use. Otherwise, for official use BI is freely available at the place of work.

Conclusion and recommendations for further research

Generally, this research was a pilot study and the amount of data used was small. This is attributed to the fact that the researcher had no official permit to collect data. Most of the data utilised in the study was collected from a sample of 4 universities. A more comprehensive study that incorporates all the 67 universities in Kenya is recommended.

For CDC determinant measure, the study investigated only the basic user demands for BI for TI. Further research could extend this uses. Universities should improve BI infrastructure in order to increase its usability for purposes of innovation. Collaboration and external linkages with the universities is generally lacking. This is an area where more emphasis could be made to help universities improve their financial capacity to provide more services. In Kenya the demand for higher education far outstrips supply. There is little competition in higher education provision which discourages innovation. The government should increase the number of universities and middle colleges to provide high education to consumers. There is a close relationship between this study and technology adoption studies. Further research could study both the factors that influence BI adoption and link it up with this study.
References

Neuro-V: An all in One Natural Supplement to Improve Nerve Regeneration, Increase Cognitive and Physical Performance and Effects on Neuroprotection

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Abstract

Worldwide, nutritional supplements have been utilized prophylactically, as well as to assist and improve specific diseases and illnesses for decades. Since the U.S. Food and Drug Administration (FDA) does not regulate dietary supplements in the same way that it regulates medicine, dietary supplements can be sold without FDA approval. Neuro-V, a product that was originally developed to improve nerve regeneration in people who suffer from Neuropathy, has a myriad of health benefits that can also protect against oxidative stress as well as improve energy production. The antioxidants and amino acids that were meticulously chosen in Neuro-V (Acetyl L-Carnitine, Alpha Lipoic Acid, N-Acetyl L-Cysteine, Cyanocobalamin (B-12), Pyridoxine HCL (B-6), Folic Acid (B-9) and Grape Seed Extract) have individually been reported and studied to reduce neuropathic pain as well as prevent mitochondrial damage. Although, there are a variety of treatments that essentially provide symptomatic relief for patients who suffer from neuropathy, including non pharmacological, pharmacological and interventional therapies, there is yet to be a supplement that can provide a multitude of benefits and is available worldwide. This paper will discuss the important ingredients of Neuro-V and research that went into specific, efficacious, safe, non-toxic doses that can not only improve nerve regeneration, and increase cognitive and physical performance, but can also be utilized as a supplement for neuroprotection.

Keywords: Neuroprotection, neuropathy, nerve regeneration, Neuro-V, natural supplement, mitochondrial damage

Introduction

Vitamins and antioxidants have often been described as nutritional supplementation that assist the human body to carry out necessary and important physiological processes. Both can be, and have been, used for disease prevention and management. Globally, the use of antioxidants has risen due to the recent studies of linking risk of disease to oxidative stress. Although some antioxidants (e.g., vitamin C and E) may also be characterized as vitamins, antioxidants provide distinctive benefits. While vitamin supplementation has been utilized daily in order to avoid deficiencies which can impair the body’s ability to heal and protect itself, antioxidant supplementation can play a vital role in protecting cellular damage caused by free radicals (Lobo et al2010). Antioxidants such as alpha lipoic acid, acetyl-l-carnitine and B vitamins have been shown not only to prevent cellular damage, but assist in neurological function, DNA synthesis and neuroprotection (Grober et al 2013). Although most diseases may be idiopathic in nature, oxidative stress or nutritional deficiencies may play an important role. Peripheral neuropathy, a disorder where nerves are damaged, has been linked to both oxidative stress and nutritional deficiency. Although there are medications that are FDA approved for neuropathy, no single treatment exists to prevent or reverse neuropathic changes or to provide total pain relief (Javed et al 2015). Because of limited pharmacological treatments for nerve regeneration, proposed pathogenic treatments including antioxidants and nutritional supplements, have been utilized and studied in neuropathy. Although there are several nutritional supplements that are taken daily prophylactically or utilized for disease progression or management globally, unlike drugs, they are not intended
to treat, diagnose, prevent, or cure diseases. In the United States, the Food and Drug Administration (FDA) is not required to review dietary supplement products for safety and effectiveness before they are marketed; therefore, supplements are not allowed to make specific efficacious claims. Since the FDA is not required to review dietary supplementation, many supplements have been manufactured by companies and immediately have gone to market without any clinical trial review. Neuro-V, a nutritional supplement that was originally created to ameliorate the signs and symptoms of neuropathy, has been on the market since 2010. Although this product was never studied in clinical trials and data is limited, it has the potential to not only repair damaged nerves, but also has the potential to protect against oxidative stress and improve energy production. This manuscript will discuss the formulation of Neuro-V and why it could be utilized prophylactically as well as for disease prevention and management.

Neuropathy treatment

In the United States alone, about 20 million people suffer from peripheral neuropathy, a condition in which a person suffers from peripheral nerve damage often associated with an underlying disease. Neuropathy is a global health problem affecting different major systems, and in many cases, impaired nerve function can be restored to some degree, even if there is no known cure. It can be triggered by disparate causes such as diabetes, alcoholism, certain chemotherapy medications, traumatic injuries, infections, metabolic disorders, toxin exposure, vitamin deficiencies and other unknown reasons (NINDS, 2012). Since every nerve in the peripheral system has a specific function, symptoms are dependent on the type of nerves that are affected. Symptoms can vary from numbness or tingling, to pricking sensations (paresthesia), pain or muscle weakness and may often be difficult to control due to sensory nerve damage (NINDS 2016). While scientific advances have been constructed in understanding pathophysiology, the impact on the clinical care of patients has been minimal, aside from symptomatic treatments that mask the pain. Pharmacologic and nonpharmacological interventions are available for the treatment of painful neuropathy; however, there are limited clinical trials comparing these therapeutic approaches, making it difficult to discern which treatment strategy is the most effective. Several different therapies have been utilized to reduce the horrific symptoms that occur with peripheral neuropathy; however, most are either non-efficacious or have adverse effects, which presents challenges to treating clinicians. Opioids, anticonvulsants, antidepressants, nonsteroidal anti-inflammatory drugs, and topical agents have been used with only limited success in mitigating symptoms (Vanotti et al 2007). Analgesics such as aspirin or ibuprofen are often utilized for painful neuropathy; however, they are typically ineffective against neuropathy pain, since effective treatment often involves medications that target more of the nerve cells (University of Utah, 2006). FDA approved antidepressants and anticonvulsants such as Duloxetine hydrochloride (Cymbalta) or Pregabalin (Lyrica) have been shown to ameliorate and minimize pain (Boyle, Erickson et.al, 2012); however, these medications typically do not improve the underlying nerve damage. Other anticonvulsants such as gabapentin (Neurontin) and topiramate (Topamax) and antidepressants such as amitriptyline (Elavil) which are not approved by the FDA to treat neuropathy, are often prescribed to treat this condition; however have unpleasant side effects. (Chong et al 2003). While pharmacologics have demonstrated pain relief, the majority of these medications used to treat neuropathy have several side effects which can decrease quality of life and cause additional health issues. Therefore, guidelines from national organizations such as the American Academy of Neurology, recommend the use of a broader range of medications (Bril et al 2011) as well as suggest therapy duration should be regulated and titrated based on regular patient feedback regarding pain relief, improved function, and adverse effects (Spallone et al 2012).

Additional treatments such as topical creams, special diets, surgical decompression, specific therapies that stimulate the nervous system and nutritional supplements have also been utilized as adjunctive therapy. Since diabetic neuropathy, a form of
peripheral neuropathy, has been linked to oxidative stress, many antioxidants have occupied the mainstream in the search for an efficient and efficacious treatment of nerve dysfunction in diabetes within the past decade (Oyenihi et al. 2015). In fact, there is an increasingly large number of antioxidants and antioxidant-mimicking agents have been tested in vivo and in vitro in animal experimental models (Coppey et al. 2003). Currently, due to FDA requirements, there has not been an antioxidant treatment that has been approved by the United States Food and Drug Administration for peripheral neuropathy; however, alpha-lipoic acid has been approved for neuropathy treatment in some European countries (Ziegler et al. 2011). Acetyl-L-carnitine and B vitamins have also been shown to not only improve nerve function but are neuroprotective and improve cognitive and physical performance. There is a growing need for studies to evaluate the most potent drugs or combinations for the management of peripheral neuropathy to maximize pain relief and improve quality of life. There has yet to be a supplement that can possibly ameliorate pain and neuropathy symptoms as well as provide additional benefits, therefore, there is still an unmet need for an all-encompassing product.

Non-pharmacologic treatments for neuropathy

Acetyl-L-Carnitine

Acetyl-L-carnitine (ALC), a naturally occurring amino acid, has been studied for the last decade and may even be considered an ideal therapeutic agent to address symptoms associated with neuropathy. Several studies have shown that ALC reduces neuron pain five times better than a placebo (De Grandis 2002). Not only has ALC been shown to be potentially effective at preventing peripheral neuropathy, but it has also been shown to lessen neuropathic symptoms, help regenerate nerves and even facilitate nerve regeneration (Fernandez et al. 1997). In two related studies of diabetic nerve degeneration and neuropathy, acetyl-L-carnitine was shown to support nerve regeneration after experimental injury. (Nakamura J et al. 1998 and Soneru IL et al. 1997). In the January 2005 issue of the American Diabetes Association journal, it was revealed that acetyl-L-carnitine (at 500-1000 mg TID) not only improves the symptoms of diabetic neuropathy, but also helps regenerate nerve fibers and vibration perception. In addition to nerve regeneration, ALC has also been known to reduce oxidative stress as illustrated in both animal and human studies, demonstrating the neuroprotective and antinociceptive effects of ALC. (Chiechio et al. 2006). In one study Acetyl-L-carnitine was shown to have significant neuro-protective affect against the degeneration of traumatized motor-neurons (Natural Alternatives International, January 2006). These observations prompted scientists to postulate a better hypotheses concerning motor-neuron regeneration and even the possibility of inducing neuronal proliferation. ALC may also prevent neural degeneration related to aging in the brain through the preservation of the neurotrophic, nerve growth factor (NGF) (Piovesan et al. 1994). These actions of ALC have been known for decades and account for the use of ALC as an antiaging or memory-supportive nutrient. In addition, ALC has been studied and well tolerated at 1,500 to 3,000 mg per day without significant risk of side effects or drug-nutrient interactions (Kaczor 2010). It is a well-researched and excellent primary nutrient for nerve support as well as a neuroprotectant by inhibiting the apoptotic pathways within nerves. This is an amino acid which is often used to treat a range of illnesses including Alzheimer’s disease, diabetic neuropathy and other forms of neuropathy. Given the level of evidence of ALC’s therapeutic effects on various types of neuropathy combined with its lack of toxicity, ALC has the potential to dramatically affect the quality of life of patients with peripheral neuropathy, as well as act as a neuroprotectant, and improve cognition.

Alpha lipoic acid

Alpha lipoic acid (ALC) is a potent antioxidant that works both in water and fatty tissue, which enables it to enter all parts of the nerve cell and protect the cell from damage (Rayman 2007). It has been known to rapidly and significantly reduce sensory symptoms and pain in
diabetic neuropathy, according to the results of a double-blind trial reported in Diabetes Care (Diabetes Care 2006) other clinical trials have studied the use of alpha-lipoic acid for diabetic complications with limited side effects. A meta-analysis conducted in Germany including 1,258 patients with polyneuropathy to determine the efficacy and dose-response effects of oral alpha-lipoic acid by studying daily doses of 600 mg, 1,200 mg and 1,800 mg. (Ziegler et al 2006). This study demonstrated a decrease in scores for pain in all three treatment groups, and concluded that the improvement of symptoms although were not dose-dependent, were dose dependent for adverse events. While there were limitations to this study, ALC was found to ameliorate symptoms of polyneuropathy, suggesting an improvement in microvascular blood flow to nerves facilitated by the antioxidant effects of the drug (Negre-Salvayre et al 2008). This study, along with others, demonstrated promising results in oral dosing of 600 mg daily in alleviation symptoms associated with peripheral neuropathy with no serious adverse events. Alpha Lipoic Acid has also been shown to influence biologic functions and act to directly seek reactive oxidative stress (ROS) (Rayman 2007), as well as be effective in a variety of pathologic conditions, especially those that are associated with oxidative stress. As an antioxidant, ALA serves to attack free radicals that are unstable and highly reactive molecules that cause damage to cells. This is advantageous since damaged cells can lead to a number of diseases such as cancer, cardiovascular diseases, and age-related diseases (Khansari et al 2009). Other studies have shown that alpha lipoic acid prevents mitochondrial damage in chemotherapy induced neurotoxicity in sensory neurons, as well as increases one’s mental and physical energy while posing some benefits to a number of medical conditions (Mellie 2009). This is because ALA plays a role in our body’s Krebs cycle which essentially refers to a series of chemical reactions associated with the production of energy through the oxidation. It is one such endogenously produced molecule that researchers have shown to be a scavenger of certain free radicals and a recycler of other antioxidants (Ragothama et al 2015). ALA crosses the blood-brain barrier with ease and since it has antioxidant and energy production benefits, it could also positively influence and assist with cognitive and physical performance. Because of many mechanisms ALA possesses, it will not only work prophylactically, but it can be neuroprotective as well as ameliorate symptoms of neuropathy, and assist with cognitive and physical performance.

B Vitamins: B6, B9, B12

The vitamin B complex is a group of water soluble compounds that differ in chemical structure and biological action, as well as function as intermediary metabolic pathways for energy production and blood cell formation (Gröber U, Kisters K, Schmidt J., 2013). One of the main causes for nerve pain, numbness, tingling, and chronic neuropathy is deficiencies in Vitamin B12 and B6; therefore, supplementing with B-vitamins could alleviate many of the symptoms associated with peripheral neuropathy. Vitamin B12 supplementation has been used to treat many diseases, as well as improve memory, and act has a neuronal protection including promoting injured nerves and axonal regeneration (Zhang et al 2013). It has also been shown to have possible analgesic effects on neuropathic pain in clinical studies (Tankaka 2013). In animal studies, it has been demonstrated that that Vitamin B12 can extenuate nerve damage caused by neuropathy by activating a chemical signal, which helps nerves to regenerate (Zhang et al 2013). In clinical studies, the combination of Vitamin B12, B9 andB6 (methylcobalmin, folic acid and pyridoxal) have been found to improve symptoms and maintain the health of nerves in the extremities as well as treat neuropathic symptoms (Fratoni et al 2015). Vitamin B9, better known as folate or folic acid, has been known to be a key nutrient in mitochondria function, as well as lead to improved functioning of nerves (Halstad et al 2002). Folic acid exhibits efficient free radical scavenging activity (comparable to that of vitamin C and E) in a number of laboratory studies (Person et al 2013). In rats exposed to arsenic, folic acid supplementation was able to mitigate DNA and mitochondrial damage by suppressing oxidative biomarkers and increasing antioxidant enzyme activity (Person et al 2013). Besides being extremely advantageous and efficacious in nerve pain and
regeneration, B12, B9 and B6 in collation, have been shown to slow the progression of brain atrophy and increased cognitive performance. A recent randomized and double-blind interventional study (VITACOG study) involving 168 elderly persons with mild cognitive impairment, were given supplementation of Vitamin B12 (500 p, g/day, p.o.), folic acid (0.8 mg/day, p.o.) and vitamin B6 (20 mg/day, p.o.) over a 2 year period (de Jager et al 2012). Data illustrated supplementation slowed the progression of brain atrophy and the reduction of cognitive performance by 53.3%, compared with the placebo group. The accelerated rate of brain atrophy in elderly with mild cognitive impairment can be slowed by treatment with B vitamins (Aisen 2013) Because Vitamin B12, folic acid (B9) and vitamin B6 lower homocysteine, which directly leads to a decrease in gray matter atrophy, this B-complex in combination can slow cognitive decline (Durga et al 2007). Not only can vitamin B deficiencies damage nerves, but supplementing them in combination can improve and repair nerve damage, as well as provide neuroprotection and improve cognitive performance.

N-Acetylcycteine

N-acetylcycteine (NAC), widely known as an antidote to acetaminophen overdose, is now emerging as treatment of vascular and nonvascular neurological disorders. NAC as a precursor to the antioxidant glutathione modulates glutamatergic, neurotrophic, and inflammatory pathways. N Acetylcycteine has shown to be efficacious in alleviating pain symptoms as well as improve nerve fiber regeneration (Kelley, 1998), as well as produce the body’s most powerful antioxidant(glutathione) to detoxify the body. In addition to reducing toxicity in the body, it’s essential to address other root causes of peripheral neuropathy such as inflammation, viruses, and oxidation (Holmay et al 2013). Supplementing with NAC might help treat the symptoms of neuropathy; it functions as a potent antioxidant as well as increasing the potential of naturally occurring antioxidants in the body like glutathione. NAC has been tested in some murine models of Alzheimer’s Disease (AD), and these studies provided supportive evidence that administration of NAC blocks oxidative damage in AD (Tchantchou et al 2005; Tucker et al 2005). NAC has a broad spectrum of actions and possible applications across multiple diseases. In addition, NAC protects the nerves from oxidative stress and damage and can also be considered a neuroprotectant.

Grape seed extract

Grape Seed Extract (GSE) has been known to provide extraordinary amounts of antioxidant protection. It’s derivative, proanthocyanidin, has been shown to prevent and repair capillary damage, as well as contain up to 50 times more protection against oxidants than vitamin E and vitamin C. Since it is clinically shown that not only does Grape Seed extract contains more protection then Vitamin C and Vitamin E, but that it remains in the body for up to three days unlike Vitamins C and E which are excreted quickly (General Health, 2008). GSE is thought to help with circulatory disorders, as well as help promote circulation and protection against free radical protection. In an animal model of diabetes, proanthocyanidins improved the speed of conduction in motor nerves and modulate pain sensation, as well as decreased the loss of the protective sheath known as myelin, which surrounds nerves (Ono et al 2008). Not only do proanthocyanidins help prevent and repair nerve damage, but they are compounds that help prevent cognitive decline and may actually boost cognitive function (Ono et al 2008). In addition, they decreased the production of AGEs, which suggests they also decreased the oxidative damage to the nerves that occurs as part of diabetic neuropathy (Cui 2008). Even though further studies need to be conducted, because of its properties, it can repair nerve damage as well as be one of the most effective steps toward preventing cognitive loss due to aging (Asha 2011).

Neuro-V

As previous research has demonstrated, nutritional support can play imperative roles in preventing and protecting nerves from injury and neuropathy. Neuro-V, a unique compound
originated by NeuroVitality, was meticulously created with specific vitamins and antioxidants that have been clinically studied and shown to be safe and effective. As previously discussed, Acetyl-L-Carnitine has been shown to improve the symptoms of peripheral neuropathy and promote nerve regeneration. The safest, most effective, doses have been studied at 1200 to 1500 mg/day, with insignificant side effects reported at 1200mg/day. Other studies have demonstrated that alpha lipoic acid and Acetyl-L-Carnitine amalgamated, have been shown to improve pain and rejuvenate nerves with ALA doses at 300 to 600mg/day (Ranieri 2009). Both ALA and Acetyl L-Carnitine are powerful antioxidants and neuroprotectants, and together, have been known to increase energy levels. Other studies and specific supplements contain high doses of B vitamins and have demonstrated that a B complex could be an effective treatment for painful neuropathy. Dosing at high doses of B12, and B9 is generally innocuous as they are eliminated in the urine as well as few known side effects are seen with doses based on the recommended daily requirement. Too much B6 supplementation can actually exacerbate neuropathy symptoms; therefore a safe, low dose of 1.5 mg is comprised in Neuro-V. Grape Seed Extract and NAC have also been studied in neuropathy and have shown to be effective at different doses without side effects. Only 25mg of GSE is included in Neuro-V, because it is possible high doses may interfere with Neurontin. In creating a supplement, combining proper supplements can yield better and more powerful results. Because all of the ingredients in Neuro-V have been studied individually, at different doses, only the most efficacious and safest doses were used in creating such a product. While creating Neuro-V, not only was efficacy intently studied, but safety was as well. Although all of the ingredients that make up Neuro-V are natural, they have not been FDA approved for neuropathy and long term effects are unknown. However, since conception in 2010, and over 400 customers, little side effects have been reported.

Methods

Neuro-V was created after extensive research was conducted on neuropathy patients at a private neurology practice. Twenty-four patients who suffered from either small fiber or peripheral neuropathy who experienced pain, paresthesia and numbness, were given a 1 month supply of Neuro-V (120 capsules). The majority of patients were on concomitant anticonvulsant or analgesics. Patients who were on vitamin B12 or B6 supplementation, were asked to stop prior to taking Neuro-V. The Brief Pain Inventory (short form) Scale was administered to patients at baseline, and then again at their next monthly clinic visit. Patients were asked to take 4 capsules a day for one month and were asked to rate their pain on a Visual Analog Scale prior to starting and then again after 1 month after being treated with Neuro-V. Patients were asked to record any change or any adverse effects they may have experienced during their treatment. Because this was not an Institutional Review Board (IRB) approved study, patients did not sign a consent and no standard study procedures were completed. Patients volunteered to try a nutritional supplement for one month and were advised they could abate treatment for any reason at any time. All patients were monitored carefully and all vitamins that patients take for neuropathy were reviewed and possibly abated prior to taking Neuro-V to prevent adverse reactions to the supplement. Because this was a nutritional supplement with only ingredients that have been studied and known to not have any significant risk, per the Dietary Supplement Health and Education Act (DSHEA) it was not required to be tested in clinical trials.

Results

In patients who had peripheral neuropathy (N=18), there was a significant improvement in rating current pain. Sixty-five percent of patients who had a six or higher on this scale at baseline, rated their current pain to be a 3 or a 4. Three out of the four patients with small fiber neuropathy, who had mostly complained of tingling, or burning, dropped 4 points on the pain scale and their visual analog scale scoring significantly improved as well. Unfortunately the two patients who had severe diabetic neuropathy experienced no change in pain in one
month of treatment. Side effects were only seen in 7% of the patients (N=2) who experienced mild abdominal discomfort for the first two weeks of taking the supplement; however, diminished by week 3 and abated by week 4. After one month of treatment, 22 out of the 24 patients opted to continue to take Neuro-V and 17 out of the original 24 patients are still taking it daily for their neuropathy. Thirteen out of the 17 patients have stated that once they stopped it, their pain increased or returned back to baseline, so they continually take it daily to avoid pain and discomfort. Two patients stated Neuro-V completely cured their neuropathic pain and symptoms after 6 months of use. The remaining 2 patients have never stopped taking it due to how well they have felt and fear to discontinue.

Discussion

When approved therapeutic options fail to alleviate the pain associated with peripheral neuropathy, the use of antioxidants should be considered as a supplement. As this article previously discussed, antioxidant drugs can prevent the onset of pathologies, as well as delay pathologic processes or play a role in repair. Conversely, research on antioxidant drugs and research related to oxidative disease processes have not converged into a therapeutic intervention in which it is first or even line after pharmacological agents. Even with such controversies, there have been numerous studies of individual nutritional supplements in the treatment of patients with painful peripheral neuropathies. These as well as over the counter natural supplements that are heavily vitamin B focused, or may be alpha lipoic acid or Acetylcarnitine specific, have been studied in well-designed placebo controlled trials and shown to have efficacy in improving both symptoms and some measures of nerve function. In clinical practice however, prescribing an individual supplement has not often met with much success, or suggesting a product that contained a compilation of 7 antioxidants and vitamins at safe, efficacious doses was non-existent. With that being said, a unique combination of 1.5mg of Pyridoxine Hal, 1mg of cyanocobalamin, 800mcg of Folic Acid, 1500mg of Acetyl-L-Carnitine, 600mg of Alpha Lipoic Acid, 300mg of N-Acetyl Cysteine, and 25mg of Grape Seed Extract was created by Neuro Vitality. Creating a multi-faceted product was originated for the purpose of maximizing nutritional supplement potential, yield more positive effects, as well as eliminate or minimize the side effects. This unique compound of nutritional supplements was created in hope to not only alleviate the symptoms seen with painful neuropathies but also rejuvenate nerves in those who suffer from neuropathy. Because each ingredient in Neuro-V has shown some form of additional benefit, Neuro-V could be used as a prophylactic for individuals to improve and assist in cognitive and physical performance, as well as act as a neuroprotective.

Conclusion

Although there are medications that are FDA approved for neuropathy, and other disorders, no single treatment exists to prevent or reverse neuropathic changes or to provide total pain relief. Because of limited pharmacological treatments for nerve regeneration, proposed pathogenic treatments including antioxidants and nutritional supplements, have been studied and utilized worldwide. As aforementioned, antioxidants and vitamins, although not FDA approved for disease prevention or management, may have a myriad of benefits. To date, several nutritional supplements are taken daily prophylactically or utilized for disease progression or management globally, including Neuro-V. This original study on Neuro-V was conducted in 2010, since then, over 400 people have been taking Neuro-V for nerve damage. Although hundreds of people have taken Neuro-V and the majority continue to take it daily, data is limited due to lack of clinical trials. In order to determine true efficacy, randomized clinical trials would be in order. Another limiting factor is lack of marketing. Although Neuro-V has been on the market for 6 years, and is sold globally online, additional marketing to expand and grow the product is needed. Recently, marketing has expanded and has been promoted in high school athletes for cognitive and physical performance as well as prophylactically for neuroprotection. Because the ingredients in Neuro-V have the ability to
also improve cognitive impairment, it has also been marketed to patients with dementia and other memory issues. Further studies are needed in order to determine true efficacy, and asking your physician prior to starting any new drug or supplement is recommended. In conclusion, given the level of evidence of the individual ingredients’ therapeutic effects on various types of neuropathy combined with its lack of toxicity, Neuro-V has the potential to dramatically affect the quality of life of patients with peripheral neuropathy, as well as act as a neuroprotectant, and possibly improve cognitive impairment.

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Enhanced Simplified Symmetric Key Encryption Algorithm

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Abstract

Data has become very important not only for individuals but for organizations as well. Data security is the biggest challenge that we care facing currently. Recent successful hacks and data breaches have certainly played an important role in the development of data security related technologies.

Cryptography is a well adopted method to ensure that data is secure and confidentiality of user data is maintained.

The content owner encrypts the actual data using an encryption key which converts the data into cipher text. The cipher text is an intermediate data which is unreadable form which can be shared amount other users and can be stored in the various storage media.

The cipher text can be converted into the actual data using the same encryption key in case of symmetric key encryption or using different key in case of asymmetric key encryption.

Currently, the Encryption/Decryption algorithms that exist depend on complex mathematical manipulations. The length of the encryption keys are growing and growing to get more secure and more stronger encryption thus processing throughput and memory consumption requirement is also growing.

In this work researchers are focusing on various symmetric key encryption throughput and memory consumption with proposed high speed new algorithm which can be useful for the devices with low memory and processing capabilities. The work sought the possibility to trim down the complicated throughput of symmetric cryptography and ensuring maximum security at the same time.

Keywords: Cryptography, Algorithms, Authentication, Cipher text, Complex Mathematical Manipulations, Encryption, Decryption, Symmetric Key.

Introduction

We are living in cyber age where data and information is the biggest wealth. Our personal, professional and organizations data is available in the devices which are connected with the Internet. Data Hacks and threats in computer networks are growing day by day which demands more security (Shrivas, Dr. Amoako, Boateng, & Dr. Yeboah, 2015) and reduction in both the time for data transmission and the space requirement for data storage. This can be achieved by encryption and compression, such kind of system is called compression-crypto system.

Cryptography is powerful tool which provides authenticity, privacy, integrity, and limited access to data. For the reason that networks often involve even greater risks, data is often secured with encryption, plausibly in combination with other controls. The content owner encrypts the actual data using an encryption key which converts the data into cipher text. The cipher text is an intermediate
data which is unreadable form which can be shared amount other users and can be stored in the various storage media (Shrivas & Singh, ICMCT, 2015).

The cipher text can be converted into the actual data using the same encryption key in case of symmetric key encryption or using different key in case of asymmetric key encryption.

The most significant type of cryptography is the symmetric key encryption. In the symmetric key encryption, encryption and decryption process both uses the same key thus key should be private to avoid any data breaches. Symmetric key algorithms are high speed and do not consume too much of computing resources. Although there are scope of improvement, thus in this work researchers are focusing on various symmetric key encryption algorithms like Data Encryption Standard (DES), Triple Data Encryption Standard (DES), Advanced Encryption Standard (AES), Blowfish (Shrivas & Singh, IJICTM, 2014), etc. and their throughputs and memory consumptions and proposing high speed new Enhanced Simplified Symmetric Key Encryption Algorithm (in short authors are going to call it proposed algorithm subsequently) which can be useful for the devices with low memory and processing capabilities. The work sought the possibility to trim down the complicated throughput of symmetric cryptography and ensuring maximum security at the same time.

Objectives of the study

• To make data encryption algorithms simple but difficult to cryptanalysis.
• To analysis the three main symmetric-key cryptography schemes: DES, AES and Blowfish, and come out with new cryptographic algorithms.
• To strengthen confidentiality, authenticity, integrity, availability and identification of user data and information in networks.
• To minimize complex mathematical manipulations of these algorithms.

Research questions

• Is it possible to reduce the complexity of algorithms mathematical manipulations and still ensure maximum security?
• Can the new encryption algorithms design and implementation to enhance performance?
• How effective is an algorithm using variable key length vary from 65 bytes to 72 bytes of symmetric key technique for encryption and decryption of data?
• Can the proposed Algorithm be comparable to DES, Triple-DES, Blowfish and AES?

Significance of the study

Data security in these contemporary times is a must. For your secrets to be secure, it may be essential to attach fortifications not afford by your computer operating systems. The incorporated fortifications may be sufficient in some cases. If no individual ever attempts to break into or pilfer data from a particular computer, its data will be secured. Otherwise if the impostor has not learned how to get around the simple default mechanisms, they are sufficient. Nevertheless many invaders do have the skills and resources to break various security systems. If you make your mind up to do nothing and hope that no skilled cracker targets your information, you may be fortunate, and nothing horrific will happen.

Data Encryption is one of the imperative tools for protecting data from an unauthorized access, any of various methods that are used to turn readable files into gobbledygook. Even if an attacker obtains the contents of the file, it is twaddle. It does not matter whether or not the operating system protections functioned.

Scope of the study

There are two type of Cryptography, Symmetric and Asymmetric which include encryption and decryption process. The scope of this study is limited to the symmetric key cryptographic scheme the algorithms considered in the study include: DES, Triple-DES, AES and Blowfish.
Literature review

The history and background of encryption algorithms should bring into being a clearer understanding for the need of complex mathematical computation for these algorithms for security.

The next part of this review will look at other previous work to serve as empirical evidence in other to have a platform to build upon this work.

Finally, this review will look at the more specific encryption techniques known as the AES, DES, Triple DES and Blowfish. Following this, the investigation has been expanded to search for Enhanced Simplified Symmetric Key Encryption Algorithm that can serve the same purpose those in existence.

Categorization of the cryptographic algorithms

The encryption algorithms are basically classified into two types based on the keys used for the encryption; these are the Symmetric and Asymmetric key encryption (Shrivas & Singh, IJICTM, 2014).

Asymmetric key encryption is the technique in which the keys are different for the encryption and the decryption process. They are also known as the public key encryption. One of these keys is published or public and the other is kept private. Diffie-Hellman key agreement algorithm, Rivest Shamir Adleman (RSA), Elliptic Curve Cryptography (ECC), El Gamal and Digital Signature Algorithm (DSA) are most popular asymmetric algorithms (Ahmad, Alam, Rahman, & Tamura, 2015).

Symmetric-key algorithms are a class of algorithms for cryptography that use pettily related cryptographic keys for both decryption and encryption. Typical symmetric encryption algorithms include DES, Triple DES, RC2, RC5, Twofish, Blowfish, IDEA and AES (Shrivas & Singh, IJICTM, 2014). Most symmetric algorithms can operate in two modes, namely Cipher Block Chaining Mode (CBC) or Electronic Codebook Mode (ECB) (Klinc, Hazay, Jagmohan, Krawczyk, & Rabin, 2012).

The Symmetric-key ciphers are split into categories, such as Permutation Ciphers, Transposition Ciphers and Substitution Ciphers. There exists other, but also combinations of the above. The main symmetric-key cryptography schemes include DES, AES and Blowfish1. (Anonov A., Gounelas F., and Kauppila J., 2006) put forth the algorithms of DES, Triple DES, AES and Blowfish as stated below:

Data encryption standard

DES was the result of a research project set up by International Business Machines (IBM) Corporation in the late 1960’s which resulted in a cipher known as LUCIFER. In the early 1970’s it was decided to commercialize LUCIFER and a number of significant changes were introduced.

As stated in (Shah K. R., March, 2012), the DES was published by the United States’ National Bureau of Standards in January 1977 as an algorithm to be used for unclassified data (information not concerned with national security).

(Mandar M. K., March 2013), affirm that from 2001 the AES will replace DES. After 25 years of analysis, the only security problem with DES found is that its key length is too short. DES uses a 56 bit key which can be broken using brute force methods, & is now considered to be insecure for many application. It was acknowledged that DES was not secure as a result of advancement in processing power computer. From (Sharma, 2010), the purpose of NIST was to define a replacement for DES that can be used in non-military information security applications by US government agencies.

(Yogesh K., Oct 2011), stated that the DES algorithm is vulnerable to Linear Cryptanalysis attacks. By such an attack, the algorithm in its sixteen rounds can be broken using $2^{44}$ plaintexts. This vulnerability raises a notable risk when encrypting bulk data that may be predictable with keys that are constant.

1 Cryptography by A. Antonov, F. Gounelas, J. Kauppila, June 13, 2006
The DES algorithm

The Data Encryption Standard (DES), as specified in FIPS Publication 46-3, is a block cipher operating on 64-bit data blocks with key length 56 bits the straightforward "work factor" of the algorithm is $2^{56}$ (i.e., the number of keys that would have to be tried is $2^{56}$ or approximately $7.6 \times 10^{16}$). From (Vikendra S., (2013))

1. Input plain text $A = \{}$
2. Divide $A$ into $n$ blocks of 64 bits.
3. For each blocks $I = 0$ to $n-1$
4. Calculate initial permutation $IP$ and
5. Divided into two parts
6. $L_0 \leftarrow$ left sub part
7. $R_0 \leftarrow$ right sub part
8. Round $i$ have inputs $L_{i-1}, R_{i-1}$
9. Output will be
   $L_i = R_{i-1}, R_i = L_{i-1} \oplus f(R_{i-1}, K_i)$
10. $K_i$ is the sub key for the $i$th round, where $1 \leq i \leq 16$.
11. After round 16, Swap $L0$ and $R0$ (so that the decryption algorithm has the same structure as the encryption algorithm.)
12. Finally, compute $IP^{-1}$
13. Output = cipher text

Triple DES

From (Ajay K., January, 2012), Triple DES was developed in 1998 and derived from DES. It applies the DES cipher algorithm three times to each of the data blocks. It has a key size of 168 bits but provides at most 112 bits of security remaining 56 bits are utilized in the keying options.

The standards define three keying options;
- $K_1, K_2, K_3$ and are given as:
  - First keying option: All the three keys are independent.
  - Second keying operation: $K_1$ & $K_2$ are independent, and $K_3 = K_1$.
  - Third Keying option is all the three keys are identical $K_1 = K_2 = K_3$.

The block size used in the algorithm is 64 bits and 48 DES equivalent rounds have been used to encrypt the data. The security of TDES is effective but the main limitation of the standard is that 56 bits are not actually used for the encryption.

Triple DES is slower than other block cipher methods. The following expression is used for encryption purpose. $C(t) = E_{K1}(D_{K2}(E_{K3}(t)))$ (Ankita P. B., April - 2013)

Triple DES algorithm

Encryption is done by-
$C = (\text{Encryption}) K_3 ((\text{Decryption}) K_2 ((\text{Encryption}) K_1 (I)))$.

with Decryption is done by:
$I = ((\text{Decryption}) K_1 ((\text{Encryption}) K_2 ((\text{Encryption}) K_3 (C))))$
$C$ ... cipher text
$ki$ ... key and $i$ is iteration
Where Encryption and Decryption are DES encryption and DES decrypt (Vikendra S., (2013))
Advanced encryption standard

(Paar C. and Pelzl J., 2010), stated that Rijndael was proposed by two Belgian cryptographers, Joan Daemen and Vincent Rijmen. The proposed encryption’s key size varies between 128, 192 and 256 bits; but only the key size of 128 bits was approved as the AES standard.

According to (Al-Hazaimeh, March 2013), the National Institute of Standards and Technology (NIST) in 1997 announced officially that Rijndael algorithm would become the Advanced Encryption Standard (AES) to replace the aging Data Encryption Standard (DES). AES algorithm is a block cipher text the block size can be 128, 192 or 256 bits. 128(AES-128), 192(AES-192) and 256 (AES-256) bits key lengths. The use of AES becomes effective in May, 2002.

The AES algorithm

1. Input Block is split up into bytes depending on its size L (see below), ex for L = 128 into 16 bytes, m₀, m₁, ..., mₙ and the same is done to Input Key which is of the same size, k₀, k₁, ..., kₙ.
2. According to the key size, a specific number of rounds of the following function are performed (for example, when L = 128 we have 10 rounds).
3. Round (S, Round Key) Where S is initially Input Block and Round Key is derived from Input Key via key scheduling.
4. Round (S, Round Key) = Sub Bytes(S); Shift Rows(S); Mix Columns(S);
   Add Round Key(S, Round Key);
They added a brief description of the operations each of these internal functions performs.

Sub bytes(S): Performs \( y_i = A x_i^2 + b \) where \( x \) is every byte of \( S \), \( A \) is an S-box and \( b \) is known dependant on the size of \( A \) (and subsequently on the size of \( m_i \)).
Shift Rows(S): This is the simplest operation of the four which simply shifts the elements of the matrix whose elements are the bytes of \( S \) by a given number of positions. For example, with \( L = 128 \), Shift Rows(S) would look like this

\[
\begin{pmatrix}
S_{0,0} & S_{0,1} & S_{0,2} & S_{0,3} \\
S_{1,0} & S_{1,1} & S_{1,2} & S_{1,3} \\
S_{2,0} & S_{2,1} & S_{2,2} & S_{2,3} \\
S_{3,0} & S_{3,1} & S_{3,2} & S_{3,3}
\end{pmatrix}\rightarrow
\begin{pmatrix}
S_{0,0} & S_{0,1} & S_{0,2} & S_{0,3} \\
S_{1,1} & S_{1,2} & S_{1,3} & S_{1,0} \\
S_{2,2} & S_{2,3} & S_{2,0} & S_{2,1} \\
S_{3,3} & S_{3,0} & S_{3,1} & S_{3,2}
\end{pmatrix}
\]

Mix Columns(S): Works by manipulating the columns of the state \( S \) (remember they look like the above). It forms a polynomial with coefficients the byte values of the columns. This polynomial is then multiplied with a fixed polynomial \( c(x) \) modulo \( x^3 - 1 \). Modulo arithmetic ensures the result to be a polynomial of degree 3. The resulting polynomials’ coefficients will be the column of the new state \( S' \). We work through all the columns of \( S \) in a similar fashion to form \( S' \).

Add Round Key(S, Round Key): This function performs the XOR operation between the elements of \( S \) and the elements of Round Key (Shrivas & Singh, IJICTM, 2014).

Blowfish

Blowfish is a symmetric block cipher that can be used as a drop-in replacement for DES (Data Encryption Standard) or IDEA (International Data Encryption Algorithm). It takes a variable-length key, from 32 bits to 448 bits, making it ideal for both domestic and exportable use (Alabaichi, Ahmad, & Mahmod, 2013). It is a freely available symmetric block cipher designed in 1993 by Bruce Schneier.

Blowfish was designed in 1993 by Bruce Schneier as a fast, free alternative to existing encryption algorithms. Since then, it has been analyzed considerably, and is slowly gaining acceptance as a strong encryption algorithm. Blowfish is not patented, is license-free, and is available free for all uses.
Blowfish process

- Initialize P array and S boxes with Hexadecimal digits of Pi.
- XOR P-array with the key bits (i.e., P1 XOR (first 32 bits of key), P2 XOR (second 32 bits of key))...
- Use the above method to encrypt the all-zero string.
- This new output is P1 and P2.
- Encrypt the new P1 and P2 with the modified sub keys.
- This new output is now P3 and P4.
- Repeat the above steps until we get all the elements of P array i.e P1, P2....

Blowfish algorithm

1. Take X = input (0-64) bits.
2. Divide X it into two equal halves such that
3. XL = input(0-31)
4. XR = input (32-63).
5. For I = 1 to 15
6. Li = Li-1
7. Compute F(XL)=((S1,a + S2,b mod232) XOR S3,c) + S4,d
8. XR = XL XOR XR
9. Swap XL and XR
10. XL = XL XOR P18
11. XR = XR XOR P17
12. output = combined result of L and R
13. return output

f-Function- f-function uses s-boxes and it can be implemented into following steps
1. Get input
2. L = input[0-15]
3. R = input[16-31]
4. Centre Lc = input[8-15]
5. Centre Rc = input[16-23]
6. L = S-Box(L) (note that the result of the S-Box is a 32 bit data stream)
7. centreLc = S-Box(centreLc)
8. centreRc = S-Box(centreRc)
9. R = S-Box(R)
10. L = L + centreLc (note: this is mod 232 addition)
11. L = L XOR centreRc
12. L = L + R
13. return L

The proposed enhanced simplified symmetric key encryption algorithm

Technology is bound to catch up to all cryptosystems and surpass their computational limits. For this reason, any new encryption method should be welcomed as future input to viable alternatives, especially suggestions that comply to the “low computational cost”-“high resilience to cryptanalysis” paradigm.²

²Stergiopoulos G., Miltiadis K., and Dimitris G.Information Security and Critical Infrastructure Protection Research Laboratory, 76 Patission Ave., Athens GR-10434, Greece.
Reasons for adopting symmetric key

Authors adopted Symmetric key cryptographic scheme because only one key is needed for communication. The selected cryptographic scheme involves five requirements and these are: plain text, cipher text, encryption algorithm, decryption algorithm, and a secret key (Agrawal & Mishra, 2012).

Symmetric key length

This new proposed algorithm is a block cipher that divides data into blocks of equal length and then encrypts each block using a special mathematical set of functions known as Key. This algorithm uses variable key length which will vary from 65 bytes to 72 bytes of symmetric key technique for encryption and decryption of data i.e. it uses the same key at both ends. Selection of the key purely random based. Thus, the key distribution predicament can be handled easily. Another positive point of the algorithm is that it protects the cipher text from Brute-force attacks as the key is length in the encryption process because of $2^{288}$ required to break the key.

Cryptographic models

The study is designed on the basis of two models:
- Simplified Model
- Conventional Model

Diagrammatically, these models that formed the bases of the design of the work is shown below.

**Figure 1.** Simplified model for symmetric encryption and decryption techniques

**Figure 2.** Conventional model

Proposed algorithm

In this algorithm, the encryption process does a variety of matrix Operation like transpose, column mix, row mix, permutation on the message for protecting it against unauthorized attacks. The propose algorithm is adopted AES, therefore has it features thereof.
**Pseudo code of proposed encryption algorithm**

1. Select 64 bytes key value from the variable key size 65 to 72 Key [64];
2. Select first 64 bytes plain text form the file
   Double Text [64];
3. Arrange both values in matrix form.
   Key [i][j] and Text [i][j];
4. Execute Column shifting
   \[ \text{Col\_Shift\_Key \{i\}\{j\} = Col\_shift \{ Key \{i\}\{j\}\}}; \]
   \[ \text{Col\_Shift\_Text \{i\}\{j\} = Col\_shift \{ Text \{i\}\{j\}\}}; \]
5. Apply Combine function between the two
   \[ \text{Com \{i\}\{j\} = ComB \{ Col\_Shift\_Key \{i\}\{j\}\}, \]
   \[ \text{Col\_Shift\_Text \{i\}\{j\}\}; \]
   \[ \text{Permu \{i\}\{j\} = PerMut \{ Com \{i\}\{j\}\}; \]
7. Execute Column Swapping.
   \[ \text{Com\_Col\_Swap \{i\}\{j\} = Com\_Col\_Swap \{ Permu \{i\}\{j\}\}; \]
8. Perform transposition.
   \[ \text{Trans \{i\}\{j\} = Trans(Com\_Col\_Swap \{i\}\{j\}); \]
   \[ \text{Row\_Mix \{i\}\{j\} = Row\_Mix \{ Trans \{i\}\{j\}\}; \]
10. Repeat step 1 to 9 till \text{Avg} (Enc\_Number, Ran\_Number).
11. Cipher \{i\}\{j\} = Row\_Mix \{i\}\{j\};
12. Exit.

**PSEUDO code of proposed decryption algorithm**

1. Select cipher text value from the encrypted file
   Cipher \{i\}\{j\};
2. Apply row mixing, in the two matrixes
   \[ \text{Rev\_Row\_Mix \{i\}\{j\} = Rev\_Row\_Mix \{ Cipher \{i\}\{j\}\}; \]
3. Apply transpositions among respective Colum
   \[ \text{Trans \{i\}\{j\} = Trans(Rev\_Row\_Mix \{i\}\{j\}); \]
4. Execute Column Shifting.
   \[ \text{Rev\_Com\_Col\_Shift \{i\}\{j\} = Rev\_Com\_Col\_Shift \{ Trans \{i\}\{j\}; \]
5. Apply Permutation function.
   \[ \text{Rev\_Permu \{i\}\{j\} = Rev\_PerMut \{ Rev\_Com\_Col\_Shift \{i\}\{j\}; \]
6. Execute Division function to again break the matrix
   \[ \text{Div\_Key \{i\}\{j\} = Divi \{ Rev\_Permu \{i\}\{j\}; \]
   \[ \text{Div\_Text \{i\}\{j\} = Divi \{ Rev\_Permu \{i\}\{j\}; \]
7. Execute Column Swapping
   \[ \text{Rev\_Col\_Swap\_Div\_Key \{i\}\{j\} = Rev\_Col\_Swap \{ Div\_Key \{i\}\{j\}; \]
   \[ \text{Rev\_Col\_Swap\_Div\_Text \{i\}\{j\} = Rev\_Col\_Swap \{ Div\_Text \{i\}\{j\}; \]
8. Reiterate step 1 to 8 till \text{Avg} (Enc\_Number, Ran\_Number).
9. Text \{i\}\{j\} = Rev\_Col\_Swap\_Div\_Text \{i\}\{j\}
10. End

**Matrix form for encryption algorithm**

For Instance: Select 16 byte key value and arrange in matrix form in the following way

1. Select 64 byte Key and arrange in the following way
2. Select 64 byte plain text and arrange in the following way

$$\begin{pmatrix}
P01 & P02 & P03 & P04 & P05 & P06 & P07 & P08 \\
P09 & P10 & P11 & P12 & P13 & P14 & P15 & P16 \\
P17 & P18 & P19 & P20 & P21 & P22 & P23 & P24 \\
P33 & P34 & P35 & P36 & P37 & P38 & P39 & P40 \\
P41 & P42 & P43 & P44 & P45 & P46 & P47 & P48 \\
P49 & P50 & P51 & P52 & P53 & P54 & P55 & P56 \\
P57 & P58 & P59 & P60 & P61 & P62 & P63 & P64
\end{pmatrix}$$

Plain Text Matrix (PT) =

3. Arrange key value and Plain Text in following way

$$\begin{pmatrix}
K01 & K02 & K03 & K04 & K05 & K06 & K07 & K08 \\
K09 & K10 & K11 & K12 & K13 & K14 & K15 & K16 \\
K17 & K18 & K19 & K20 & K21 & K22 & K23 & K24 \\
K25 & K26 & K27 & K28 & K29 & K30 & K31 & K32 \\
K33 & K34 & K35 & K36 & K37 & K38 & K39 & K40 \\
K41 & K42 & K43 & K44 & K45 & K46 & K47 & K48 \\
K49 & K50 & K51 & K52 & K53 & K54 & K55 & K56 \\
K57 & K58 & K59 & K60 & K61 & K62 & K63 & K64
\end{pmatrix}$$

4. (a) Execute Column Shifting Function in the following way:
   i. Replace 1st column of KM with 2nd column of PT
   ii. Replace 3rd column of KM with 4th column of PT
   iii. Replace 5th column of KM with 6th column of PT
   iv. Replace 7th column of KM with 8th column of PT

5. Apply Combine function between the two matrixes in the following way:
Joint corresponding columns of 4(b) to 4(a), that is columns 1 and 1, 2 and 2, 3 and 3, … 8 and 8

\[
\begin{align*}
P02 & K02 & P04 & K04 & P06 & K06 & P08 & K08 \\
P10 & K10 & P12 & K12 & P14 & K14 & P16 & K16 \\
P18 & K18 & P20 & K20 & P22 & K22 & P24 & K24 \\
P26 & K26 & P28 & K28 & P30 & K30 & P32 & K32 \\
P34 & K34 & P36 & K36 & P38 & K38 & P40 & K40 \\
P42 & K42 & P44 & K44 & P46 & K46 & P48 & K48 \\
P50 & K50 & P52 & K52 & P54 & K54 & P56 & K56 \\
P58 & K58 & P60 & K60 & P62 & K62 & P64 & K64 \\
P01 & K01 & P03 & K03 & P05 & K05 & P07 & K07 \\
P09 & K09 & P11 & K11 & P13 & K13 & P15 & K15 \\
P17 & K17 & P19 & K19 & P21 & K21 & P23 & K23 \\
P25 & K25 & P27 & K27 & P29 & K29 & P31 & K31 \\
P33 & K33 & P35 & K35 & P37 & K37 & P39 & K39 \\
P41 & K41 & P43 & K43 & P45 & K45 & P47 & K47 \\
P49 & K49 & P51 & K51 & P53 & K53 & P55 & K55 \\
P57 & K57 & P59 & K59 & P61 & K61 & P63 & K63 \\
\end{align*}
\]

6. Execute Permutation function in the following way: Here the first column is obtained by writing the elements of the sixteenth row and then the fifteenth row of in reverse order; similarly the other seven columns are obtained by using the fourteenth and thirteenth rows, twelfth and eleventh rows, and in that order.

\[
\begin{align*}
K63 & K47 & K31 & K15 & K64 & K48 & K32 & K16 \\
P63 & P47 & P31 & P15 & P64 & P48 & P32 & P16 \\
K61 & K45 & K29 & K13 & K62 & K46 & K30 & K14 \\
P61 & P45 & P29 & P13 & P62 & P46 & P30 & P14 \\
K59 & K43 & K27 & K11 & K60 & K44 & K28 & K12 \\
P59 & P43 & P27 & P11 & P60 & P44 & P28 & P12 \\
K57 & K41 & K25 & K09 & K58 & K42 & K26 & K10 \\
P57 & P41 & P25 & P09 & P58 & P42 & P26 & P10 \\
K55 & K39 & K23 & K07 & K56 & K40 & K24 & K08 \\
P55 & P39 & P23 & P07 & P56 & P40 & P24 & P08 \\
K53 & K37 & K21 & K05 & K54 & K38 & K22 & K06 \\
P53 & P37 & P21 & P05 & P54 & P38 & P22 & P06 \\
K51 & K35 & K19 & K03 & K52 & K36 & K20 & K04 \\
P51 & P35 & P19 & P03 & P52 & P36 & P20 & P04 \\
K49 & K33 & K17 & K01 & K50 & K34 & K18 & K02 \\
P49 & P33 & P17 & P01 & P50 & P34 & P18 & P02 \\
\end{align*}
\]

7. Execute Column Swapping Function. Swap the columns 1 and 2, 3 and 4, 5 and 6, and 7 and 8.

\[
\begin{bmatrix}
K_47 & K_63 & K_{15} & K_{31} & K_{48} & K_{64} & K_{16} & K_{32} \\
K_{45} & K_{61} & K_{29} & K_{46} & K_{62} & K_{14} & K_{30} \\
K_{43} & K_{59} & K_{27} & K_{44} & K_{60} & K_{12} & K_{28} \\
K_{41} & K_{57} & K_{25} & K_{42} & K_{58} & K_{10} & K_{26} \\
K_{39} & K_{55} & K_{07} & K_{23} & K_{40} & K_{56} & K_{08} & K_{24} \\
P_{39} & P_{55} & P_{07} & P_{23} & P_{40} & P_{56} & P_{08} & P_{24} \\
P_{37} & P_{53} & P_{05} & P_{21} & P_{38} & P_{54} & P_{06} & P_{22} \\
P_{35} & P_{51} & P_{03} & P_{19} & P_{36} & P_{52} & P_{04} & P_{20} \\
P_{33} & P_{49} & P_{01} & P_{17} & P_{34} & P_{50} & P_{02} & P_{18} \\
P_{31} & P_{47} & P_{01} & P_{15} & P_{32} & P_{46} & P_{03} & P_{18} \\
P_{29} & P_{45} & P_{03} & P_{13} & P_{30} & P_{44} & P_{05} & P_{17} \\
P_{27} & P_{43} & P_{05} & P_{11} & P_{29} & P_{42} & P_{07} & P_{16} \\
P_{25} & P_{41} & P_{07} & P_{09} & P_{27} & P_{40} & P_{09} & P_{15} \\
P_{23} & P_{39} & P_{09} & P_{07} & P_{25} & P_{38} & P_{01} & P_{14} \\
P_{21} & P_{37} & P_{07} & P_{05} & P_{23} & P_{36} & P_{03} & P_{12} \\
P_{19} & P_{35} & P_{05} & P_{03} & P_{21} & P_{34} & P_{05} & P_{10} \\
P_{17} & P_{33} & P_{03} & P_{01} & P_{19} & P_{32} & P_{07} & P_{08} \\
P_{15} & P_{31} & P_{01} & P_{09} & P_{17} & P_{30} & P_{09} & P_{06} \\
P_{13} & P_{29} & P_{01} & P_{07} & P_{15} & P_{28} & P_{01} & P_{05} \\
P_{11} & P_{27} & P_{01} & P_{05} & P_{13} & P_{26} & P_{01} & P_{04} \\
P_{09} & P_{25} & P_{01} & P_{03} & P_{11} & P_{24} & P_{01} & P_{03} \\
P_{07} & P_{23} & P_{01} & P_{01} & P_{09} & P_{22} & P_{01} & P_{02} \\
P_{05} & P_{21} & P_{01} & P_{09} & P_{05} & P_{20} & P_{01} & P_{01} \\
P_{03} & P_{19} & P_{01} & P_{07} & P_{03} & P_{18} & P_{01} & P_{01} \\
P_{01} & P_{17} & P_{01} & P_{05} & P_{01} & P_{16} & P_{01} & P_{01} \\
\end{bmatrix}
\]

9. Perform Row Mixing Function. The rows 1 and 8, 2 and 7, 3 and 6, and 4 and 5 swap

\[
\begin{bmatrix}
K_{47} & K_{45} & K_{64} & K_{62} & K_{15} & K_{13} & K_{30} & K_{28} \\
K_{43} & K_{41} & K_{59} & K_{57} & K_{11} & K_{13} & K_{29} & K_{27} \\
K_{39} & K_{37} & K_{55} & K_{53} & K_{07} & K_{11} & K_{25} & K_{23} \\
K_{35} & K_{33} & K_{51} & K_{59} & K_{03} & K_{07} & K_{19} & K_{17} \\
K_{31} & K_{29} & K_{46} & K_{44} & K_{12} & K_{14} & K_{26} & K_{24} \\
K_{27} & K_{25} & K_{42} & K_{40} & K_{10} & K_{12} & K_{22} & K_{20} \\
K_{23} & K_{21} & K_{38} & K_{36} & K_{08} & K_{10} & K_{18} & K_{16} \\
K_{19} & K_{17} & K_{34} & K_{32} & K_{06} & K_{08} & K_{14} & K_{12} \\
K_{15} & K_{13} & K_{30} & K_{28} & K_{04} & K_{06} & K_{12} & K_{10} \\
K_{11} & K_{09} & K_{26} & K_{24} & K_{02} & K_{04} & K_{10} & K_{08} \\
K_{07} & K_{05} & K_{22} & K_{20} & K_{00} & K_{02} & K_{08} & K_{06} \\
K_{03} & K_{01} & K_{19} & K_{17} & K_{01} & K_{03} & K_{09} & K_{07} \\
K_{09} & K_{07} & K_{15} & K_{13} & K_{01} & K_{03} & K_{09} & K_{07} \\
K_{05} & K_{03} & K_{11} & K_{09} & K_{01} & K_{03} & K_{09} & K_{07} \\
K_{01} & K_{09} & K_{07} & K_{05} & K_{01} & K_{03} & K_{09} & K_{07} \\
\end{bmatrix}
\]

10. Reiterate Processes 3 to 9 until Average (Encryption, Random Number).

11. Cipher

\[
\begin{bmatrix}
K_{32} & K_{30} & K_{38} & K_{26} & K_{24} & K_{22} & K_{20} & K_{18} \\
K_{31} & K_{29} & K_{27} & K_{25} & K_{23} & K_{21} & K_{19} & K_{17} \\
K_{29} & K_{27} & K_{25} & K_{23} & K_{21} & K_{19} & K_{17} & K_{15} \\
K_{27} & K_{25} & K_{23} & K_{21} & K_{19} & K_{17} & K_{15} & K_{13} \\
K_{25} & K_{23} & K_{21} & K_{19} & K_{17} & K_{15} & K_{13} & K_{11} \\
K_{23} & K_{21} & K_{19} & K_{17} & K_{15} & K_{13} & K_{11} & K_{09} \\
K_{21} & K_{19} & K_{17} & K_{15} & K_{13} & K_{11} & K_{09} & K_{07} \\
K_{19} & K_{17} & K_{15} & K_{13} & K_{11} & K_{09} & K_{07} & K_{05} \\
K_{17} & K_{15} & K_{13} & K_{11} & K_{09} & K_{07} & K_{05} & K_{03} \\
K_{15} & K_{13} & K_{11} & K_{09} & K_{07} & K_{05} & K_{03} & K_{01} \\
K_{13} & K_{11} & K_{09} & K_{07} & K_{05} & K_{03} & K_{01} & K_{09} \\
K_{11} & K_{09} & K_{07} & K_{05} & K_{03} & K_{01} & K_{09} & K_{07} \\
K_{09} & K_{07} & K_{05} & K_{03} & K_{01} & K_{09} & K_{07} & K_{05} \\
\end{bmatrix}
\]

12. End

**Matrix form for decryption algorithm**

1. Select cipher text value from the encrypted file
2. Apply row mixing in the matrix by swapping rows 1 and 8, 2 and 7, 3 and 4, and 5 and 6 to obtain this result.

\[
\begin{pmatrix}
K_{47} & P_{47} & K_{45} & P_{45} & K_{43} & P_{43} & K_{41} & P_{41} & K_{39} & P_{39} & K_{37} & P_{37} & K_{35} & P_{35} & K_{33} & P_{33} \\
K_{47} & P_{47} & K_{45} & P_{45} & K_{43} & P_{43} & K_{41} & P_{41} & K_{39} & P_{39} & K_{37} & P_{37} & K_{35} & P_{35} & K_{33} & P_{33}
\end{pmatrix}
\]

3. Apply transpositions among respective Columns

\[
\begin{pmatrix}
K_{47} & K_{63} & K_{15} & K_{31} & K_{48} & K_{64} & K_{16} & K_{32} \\
P_{47} & P_{63} & P_{15} & P_{31} & P_{48} & P_{64} & P_{16} & P_{32} \\
K_{45} & K_{61} & K_{13} & K_{29} & K_{46} & K_{62} & K_{14} & K_{30} \\
P_{45} & P_{61} & P_{13} & P_{29} & P_{46} & P_{62} & P_{14} & P_{30} \\
K_{43} & K_{59} & K_{11} & K_{27} & K_{44} & K_{60} & K_{12} & K_{28} \\
P_{43} & P_{59} & P_{11} & P_{27} & P_{44} & P_{60} & P_{12} & P_{28} \\
K_{41} & K_{57} & K_{09} & K_{25} & K_{42} & K_{58} & K_{10} & K_{26} \\
P_{41} & P_{57} & P_{09} & P_{25} & P_{42} & P_{58} & P_{10} & P_{26} \\
K_{39} & K_{55} & K_{07} & K_{23} & K_{40} & K_{56} & K_{08} & K_{24} \\
P_{39} & P_{55} & P_{07} & P_{23} & P_{40} & P_{56} & P_{08} & P_{24} \\
K_{37} & K_{53} & K_{05} & K_{21} & K_{38} & K_{54} & K_{06} & K_{22} \\
P_{37} & P_{53} & P_{05} & P_{21} & P_{38} & P_{54} & P_{06} & P_{22} \\
K_{35} & K_{51} & K_{03} & K_{19} & K_{36} & K_{52} & K_{04} & K_{20} \\
P_{35} & P_{51} & P_{03} & P_{19} & P_{36} & P_{52} & P_{04} & P_{20} \\
K_{33} & K_{49} & K_{01} & K_{17} & K_{34} & K_{50} & K_{02} & K_{18} \\
P_{33} & P_{49} & P_{01} & P_{17} & P_{34} & P_{50} & P_{02} & P_{18}
\end{pmatrix}
\]

4. Execute Column Swapping. That is Swap the columns 1 and 2, 3 and 4, 5 and 6, and 7 and 8.

\[
\begin{pmatrix}
K_{63} & K_{47} & K_{31} & K_{15} & K_{64} & K_{48} & K_{32} & K_{16} \\
P_{63} & P_{47} & P_{31} & P_{15} & P_{64} & P_{48} & P_{32} & P_{16} \\
K_{61} & K_{45} & K_{29} & K_{13} & K_{62} & K_{46} & K_{30} & K_{14} \\
P_{61} & P_{45} & P_{29} & P_{13} & P_{62} & P_{46} & P_{30} & P_{14} \\
K_{59} & K_{43} & K_{27} & K_{11} & K_{60} & K_{44} & K_{28} & K_{12} \\
P_{59} & P_{43} & P_{27} & P_{11} & P_{60} & P_{44} & P_{28} & P_{12} \\
K_{57} & K_{41} & K_{25} & K_{09} & K_{58} & K_{42} & K_{26} & K_{10} \\
P_{57} & P_{41} & P_{25} & P_{09} & P_{58} & P_{42} & P_{26} & P_{10} \\
K_{55} & K_{39} & K_{23} & K_{07} & K_{56} & K_{40} & K_{24} & K_{08} \\
P_{55} & P_{39} & P_{23} & P_{07} & P_{56} & P_{40} & P_{24} & P_{08} \\
K_{53} & K_{37} & K_{21} & K_{05} & K_{54} & K_{38} & K_{22} & K_{06} \\
P_{53} & P_{37} & P_{21} & P_{05} & P_{54} & P_{38} & P_{22} & P_{06} \\
K_{51} & K_{35} & K_{19} & K_{03} & K_{52} & K_{36} & K_{20} & K_{04} \\
P_{51} & P_{35} & P_{19} & P_{03} & P_{52} & P_{36} & P_{20} & P_{04} \\
K_{49} & K_{33} & K_{17} & K_{01} & K_{50} & K_{34} & K_{18} & K_{02} \\
P_{49} & P_{33} & P_{17} & P_{01} & P_{50} & P_{34} & P_{18} & P_{02}
\end{pmatrix}
\]
5. Apply Permutation function. That is column 8 forms rows 1 and 2, column 7 forms rows 3 and 4, column 6 forms rows 5 and 6 in that order.

\[
\begin{pmatrix}
P02 & K02 & P04 & K04 & P06 & K06 & P08 & K08 \\
P10 & K10 & P12 & K12 & P14 & K14 & P16 & K16 \\
P18 & K18 & P20 & K20 & P22 & K22 & P24 & K24 \\
P26 & K26 & P28 & K28 & P30 & K30 & P32 & K32 \\
P34 & K34 & P36 & K36 & P38 & K38 & P40 & K40 \\
P42 & K42 & P44 & K44 & P46 & K46 & P48 & K48 \\
P50 & K50 & P52 & K52 & P54 & K54 & P56 & K56 \\
P58 & K58 & P60 & K60 & P62 & K62 & P64 & K64 \\
P01 & K01 & P03 & K03 & P05 & K05 & P07 & K07 \\
P09 & K09 & P11 & K11 & P13 & K13 & P15 & K15 \\
P17 & K17 & P19 & K19 & P21 & K21 & P23 & K23 \\
P25 & K25 & P27 & K27 & P29 & K29 & P31 & K31 \\
P33 & K33 & P35 & K35 & P37 & K37 & P39 & K39 \\
P41 & K41 & P43 & K43 & P45 & K45 & P47 & K47 \\
P49 & K49 & P51 & K51 & P53 & K53 & P55 & K55 \\
P57 & K57 & P59 & K59 & P61 & K61 & P63 & K63 \\
\end{pmatrix}
\Rightarrow
\begin{pmatrix}
P02 & K02 & P04 & K04 & P06 & K06 & P08 & K08 \\
P10 & K10 & P12 & K12 & P14 & K14 & P16 & K16 \\
P18 & K18 & P20 & K20 & P22 & K22 & P24 & K24 \\
P26 & K26 & P28 & K28 & P30 & K30 & P32 & K32 \\
P34 & K34 & P36 & K36 & P38 & K38 & P40 & K40 \\
P42 & K42 & P44 & K44 & P46 & K46 & P48 & K48 \\
P50 & K50 & P52 & K52 & P54 & K54 & P56 & K56 \\
P58 & K58 & P60 & K60 & P62 & K62 & P64 & K64 \\
P01 & K01 & P03 & K03 & P05 & K05 & P07 & K07 \\
P09 & K09 & P11 & K11 & P13 & K13 & P15 & K15 \\
P17 & K17 & P19 & K19 & P21 & K21 & P23 & K23 \\
P25 & K25 & P27 & K27 & P29 & K29 & P31 & K31 \\
P33 & K33 & P35 & K35 & P37 & K37 & P39 & K39 \\
P41 & K41 & P43 & K43 & P45 & K45 & P47 & K47 \\
P49 & K49 & P51 & K51 & P53 & K53 & P55 & K55 \\
P57 & K57 & P59 & K59 & P61 & K61 & P63 & K63 \\
\end{pmatrix}
\]

6. Execute Division function to again break the matrix

\[
\begin{pmatrix}
P02 & K02 & P04 & K04 & P06 & K06 & P08 & K08 \\
P10 & K10 & P12 & K12 & P14 & K14 & P16 & K16 \\
P18 & K18 & P20 & K20 & P22 & K22 & P24 & K24 \\
P26 & K26 & P28 & K28 & P30 & K30 & P32 & K32 \\
P34 & K34 & P36 & K36 & P38 & K38 & P40 & K40 \\
P42 & K42 & P44 & K44 & P46 & K46 & P48 & K48 \\
P50 & K50 & P52 & K52 & P54 & K54 & P56 & K56 \\
P58 & K58 & P60 & K60 & P62 & K62 & P64 & K64 \\
P01 & K01 & P03 & K03 & P05 & K05 & P07 & K07 \\
P09 & K09 & P11 & K11 & P13 & K13 & P15 & K15 \\
P17 & K17 & P19 & K19 & P21 & K21 & P23 & K23 \\
P25 & K25 & P27 & K27 & P29 & K29 & P31 & K31 \\
P33 & K33 & P35 & K35 & P37 & K37 & P39 & K39 \\
P41 & K41 & P43 & K43 & P45 & K45 & P47 & K47 \\
P49 & K49 & P51 & K51 & P53 & K53 & P55 & K55 \\
P57 & K57 & P59 & K59 & P61 & K61 & P63 & K63 \\
\end{pmatrix}
\]

(a)

\[
\begin{pmatrix}
P02 & K02 & P04 & K04 & P06 & K06 & P08 & K08 \\
P10 & K10 & P12 & K12 & P14 & K14 & P16 & K16 \\
P18 & K18 & P20 & K20 & P22 & K22 & P24 & K24 \\
P26 & K26 & P28 & K28 & P30 & K30 & P32 & K32 \\
P34 & K34 & P36 & K36 & P38 & K38 & P40 & K40 \\
P42 & K42 & P44 & K44 & P46 & K46 & P48 & K48 \\
P50 & K50 & P52 & K52 & P54 & K54 & P56 & K56 \\
P58 & K58 & P60 & K60 & P62 & K62 & P64 & K64 \\
P01 & K01 & P03 & K03 & P05 & K05 & P07 & K07 \\
P09 & K09 & P11 & K11 & P13 & K13 & P15 & K15 \\
P17 & K17 & P19 & K19 & P21 & K21 & P23 & K23 \\
P25 & K25 & P27 & K27 & P29 & K29 & P31 & K31 \\
P33 & K33 & P35 & K35 & P37 & K37 & P39 & K39 \\
P41 & K41 & P43 & K43 & P45 & K45 & P47 & K47 \\
P49 & K49 & P51 & K51 & P53 & K53 & P55 & K55 \\
P57 & K57 & P59 & K59 & P61 & K61 & P63 & K63 \\
\end{pmatrix}
\]

(b)

7. Execute Column Swapping that is swap columns 1 of (a) and 2 of (b), 3 of (a) and 4 of (b), 5 of (a) and 6 of (b), and 7 of (a) and 8 of (b).
8. Reiterate step 1 to 8 till Avg (Enc_Number, Ran_Number).

9. Text

Key Matrix (KM) =

\[
\begin{pmatrix}
K_{01} & K_{02} & K_{03} & K_{04} & K_{05} & K_{06} & K_{07} & K_{08} \\
K_{09} & K_{10} & K_{11} & K_{12} & K_{13} & K_{14} & K_{15} & K_{16} \\
K_{17} & K_{18} & K_{19} & K_{20} & K_{21} & K_{22} & K_{23} & K_{24} \\
K_{25} & K_{26} & K_{27} & K_{28} & K_{29} & K_{30} & K_{31} & K_{32} \\
K_{33} & K_{34} & K_{35} & K_{36} & K_{37} & K_{38} & K_{39} & K_{40} \\
K_{41} & K_{42} & K_{43} & K_{44} & K_{45} & K_{46} & K_{47} & K_{48} \\
K_{49} & K_{50} & K_{51} & K_{52} & K_{53} & K_{54} & K_{55} & K_{56} \\
K_{57} & K_{58} & K_{59} & K_{60} & K_{61} & K_{62} & K_{63} & K_{64}
\end{pmatrix}
\]

Plain Text Matrix (PT) =

\[
\begin{pmatrix}
P_{01} & P_{02} & P_{03} & P_{04} & P_{05} & P_{06} & P_{07} & P_{08} \\
P_{09} & P_{10} & P_{11} & P_{12} & P_{13} & P_{14} & P_{15} & P_{16} \\
P_{17} & P_{18} & P_{19} & P_{20} & P_{21} & P_{22} & P_{23} & P_{24} \\
P_{25} & P_{26} & P_{27} & P_{28} & P_{29} & P_{30} & P_{31} & P_{32} \\
P_{33} & P_{34} & P_{35} & P_{36} & P_{37} & P_{38} & P_{39} & P_{40} \\
P_{41} & P_{42} & P_{43} & P_{44} & P_{45} & P_{46} & P_{47} & P_{48} \\
P_{49} & P_{50} & P_{51} & P_{52} & P_{53} & P_{54} & P_{55} & P_{56} \\
P_{57} & P_{58} & P_{59} & P_{60} & P_{61} & P_{62} & P_{63} & P_{64}
\end{pmatrix}
\]

10. End

**Flow chart of proposed encryption algorithm**
Figure 3. Flow Chart of Proposed Encryption algorithm

Flow Chart of Proposed Decryption algorithm
Cryptanalysis on the algorithm

In the Cryptography literature, the general types of attacks on a cipher are:
1. Brute force attack
2. Known plaintext attack
3. Chosen plaintext attack
4. Chosen cipher text attack

In the cipher under consideration, the keys K and plain text P both put together are containing $2n^2$ numbers, wherein each number can be represented in terms of some binary bits. Thus the key space is of size

$$2^{64n^2} = 2^{10 \times 6.4n^2}$$

$$\approx 10^{19.3^n}$$

For instance, the execution of the cipher takes 10-7 seconds with a specified pair of values of the keys, for the brute force attack the time required is attained by

$$10^{19.3^n} \times 10^{-7}$$

$$= 365 \times 24 \times 60 \times 60$$

$$= 57 \times 10^{19.3^n} \times 10^{-15}$$

$$= 57 \times 10^{(19.3^n) - 15}$$
From the above formula it presents that the required time for execution is several years when \( n \geq 2 \). With the help of cipher text only attack it cannot be broken. In the case of known plaintext attack, it has as many plaintext and cipher text pairs as require for attack. In this analysis, as the plaintext pass through several transformations on account of multiplication and addition or division by the permutation and key matrices, in every round of the iteration, before the plaintext becomes the cipher text, the on linearity include in the process does not allow anybody to break the cipher. It is impossible to choosing a plaintext or a cipher text from one as the process involved in the cipher is a complex one. With the help of chosen plaintext/cipher text attack, cipher cannot be broken. In the light of the above discussion, conclude that the cipher is a strong one.

Methodology and simulation setting

The widespread availability of inexpensive computing power is having a major impact on data analysis.

Computers allow us to carry out calculations and displays of data that were literally unthinkable only a decade ago. This will have a profound impact on the design of computer systems: an integral part of the design will be data gathering and analysis tools to determine system performance. As more and more data is gathered on each design, iterations will be carried out based on inferences from data.

Digital simulation provides a useful and effective adjunct to direct analytical evaluation of communication system performance. Indeed, there are many situations where explicit performance evaluation defies analysis and meaningful results can be obtained only through either actual prototype hardware and software evaluation or digital computer simulations.

Simulation moreover, frees the analyst from a great deal of repetitive work involved in substituting numbers into formulae and tables and enables the analyst to concentrate on results. Another advantage is the insight into system performance provided, both by the modeling process itself and by the experience gained from simulation experiments. Again, computers can assist us: it may be quite difficult or expensive to gather data or measurements, so computer assisted analysis can quantify the importance of the data gathering and analysis procedures.

Research design

Experimental research design was used in this work to manipulate some of the independent variables in order to observe the final results of the experiment.

The experiments were performed couple of times to assure that the results were consistent and were valid to ensure effective evaluation of the proposed algorithm and the other algorithms (DES, Triple-DES, Blowfish and AES).

All the implementations were accurate to make sure that the results are relatively fair and truthful.

Variables measured

There is no limit to the number of variables that can be measured, although the more variables, the more complex the study and the more complex the statistical analysis. The following variables were taken care of in this paper: dependent, independent, moderator, Control, and confounding variables (extraneous and intervening).

For the experiment researchers collected the following performance metrics:-

Avalanche effect

A desirable property of any encryption algorithm is that a small change in either the plaintext or the key should produce a significant change in the cipher text. In, particular a change in one bit of the plaintext or one bit of the key should produce a change in many bits of the cipher texts.

Encryption time

Encryption time is the total time taken to produce a cipher text from plain text. The calculated encryption time is then used to calculate the throughput of the encrypted algorithm. It gives the rate of
encryption. The more the encryption time more will the power consumption and speed will be less. The powerful processors consume more power in the key generation process as a result node capacitance, charge sharing and leakage current exist in the model. These parameters are responsible for the loss of data and cause station failure. The throughput of the encryption scheme will be calculated as the total encrypted plaintext in bytes divided by the encryption time.

**Decryption time**

Decryption time is the total time taken to produce the plain text from plain text. The calculated decryption time is then used to calculate the throughput of the decrypted algorithm. It gives the rate of decryption. More decryption time more will the power consumption and speed will be less. The throughput of the decryption scheme is calculated as the total decrypted plaintext in bytes divided by the decryption time.

**Memory required for implementation**

Different encryption techniques require different memory size for implementation. This memory requirement depends on the number of operations to be done by the algorithm. It is desirable that the memory required should be as small as possible.

**The CPU process time**

The CPU process time is the time that a CPU is committed only to the particular process of calculations. It reflects the load of the CPU. The more CPU time is used in the encryption process, the higher is the load of the CPU.

The time was in milliseconds and the text file size was in kilobytes.

As state in the literature, execution time of algorithm directly depends on the functionality of the algorithm and it is clearly defines that more complex structure originates poor execution time. Security of the data directly depends on the key length, higher key length will provide higher security but it can increase the execution time of the algorithm so it is very important that what should be the key length and how execution time got controlled, if selected key length is higher.

**Experimental design for metric of proposed system**

For the experiment, authors used a laptop with following the System configuration:-

- Operating System - Windows 8
- Clock Speed - 1.6GHz
- Processor - AMD Athlon TF-20
- RAM Capacity - 3.0GB
- Hard Disk - 150 GB
- Monitor - SVGA Color
- System Bus - 64 Bits

In which performance data is collected. In the experiments, the laptop is used for encryption and decryption of different file size ranges from 20 Kilobytes to 990 Bytes for text data. Authors have used Java SE Run-time Environment ("JRE") 1.7 and Java SDK 1.7 and NetBeans IDE 7.3. These implementations are thoroughly tested and are optimized to give the maximum performance for the algorithms.

**Simulation tools for data collections**

Netbeans profiler was used for data collection.

---

The simulation was the provided classes in java environment to simulate the performance of the proposed algorithm, DES, 3DES, AES and Blowfish. The implementation uses managed wrappers for the Algorithms available in java.crypto and java.security [CryptoSpec] that wraps unmanaged implementations available in JCE (Java Cryptography Extension) & JCA (Java Cryptography Architecture). The Cipher class provides the functionality of a cryptographic cipher used for encryption and decryption. It forms the core of the JCE framework.

The Simulation program accepts the inputs: Algorithm. After a successful execution, the data generated, encrypted, and decrypted.

Simulation result analysis and discussion

Avalanche effect

The simulation results for this evaluation shown in figure 5 and table 1 below, it is clear that, based on the simulation results; avalanche effect is highest in AES. It is medium in DES, Triple-DES and Blowfish. It is smallest in the propose algorithm. Therefore, if one desires a good avalanche effect; AES is the best option not the proposed algorithm. According to the graph, there is a tendency that the avalanche effect increases with file size.

<table>
<thead>
<tr>
<th>Technique</th>
<th>1 bit variation in key keeping plain text constant</th>
<th>1 bit variation in plain text keeping key constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed Algorithm</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>DES</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>Triple-DES</td>
<td>37</td>
<td>34</td>
</tr>
<tr>
<td>AES</td>
<td>65</td>
<td>78</td>
</tr>
<tr>
<td>Blowfish</td>
<td>36</td>
<td>24</td>
</tr>
</tbody>
</table>

Table-1. Evaluation of the techniques based on Avalanche effect

Figure 5. The simulation results avalanche effect
Encryption time

Encryption time is used to calculate the throughput of an encryption scheme. It indicates the speed of encryption. Different text sizes are used in this experiment for the propose algorithm, DES, Triple-DES, Blowfish and AES. The encryption time is recorded for these encryption algorithms. The average data rate is calculated for these algorithms based on the recorded data. The formula used for calculating average data rate is

\[ \text{AvgTime} = \frac{1}{NB} \sum_{i=0}^{NB} \frac{Mi}{ti(Kb/s)} \]

Where
- AvgTime = Average Data Rate (Kb/s)
- Nb = Number of Text
- Mi= Text Size (Kb)
- ti=Time taken to Encrypt Text Mi

Encryption Throughput:- Encryption throughput and power consumption are inversely proportional to each other. As the encryption throughput value is increased the power consumption of the following encryption is decreased and this “encryption throughput “can be evaluated by dividing the total plaintext in megabytes encrypted on the total encryption time for each algorithm which is ready for encryption or in the process of encryption or encrypted. This can be illustrated from the following:

Encryption time is used to compute the throughput of an encryption scheme. It indicates the speed of encryption. The throughput of the encryption scheme is calculated using the formula

\[ \text{Throughput} = \frac{Tp}{Et} \]

Where Tp= Total Plain text and Et= Encryption time

It is very important to calculate the throughput time for the encryption algorithm to known better performance of the algorithm. Encryption Time Comparison between Proposed Algorithm and the Selected Existing Algorithm on Text File is illustrated below.

Table 2. Comparative execution times (in milliseconds) of encryption algorithms with different packet size

<table>
<thead>
<tr>
<th>Text File Size In Kbyes</th>
<th>DES</th>
<th>Triple-DES</th>
<th>Blowfish</th>
<th>Propose Algorithm</th>
<th>AES</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>20</td>
<td>34</td>
<td>25</td>
<td>23</td>
<td>42</td>
</tr>
<tr>
<td>48</td>
<td>30</td>
<td>55</td>
<td>27</td>
<td>26</td>
<td>55</td>
</tr>
<tr>
<td>100</td>
<td>47</td>
<td>81</td>
<td>33</td>
<td>30</td>
<td>90</td>
</tr>
<tr>
<td>247</td>
<td>83</td>
<td>111</td>
<td>45</td>
<td>43</td>
<td>112</td>
</tr>
<tr>
<td>321</td>
<td>90</td>
<td>167</td>
<td>46</td>
<td>44</td>
<td>164</td>
</tr>
<tr>
<td>694</td>
<td>144</td>
<td>226</td>
<td>47</td>
<td>45</td>
<td>210</td>
</tr>
<tr>
<td>899</td>
<td>240</td>
<td>230</td>
<td>64</td>
<td>56</td>
<td>256</td>
</tr>
<tr>
<td>910</td>
<td>245</td>
<td>299</td>
<td>68</td>
<td>63</td>
<td>213</td>
</tr>
<tr>
<td>Average Time</td>
<td>112.375</td>
<td>150.00</td>
<td>44.375</td>
<td>41.25</td>
<td>142.75</td>
</tr>
</tbody>
</table>

The data analyzed in the table is illustrated in the graph below.

Simulation results for this compassion point are shown Figure 6 and Table 2 at encryption stage. The results show the superiority of Propose Algorithm over other algorithms in terms of the processing time. An additional position can be noticed here; that Blowfish requires less time than the remaining algorithms: DES, AES and Triple-DES algorithms except the Propose Algorithm. A third point can be noticed here; that AES has an advantage over other DES, DES and the Proposed
Algorithm in terms of time consumption and throughput. A fourth point can be noticed here; that Triple-DES has low performance in terms of power consumption and throughput when compared with DES. It requires always more time than DES because of its triple phase encryption characteristics. Finally, it is found that Triple-DES has low performance and low throughput when compared with other five algorithms in spite of the small key size used.

![Graph showing throughput of each encryption algorithm (Kilobyte/Sec)](image)

**Figure 6.** Throughput of each encryption algorithm (Kilobyte/Sec)

**Encryption time**

<table>
<thead>
<tr>
<th>Text File Size in Kbytes</th>
<th>DES</th>
<th>Triple-DES</th>
<th>Blowfish</th>
<th>Propose Algorithm</th>
<th>AES</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>34</td>
<td>40</td>
<td>28</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>48</td>
<td>50</td>
<td>53</td>
<td>34</td>
<td>29</td>
<td>63</td>
</tr>
<tr>
<td>100</td>
<td>57</td>
<td>57</td>
<td>56</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>247</td>
<td>72</td>
<td>77</td>
<td>73</td>
<td>70</td>
<td>76</td>
</tr>
<tr>
<td>321</td>
<td>87</td>
<td>87</td>
<td>81</td>
<td>79</td>
<td>149</td>
</tr>
<tr>
<td>694</td>
<td>120</td>
<td>146</td>
<td>90</td>
<td>88</td>
<td>142</td>
</tr>
<tr>
<td>899</td>
<td>152</td>
<td>171</td>
<td>99</td>
<td>99</td>
<td>171</td>
</tr>
<tr>
<td>910</td>
<td>160</td>
<td>173</td>
<td>120</td>
<td>112</td>
<td>144</td>
</tr>
<tr>
<td><strong>Average Time</strong></td>
<td>91.875</td>
<td>100.875</td>
<td>72.625</td>
<td>69.5</td>
<td>106.25</td>
</tr>
<tr>
<td><strong>Throughput (Kilobytes/sec)</strong></td>
<td>5.09</td>
<td>4.63</td>
<td>6.40</td>
<td>6.72</td>
<td>4.40</td>
</tr>
</tbody>
</table>

**Table 3.** Comparative Decryption Time (in milliseconds) of various algorithms with different packet size
Simulation results for this compassion point are shown Figure 7 and Table 3 decryption stage. We can find in decryption that the Proposed Algorithm is the better than other algorithms in throughput and power consumption, its throughput is 24.7% as against 23.5%, 18.7%, 17.0% and 16.2% of Blowfish, DES, Triple-DES and AES respectively. Because less the time; less will be the power consumption & more the speed of the algorithm Second point can be notice here that Blowfish has advantage over the other DES and Triple-DES in terms of processing decryption time except the Proposed Algorithm. Third point is to be noticed here that DES has a better performance than Triple-DES in terms of Decryption time. Fourth point which has been observed is that AES has least performance than all. Finally it is concluded that the proposed Algorithm is the best among them all.

**Memory required for implementation**

This memory requirement depends on the number of operations to be done by the algorithm. It is desirable that the memory required should be as small as possible.

**Table 4. Comparison based on memory required for implementation.**

<table>
<thead>
<tr>
<th>Cryptographic Algorithm</th>
<th>Memory required for implementation (KB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DES</td>
<td>12.8</td>
</tr>
<tr>
<td>Triple-DES</td>
<td>14.8</td>
</tr>
<tr>
<td>Blowfish</td>
<td>6.88</td>
</tr>
<tr>
<td>Proposed Algorithm</td>
<td>5.7</td>
</tr>
<tr>
<td>AES</td>
<td>10.6</td>
</tr>
</tbody>
</table>
How much memory space is required to execute an algorithm as known as space complexity? Memory space has depended upon program length, that mean memory utilization is directly depend on length of the program; if any program have used large amount of code then we can say that large memory space will required to execute. In the proposed algorithm used simple and small code.

From Table 5 and the figure 8 above, it is clear that the memory required for implementation is smallest in the proposed algorithm whereas it is largest in 3DES. DES, AES and Blowfish require medium size of memory. Therefore, if the demand of any application is the smallest memory size; the proposed algorithm is the best option.

**The CPU execution time**

The CPU process time is the time that a CPU is committed only to the particular process of calculations. It reflects the load of the CPU. The more CPU time is used in the encryption process, the higher is the load of the CPU. The CPU execution time in seconds for the proposed algorithm and the four algorithms (DES, Triple-DES, Blowfish and AES) were determined on file size of 100 KB.

The experiment was repeated 10 times for each algorithm and for each operation, key generation, the encryption operation and the decryption operation. The average of the 10 runs for each operation was computed for each algorithm.

The result is illustrated in the figure 9 and the table 5. In the experiment, the CPU execution time is computed for the five algorithms CPU time includes: system (kernel) time and user time. The system time is the execution time in kernel mode, and the user time is execution time in user mode.

**Table 5. CPU Execution Time in Seconds for 100KB Text**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Cryptographic Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DES</td>
</tr>
<tr>
<td>Key Generation</td>
<td>0.316</td>
</tr>
</tbody>
</table>

---

4Yan Wang and Ming Hu “Timing evaluation of the known cryptographic algorithms” 2009 International Conference on Computational Intelligence and Security
The CPU execution time for the proposed Algorithm is shorter than the CPU execution time of the other algorithms by the factors shown in the graph.

Simulation time

The time required by the algorithm for processing completely a particular length of data is called the simulation time. It depends on the processor speed, complexity of the algorithm etc. The smallest value of simulation time is desired. From Table 6 the text files of different sizes/text lengths are taken.

Table 6. Comparison based on simulation time required for different length of plaintexts (in sec.)

<table>
<thead>
<tr>
<th>Text Length (KB)</th>
<th>DES</th>
<th>Triple-DES</th>
<th>Blowfish</th>
<th>Proposed Algorithm</th>
<th>AES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>2.0</td>
<td>6.0</td>
<td>4.2</td>
<td>0.18</td>
<td>3.2</td>
</tr>
<tr>
<td>0.7</td>
<td>5.1</td>
<td>16.2</td>
<td>6.1</td>
<td>0.24</td>
<td>5.4</td>
</tr>
<tr>
<td>3.0</td>
<td>59.0</td>
<td>332.0</td>
<td>10.0</td>
<td>0.87</td>
<td>14</td>
</tr>
<tr>
<td>6.0</td>
<td>243</td>
<td>1301</td>
<td>14.5</td>
<td>2.00</td>
<td>21.9</td>
</tr>
</tbody>
</table>

These are encrypted and decrypted using all the Cryptographic techniques one by one. The simulation time taken by different techniques is recorded in sec. It is clear that the Proposed Algorithm is the fastest Cryptographic technique. Triple-DES is the slowest technique. The speed of DES, AES and Blowfish is average. This is graphically shown in figure 10, where with text length 6KB the bar of Triple-DES indicate remarkable height far above other cryptographic techniques. The graph depicts that the simulation time is best on the proposed algorithm for the four types of text length.
From the simulation analysis it can be observed that it is possible to reduce the complexity of algorithms mathematical manipulations and still ensure maximum security, however the more the algorithms mathematical manipulations is simplified the less secure it becomes.

On the question; can the new encryption algorithms design and implementation to enhance performance? It has been proved yes not only that simulation results shows the possibility of comparing some of the proposed algorithm’s variables with that of the tested and proving algorithms like: DES, Triple-DES, Blowfish and AES.

**Conclusion**

This paper presents a performance evaluation of selected Proposed Enhanced Simplified Symmetric Key Encryption Algorithm and other selected symmetric encryption algorithms on avalanche effect, time consumption for encryption and decryption. The selected algorithms are AES, DES, Triple-DES and Blowfish. Several points will include in the simulation results. First; in the case of Avalanche effect, it can be concluded that proposed algorithm produces smallest avalanche effect as compared with DES, Triple-DES, Blowfish and AES, and AES produced the highest avalanche effect, therefore AES is the best option not the proposed algorithm. Second; in the case of Encryption and Decryption Time the proposed Algorithm is the best among as compared with DES, Triple-DES, Blowfish and AES. Therefore it has found proposed algorithm produced better performance than other selected encryption algorithms used in terms of time consumption.

On Memory required for implementation, comparatively, DES, Triple-DES, Blowfish and AES each uses more memory space than the proposed algorithm. From the above stimulation results, there is possibility to reduce the complexity of algorithms mathematical manipulations and still ensure maximum security; however, the proposed algorithm is not all that simple.

**Limitations of the study**

**Technology constriction:** The problem encountered here is securing the data through data encryption algorithms like DES, Triple-DES, AES and Blowfish Algorithms and another problem is since cryptography is depends on complex mathematical manipulations the more you are simplifying mathematical principles the weaker the resulted algorithm becomes.

**Resource constriction:** There was not adequate fund and computing resources to carried out cryptanalysis.

**Testing constriction:** Future researches can test to break the security of the proposed algorithm by writing their own code and using highly classified testing/hacking approach to perform more complex cryptanalysis.
Future enhancement

This system can be enhanced by developing a standard formula for generating the number N which determines the number of iterations that is to be carried out. Though the system is designed for storage level but the modules can be used in web services also. Security can also be enhanced by using more complex operation to increase security level.

The algorithms can be implemented by iterative model instead of using steady algorithm not only that it can use random order algorithm for compression and encryption.

References


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The Impact of Early Childhood Development Centres on Performance of Children in Early Primary School

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Abstract

Communities in Malawi establish Early Childhood Development (ECD) centres where children aged from 3 to 5 years are enrolled. At the age of 6, children enrol in Grade 1 in primary school. Community members claimed that graduates from ECD centres performed better in early primary school than non-ECD centre graduates. However, there was lack of empirical evidence to substantiate the claim. This study was aimed at assessing the impact of ECD enrolment on children’s performance in early primary school by tracking the performance of ECD centre graduates in Grade 1 and comparing it with performance of non-ECD centre graduates. Four primary schools which enrolled more ECD centre graduates in Grade 1 were purposively sampled for this study in Blantyre district, Malawi. Performance of 943 children was tracked, of which 159 were ECD centre graduates. End of year Grade 1 assessment results for the 943 children were used to get numbers of children who were promoted to Grade 2, who repeated in Grade 1 and who dropped out of Grade 1. Then promotion rate, repetition rate and dropout rate for ECD centre graduates and non-ECD centre graduates were calculated and compared. The results revealed that promotion rate was higher for ECD centre graduates than for non-ECD centre graduates while repetition rate and dropout rate were lower for ECD centre graduates than for non-ECD centre graduates. It was therefore concluded that Early Childhood Development centres impact positively on children’s performance in early primary school.

Keywords: Early Childhood Development, feeder ECD Centres, early primary school, promotion rate, repetition rate, dropout rate

Introduction

Communities in Malawi establish Early Childhood Development (ECD) centres where children aged from 3 to 5 years are enrolled. Many of these ECD Centres are established with the support of either government or non-government organisations. ECD Centres prepare children for enrolment in Grade 1 at a primary school. Upon reaching age 6, the children graduate from the ECD Centre to enrol in Grade 1 at a primary school. It was a common belief among community members that graduates from ECD centres performed better in early primary school than non-ECD centre graduates. However, the claim could not be substantiated due lack of empirical evidence.

The purpose of the study was to assess the impact of ECD Centre attendance on children’s performance in Grade 1 at early primary school by tracking the performance of ECD centre graduates in Grade 1 and comparing it with performance of non-ECD centre graduates. To achieve this purpose, the study focused on the following objectives:

1. Calculate the promotion rates from Grade 1 to Grade 2 of ECD Centre graduates and non-ECD Centre graduates in the sampled primary schools.
2. Compare Grade 1 repetition rates of ECD Centre graduates and non-ECD Centre graduates in sampled primary schools.
3. Compare Grade 1 dropout rates of ECD Centre graduates and non-ECD Centre graduates in sampled primary schools.
This study was significant in that it provided research evidence that ECD programs produce desirable benefits. Such empirical evidence can be used for mobilising political and public support for financing the establishment of more ECD Centres.

**Literature review**

Early childhood Development education involves provision of supervised programs with social and educational goals for children aged 3 to 5 years. These children participate in ECD education until age of school entry. Participating in early childhood Development education helps to enhance a child’s readiness for primary school enrolment (Estes, 2015). Rao et al. (2014) reported that ECD educational interventions resulted in consistent positive effects on children’s cognitive development and school success and reduced the achievement gap between children from low-income families and their more advantaged peers. They argued that since ECD education enhanced children’s cognitive development and learning, it leveled the playing field for disadvantaged children during the early years of primary school. Similar cognitive and academic achievement in early primary school was also reported to be positive for children who graduated from preschool (Ramey et al, 2000).

In their study of the benefits of ECD education interventions in relation to academic success, Campbell, et al. (2002), Loeb, et al. (2007) and Nores & Barnett (2010) found that children who participated in preschool earned significantly higher scores on intellectual and academic measures as compared to children who never enrolled in pre-school. The studies also revealed that pre-school education enhanced the children’s skills in mathematics and reading. These findings agreed with what Berlinski, Galiani & Gertler (2006) found in their investigation of the effect of pre-primary school on subsequent primary school performance in Argentina. The investigation confirmed that pre-primary school attendance positively affected children’s performance in primary school. Similar findings were also revealed by Camilli, et al. (2010) who did a meta-analysis of 123 comparative studies on the benefits and costs of preschool programs. The results showed that there was a positive impact on social skills and school progress for children who attended preschool before enrolling in Grade 1 at primary school.

Barnett (1995) reviewed 36 studies on long-term effects of early childhood programs on cognitive and school outcomes. The review focused on the effects of ECD program participation on children’s cognitive development. The results showed that early childhood programs produce large short-term benefits for children on intelligence quotient (IQ) and sizable long-term effects on school achievement, grade retention, and social adjustment. These revelations meant that ECD programs impact on many aspects of the child’s development, hence the need for increased financial support from governments to increase access. Early, et al. (2007) reported that while it is important to provide high-quality preschool education, increasing the qualification of preschool teachers was not adequate for improving classroom quality or maximizing children’s academic gains. Early, et al. (2007) recommended that raising the effectiveness of ECD education requires a wide range of professional development activities and supports targeted toward teachers’ interactions with children.

Gardinal-Pizato, Marturano, & Fontaine (2012) carried out a study on access to early childhood education and academic achievement in elementary school with a view to verifying the impact of exposure to ECD education on the academic performance of children and evaluate their academic progress from the 3rd to the 5th grade when there is exposure to early childhood education. The results showed that ECD education was consistently associated with greater achievement. Gilliam & Zigler (2001) did a critical meta-analytic review of the evaluations of the impact of state-funded preschool programs on child outcomes. The findings provided support for positive impacts of preschool programs in improving children’s school attendance and performance, as well as reducing grade repetition (retention) several years beyond preschool (Rhee & Lee, 1990). These findings were corroborated by Ruhm & Waldfogel (2011) in their study of long-term effects of early childhood care and education.
Methodology

Research design

The study used a quantitative approach. Statistics were computed to determine the promotion rate, repetition rate and dropout rate of ECD Centre graduates and non-ECD Centre graduates. The study was carried out in Blantyre district in Malawi.

Selection of primary schools

Four primary schools were purposively sampled in Blantyre district. These were the first four schools which enrolled more ECD Centre graduates in Grade 1. The four schools had a total of eight feeder ECD Centres. The feeder ECD Centres are centres which fed primary schools with ECD graduates.

Data collection

The study used ECD Centre data for 2008 and primary school enrolment data for 2009. As the study commenced, names of children who graduated from ECD Centre in 2008 were collected from the eight feeder ECD centres including the names of respective schools where they enrolled. Then names of all children (ECD Centre graduates and non-ECD Centre graduates) who enrolled in Grade 1 in 2009 academic year were compiled for each of the four primary schools. Class attendance registers were used to get enrolment figures by sex as well as number of dropouts and to verify which of the ECD Centre graduates actually enrolled in Grade 1. Then the performance of ECD Centre graduates in Grade 1 was tracked by focussing on promotion, repetition and dropout. Children who were enrolled but either died or transferred to other primary schools where their performance could not be tracked were excluded from the study. End of 2009 school year assessment results were used to get numbers of children who were promoted to Grade 2, repeated in Grade 1 and dropped out of Grade 1. Two check lists were used as data collection tools. One check list consisted of names of ECD Centre graduates who enrolled in Grade 1 in 2009 and the other consisted of names of non-ECD Centre graduates who enrolled for Grade 1 in 2009. Then, using end of 2009 school year assessment results, the researcher indicated against each name whether the child was promoted to Grade 2, repeated in Grade 1 or dropped out of Grade 1.

Data analysis

Data analysis was done using descriptive statistics. It involved the calculation of promotion rate, repetition rate and dropout rate of ECD Centre graduates which were then compared with those of non-ECD Centre graduates. Similar analysis was also done based on sex of the students.

Results

Comparison of performance of ECD centre graduates and non-ECD centre graduates

During the study, end of year Grade 1 assessment results were used to determine the numbers of the children who were promoted to grade 2 and those who repeated grade 1. The Grade 1 assessment results were compared with the enrolment record to determine the number of children who dropped out of school. Performance of 943 Grade 1 children was tracked, of which 159 were ECD Centre graduates while 784 were non-ECD Centre graduates.

The study results presented in Tables 1 and 2 give the distribution in terms of promotion, repetition and dropout of ECD Centre graduates and non-ECD Centre graduates. Of the 159 ECD Centre graduates who enrolled in Grade 1 in 2009 in the four primary schools, 83 were boys and 76 were girls. End of year assessment results revealed that 110 children were promoted to Grade 2 while 35 repeated in Grade 1 and 14 dropped out of Grade 1.
Table 1: Number of ECD centre graduates by sex

<table>
<thead>
<tr>
<th></th>
<th>Promoted to grade 2</th>
<th>Repeated in grade 1</th>
<th>Dropped out of grade 1</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>59</td>
<td>15</td>
<td>9</td>
<td>83</td>
</tr>
<tr>
<td>Girls</td>
<td>51</td>
<td>20</td>
<td>5</td>
<td>76</td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>35</td>
<td>14</td>
<td>159</td>
</tr>
</tbody>
</table>

Table 2 indicates that of the 784 non-ECD Centre graduates, who enrolled in Grade 1 in 2009 in the sampled primary schools, 397 were boys and 387 were girls. End of year assessment results revealed that 383 children were promoted to Grade 2 while 266 repeated in Grade 1 and 135 dropped out of Grade 1.

Table 2: Number of non-ECD centre graduates by sex

<table>
<thead>
<tr>
<th></th>
<th>Promoted to grade 2</th>
<th>Repeated in grade 1</th>
<th>Dropped out of grade 1</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>177</td>
<td>165</td>
<td>55</td>
<td>397</td>
</tr>
<tr>
<td>Girls</td>
<td>206</td>
<td>101</td>
<td>80</td>
<td>387</td>
</tr>
<tr>
<td>Total</td>
<td>383</td>
<td>266</td>
<td>135</td>
<td>784</td>
</tr>
</tbody>
</table>

Descriptive analysis of the performance of Grade 1 children revealed that 69.2% of the ECD centre graduates were promoted to Grade 2 as compared to only 48.9% of the non-ECD Centre graduates (Figure 1). A larger proportion of non-ECD Centre graduates repeated in Grade 1 (33.9%) and dropped out of Grade one (17.2%) as compared to 22.0% and 8.8% respectively for ECD Centre graduates.

Figure 1: Comparison of Grade 1 Performance of ECD Centre graduates and Non-ECD Centre graduates in Blantyre District

**Grade 1 performance by sex**

Performance of the ECD Centre graduates and non-ECD Centre graduates in Grade 1 was also analysed by sex. The results as shown in figure 2 revealed that for ECD Centre graduates, more boys (71.1%) were promoted to Grade 2 than girls (67.1%). More girls repeated in Grade 1 than boys while more boys dropped out than girls. The opposite was observed for non-ECD Centre graduates where more girls (53.2%) were promoted to Grade 2 than boys (44.6%) while more boys repeated in Grade 1 than girls. In addition, there were more girl dropouts than boys.
Discussion

The purpose of the study was to assess the impact of ECD Centre attendance on children’s performance in Grade 1 at early primary school by tracking the performance of ECD centre graduates in Grade 1 and comparing it with performance of non-ECD centre graduates. This was done by calculating the rates of promotion, repetition and dropout for ECD Centre graduates and non-ECD Centre graduates. The results of the study confirmed the claim that graduates from ECD centres performed better in early primary school than non-ECD centre graduates. This was demonstrated by a higher percentage of ECD centre graduates who were promoted to grade 2 and lower percentage of ECD centre graduates who repeated Grade 1 and dropped out of school. These results agree with the findings of other studies such as Rao et al. (2014) and Gardinal-Pizato, Marturano, & Fontaine (2012). In addition, Sylva & Wiltshire (1993) highlighted that most studies have shown that ECD education has immediate, significant gains on the social and cognitive development of children, and that ECD education boosts educational performance. Similar results were also reported by Barnett (1995) whose findings revealed that participation in early childhood education programs promotes cognitive development and school success. The findings of this study call for enhanced policy review to promote ECD education through strategic establishment of ECD centres so that many children may have access to ECD education services.

Conclusion

Overall, the Grade 1 performance of ECD Centre graduates in the sampled schools was better than the performance of non-ECD Centre graduates. The results of the study showed that ECD Centre graduates performed better in Grade 1 in all the three areas (promotion, repetition and dropout). It was therefore concluded that ECD Centres play a significant role in contributing towards children’s academic success in early primary school. In other words, this study has demonstrated that ECD education increases children's success in school and the children are less likely to either repeat a grade or drop out of school. In view of this conclusion, it is recommended that more support from government and non-governmental organizations should be provided for establishment of more ECD Centres to allow more children to access to early childhood development education. Besides, the community leaders should make deliberate efforts to encourage parents to enrol their children for early childhood development education.

Further research

This study focussed on assessing the impact of ECD education on the academic performance of children in early primary school. However, there is need for future studies to focus on the quality of ECD programs being offered in ECD Centres with a view to mobilising the necessary support to overcome any challenges.
Acknowledgements

I would like to acknowledge, with sincere appreciation, the assistance that the ECD District Coordination Office for Blantyre district provided in ensuring that names of 2008 ECD Centre graduates were compiled in addition to making proper arrangements with the four sampled primary schools. I am also grateful to the Blantyre District Education Office for granting me permission for the study to be conducted in the respective schools. A lot of thanks should also go to all the Head teachers and teachers of the sampled primary schools for their cooperation to provide the required information. Finally, thanks to everyone who in one way or another contributed to the success of the study.

References


What can be the outcome if Technology is incorporated into the Education Aspect of the Patient and their Families for the Effective Management of their Health Care?

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Abstract

The evolution of patient and family education technology continues to improve patient health outcomes and reduce patient safety related concerns. The health care team is adopting many platforms to better educate their patients.

The intention is that instant access to health information through technology will allow patients to better manage their health issues. Health education technology has come a far way since 1960’s. Previously, health care workers were handing out pamphlets and brochures to patients. Now health care professionals have developed videos and presentations to educate their patients and families. Most recently, electronic information through the internet is enabling patients and their families to obtain information about their health and make informed decisions with the assistance of their health care provider.

In the 21st century also health educators, doctors, patients and their families are proving that this venture has promoted cost containment, improved patient outcomes and effective patient care management. The literature examined research related to computer based patient education. Health care data base resources were selected for review of the current literature from Medline, CINAHL and the World Wide Web. The search strategy included exploring the subject heading terms ‘technology’ and ‘patient education’. The findings presented in this paper suggest that the use of technology to improve patients' knowledge and to involve them in health care decisions leads to better health outcomes. Kaiser Permanente Panorama City (Calif.) Hospital is one of the hospitals utilizing these creative techniques. This hospital has seen improvements in readmission rates, patient satisfaction and overall hospital satisfaction. There has been reduction in both cardiac and pneumonia readmission rates by more than six percent in less than two years. Patient satisfaction, reported as those patients who understand their condition, has increased from just over 70 percent in 2008 to 90 percent in 2010. Overall hospital satisfaction increased from approximately 80 percent in 2008 to 90 percent in 2010. The purpose of this article is to explore the evolution of computer technology in health care education and, in particular, to examine the application of technology in the process of knowledge transfer and skill development necessary for self-health promotion and disease self-management. A systematic review of the published literature on the development and use of computer-based patient education is followed by a discussion of the application of research findings to practice.

Keywords
- Technology
- Patient education
- Health education
- Health information
- Doctors
- Family
- Introduction
It has been observed that patient education has slowly become a major concern and that hospitals want to get involved in implementing better education for patients and their families. The importance of patient education is an example of critical study and evidence based practice by nurses that has shown that knowledge, on the part of patients and their families, can reduce re-admission rates, decrease healing time, improve mental discomfort, and produce better patient results. Today, patients are educated with the help of technology including modern televisions, I-pads and other sophisticated electronic devices where the patient can watch, learn and explore their illnesses and care. Partnership with team members and families is essential to optimal treatment. The application of individual nursing practice is based on an arrangement of the clinician and the patient. Traditional patient education relied on written material about disease processes, medication, medical management, and self-care instruction guidelines. Today, patients benefit from many forms of education and with all these forms of education nurses can provide patients with knowledge that enables them to understand the disease process and make important decisions about their health. Nursing interventions in proper patient education improves patient self-care, satisfaction, moral support, coping skills and mental stability. Addressing improvement in nursing workflow is essential to the improvement of patient stability and safety. The nurse's ultimate goal through the use of information technology is patient education, while providing high quality care and most importantly patient safety.

Methodology

Health care resources, medline, cinahl and the world wide web were selected to review the current literature. A listing of articles related to the use of computer technology in patient education was obtained from these health care databases. The search strategy included exploding subject heading terms “computer”, “technology” “informatics” and the heading “patient education.” The results from these searches were combined to identify relevant literature in the areas of patient education and informatics, patient education and computer technology. Common key words identified were “patient education,” “health information,” “health education,” “computer technology,” “Family,” “Doctor”.

Results

Data analysis

Systematic research reports of 32 research found that there are significant changes in the patient knowledge level when they are provided with access to computer base learning programs. Self care behaviours, social support, adherence, confidence, satisfaction and clinical outcomes are improved (Brown University, 2016).

The ethical issue is that if patients and their families are not given enough knowledge they may not be adequately prepared for self care after discharge. Also these systems might be difficult for the patient to use and time consuming. On the other hand without these technologies base systems the patients are educated when it is convenient for the nurse (Brown University, 2016).

The nurse may not have enough time to teach the patient how to use the systems. However this can be achieved when the nurse can make time given the right patient to nurse ratio. The nurse can provide discharge teaching and the materials which are useful to the patient with particular diagnosis, procedures and medications. Therefore during hospitalization the patient and family can discuss self care after discharge (Brown University, 2016).

Many hospitals are finding it difficult to engage patients in healthcare management and help them in making effective decisions to improve the health and wellness. Regulatory bodies are urging hospitals to use health information technology to improve patient engagement, understanding and compliance. Hospital who adapt this way often see better outcomes, reduce readmissions and enhanced patient and staff satisfaction (Brown University, 2016).

Hospitals are starting creative techniques to meet current expectations for patient centric health care such as on demand digitalized video education technology and interactive patient education.
system which allow them to customize patient education and information sharing for a variety of medical needs (Brown University, 2016).

**Discussion**

The area of health care education and technology brings meaningful advancements in this new century. Patient education and technology comes in a package with well educated health care professionals in this field. In this twenty first century patients are seeking quick access to health information to improve their health and prevent further complications and diseases. With this new trend of empowering patients to better manage their health problems has motivated many health care technology specialists to develop this area for the patients. Patient education technology can be utilized in the form of video and internet platform to improve health care treatment and prevention (Jacobs, 2011).

Patient education began in the 1960’s and 1970’s. Doctors have been participating in traditional roles and trends to improve patient care in medical homes. Today they are hoping that patient will have instant access to information allowing them to better manage their health problems. During 1980’s videos and slide show presentations was the centre of patient education in hospitals and homes (Jacobs, 2011).

Patients became very involved in managing their own health conditions. They were enquiring for treatment and prevention through this new technology. Videos helped patients to understand their health condition from diagnosis to treatment then to consent for procedures and finally discharged for home. Patients became more involved in promoting their own health and also making informed choices regarding their health status goals (Jacobs, 2011).

During the 1990’s the internet helped patients to obtain information away from the traditional patient doctor interaction to the comfort in their own home. Patient education programmes help patients how to use the internet and access the skills they needed to be self regulated and provide self care in their homes.

During this 21st century patients are moving forward with health education through technology. Patients have access to accounts with their health care provider where they can login in and upload their health information. Patients can access their own data and remain actively involved in their own care. The doctors can now do close monitoring and serve as coach and advisor to the patients. This helps the patients and their doctors to communicate on line with the goal of improving their health condition (Jacobs, 2011).

Patient education is at the core of modern health care and its importance has been demonstrated in many diverse diseases and its treatment for diseases such as asthma, diabetes, hormone replacement therapy etc. Providing quality educational information to patients will give patients empowerment and control over their disease. These will lead to improved health outcomes and decrease health care burden. Patient education has changed significantly during the past 50-60 years from the health care professional telling the patient what to do to empowerment through technology (Jacobs, 2011).

The greatest change in patient education is that it is no longer appropriate to give a patient a leaflet to read and send them away. Technology use has changed the way patients are educated about their health or condition (Jacobs, 2011).

Technology base patient education can be both effective for the patient and free up the doctor’s time. This reduced doctor’s time was calculated to save hospitals millions of dollars. Not all technology has to be utilized. A simple iPod has been shown to enhance conversation between doctors and patients through quick access to health information and videos.

Interactive technology has proved effective in communicating with patients which improves patient satisfaction with hospital educational materials when interactive technology was utilized. With the expanding use of the internet presently, e learning will also provide a valuable useful resource for patients (PMLive 2016).
Another writer stated that informatics and nurses support for ongoing professional development that implements the work knowledge of nurses can eventually lead to high quality patient care and satisfaction. Many nurses are professionally and ethically motivated to participate in high quality improvement, new knowledge and innovation through evidence base decision making (Cassano, 2014).

Patient education has slowly become a major concern and many hospitals are implementing better education for their patients and their families. Evidence base practice has shown that patient education by nurses that has shown that knowledge can reduce re-admission rates, decrease healing time, improve mental discomfort, and produce better patient results (Cassano, 2014).

Today patients are educated using technology which includes televisions, i pads, and other complicated electronic devices, which the patient can watch, learn and explore their illness and care. Traditional patient education can also be utilized. Patient benefit from many types of education which nurses can provide patient with knowledge that enables them to comprehend the disease process and make important decisions about their health. Nursing interventions which is carried out in proper patient education improves patient self care, satisfaction, moral support, coping skills and stability (Cassano, 2014).

Another writer stated that patient specific education was meant to help medical professionals make good decisions about their health and links to appropriate information with wide range of videos, articles, videos and images for the patient. Patient education allows for the patient to better understand their health and informed decisions and lifestyle changes (Health IT, 2014).

Patient education resources can give information specific to the patient’s health condition, their point of care, and health care decisions they may have to face. Ensuring that patient have the appropriate education resources can help them remember valuable information, improve their ability to take care of their health, and help them to take part in informed decision making (Health IT, 2014).

Health care providers should provide educational resources during consultation. When information is shared during patient visits, it allow providers to review materials directly with the patient, highlight critical information, action items and ascertain patient understanding. Also on line resources and other learning tools, the providers can demonstrate to the patient how to access and use those tools. Patient information, language, printed materials and other preferences can be ascertained (Health IT, 2014).

When computers and printers are placed in the health care settings, workers as well as patients can easily access printed materials and view on line educational resources during the consultation visits (Health IT, 2014).

Patient education plays an important role in empowering patient and their families. Educating patients about their disease, its treatment, side effects and its management can decrease patient anxiety, improve quality of life, enhance coping, decrease decisional conflicts, encourage patient autonomy with improved patient experience. When patients understand their disease and treatment they develop greater compliance with their treatment which results in better outcomes. All patients have a variety information and educational needs. Information which concerns their diagnosis, treatment and support services is the greatest priority for patients and their families (Cancer care, nd).

Patient education should be an ongoing process and can be provided in a variety of ways to meet the individual needs of the patients. Using individual or group teaching can be supported by various teaching strategies such as printed material computer base educational programmes, interactive multimedia technology, audiovisual programs can be utilized. Regardless of the approach adapted health care workers must incorporate learning throughout patient care (Cancer care, nd).

It is very important for health care workers to recognise barriers to patient learning. Some of these can be anxiety, emotional distress, in ability to read and use computers before initiating teaching. They should ensure that teaching talks place in environments which are promoting learning (Cancer care, nd).
Technology has proven to make patient education material more accessible. There are so many health care facilities which have educational resources and printed materials for patients with the touch of a button. Internet sources are also available. Patient health information may be provided through a wide range of techniques (Practical nursing, 2016).

Watching a DVD, reading, or even hand on approach can be effective. Teaching patients by utilizing technological methods can be one of the most challenging and rewarding areas of nursing care. Excellent instructions improve patient outcomes significantly. It is one of the most creative parts of nursing (Practical nursing, 2016).

Almost all nurses understand the importance of patient education. Sometimes they are overcome by the lack of time and resources to support it. They are aware that the limited time they spent with patients can restore health to some degree. As the world changes, the methods which are accessible to teach patients and their families expand. Booklets, group classes, information by telephone, telephone hotlines and help lines, videos, podcasts, websites, text messaging, webinars, chronic disease management programs and social networking are all available (Practical nursing, 2016).

**Conclusion**

Innovation can always help to advance a field, however while cutting edge methods can provide a fantastic resource, in this case, it is very likely the future of patient education will feature even more extensive use of apps, in particular these will focus on helping patients manage complex ‘lifestyle diseases’ such as type 2 diabetes. While there is concern that the field of medical apps is somewhat unregulated. There can be no doubt that apps provide a fantastic opportunity to provide information, conveniently to patients. With the expanding use of the internet, e-learning will also provide an increasingly useful resource for patients. While cutting edge innovation is more likely to be driven by the private sector, the pharmaceutical industry often competes in a very crowded market; as such they are always seeking a new way to stand out from their competitors. Use of technology and innovation should seek to drive enhanced patient experience and improve outcomes both on an individual and an economic level (PMLive, 2016).

**Tables and figures**

**Kaiser Permanente Panorama City (Calif.) Hospital case study outcomes**

**Cardiac and Pneumonia Readmission**

<table>
<thead>
<tr>
<th>Year</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>2010</td>
</tr>
<tr>
<td>10 cases</td>
<td>6 cases (over 6%)</td>
</tr>
</tbody>
</table>

**Patient Satisfaction**

<table>
<thead>
<tr>
<th>Year</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>2010</td>
</tr>
<tr>
<td>70%</td>
<td>90%</td>
</tr>
</tbody>
</table>

**Hospital Satisfaction**

<table>
<thead>
<tr>
<th>Year</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>2010</td>
</tr>
<tr>
<td>80%</td>
<td>90%</td>
</tr>
</tbody>
</table>

Studies have shown that Kaiser Permanente Panorama City (Calif.) Hospital is one of the hospitals utilizing these creative techniques. This hospital has seen improvements in readmission rates, patient satisfaction and overall hospital satisfaction. There has been reduction in both cardiac and pneumonia readmission rates by more than six percent in less than two years. Patient satisfaction, reported as those patients who understand their condition, has increased from just over 70 percent in 2008 to 90 percent in 2010.
Overall hospital satisfaction increased from approximately 80 percent in 2008 to 90 percent in 2010 (Roney, 2012).

**KPPC outcomes** KPPC has used the TIGR AP (interactive patient education solution) system as an effective engagement tool to provide patients and families timely prevention and treatment information. When patients better understand their conditions and recovery steps, it is less likely they will be readmitted to the hospital. According to the KPPC case study, the hospital has seen improvements in readmission rates, patient satisfaction and overall hospital satisfaction. Hospital officials need to be thinking creatively to harness health information technology in order to reduce readmissions and increase patient engagement, especially with upcoming CMS readmission fines and stage 2 of meaningful use. The ability of interactive patient education systems to marry information technology and patient education makes them a valuable tool for hospitals (Roney, 2012)

**References**


http://www.pmlive.com/pmhub/medical_communications/fti_consult
Knowledge and use of Information and Communications Technologies (ICTs) in Teaching and Learning among Teachers and Students of Schools of Nursing and Midwifery in Benue State, Nigeria

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Abstract

The research is a cross-sectional descriptive survey conducted at Schools of Nursing and Midwifery in Benue State on “Knowledge and Use of ICT in Teaching and Learning Among Teachers and Students”. The specific objectives were: to assess the availability of ICT facilities in the schools, to assess the knowledge of the teachers and students on the use of ICT facilities in teaching and learning, to ascertain the extent to which the teachers and students make use of the available ICT facilities, to assess the perceived usefulness of the ICT to teachers and students, and to determine factors hindering the availability and use of ICT facilities in the schools for teachers and students use. Stratified sampling technique was used to group the students into homogeneous subsets of classes/levels of study after which convenience sampling technique was used to select samples used for the study disproportionately. Data were collected from the respondents through self-structured and validated questionnaire. Data obtained were analyzed and presented using frequency distribution table while chi-square was used to analyse the stated hypotheses. Based on the findings; there is availability of ICT in the schools, however, not all items needed for smooth running of ICT were available and the existing ones are insufficient, both the teachers and the students have some degree of knowledge about ICT but such knowledge is seriously limited as most of the teachers and students were not computer literate, most teachers and students were not making use of the available ICTs in the school and those who made use of it were inconsistent in their use of the ICT facilities even though most of them believed that ICT use in teaching and learning is very essential for better and quality education. Factors hindering the availability and use of ICT facilities in the schools were multifactorial as shown in the study. The researcher made the following recommendations; management and leadership of the schools should put more effort to ensure provision of adequate ICT facilities for teachers and students use as this will enhance the quality of the teaching and learning in the school, and that the government should make use of ICT facilities in teaching and learning mandatory in all schools even as they assist schools who cannot afford it to secure adequate ICT facilities for teachers and students use.

Keywords: Knowledge, Use, ICT, Teaching, Learning, Teachers, and Students.

Introduction

Information and communications technology or technologies (ICT) is an umbrella term that includes any communication device or application, encompassing; radio, television, cellular phones, computer and network hardware and software, projectors, satellite systems and sour, as well as the various services and applications associated with them, such as videoconferencing and distance learning. ICTs are often spoken of in a particular context, such as ICTs in education, health care, or libraries (Margaret, 2016).

ICT have become commonplace entities in all aspects of life. Across the past twenty years the use of ICT has fundamentally changed the practices and procedures of nearly all forms of endeavor within business and governance. Education is a very socially oriented activity and quality education has traditionally been associated with strong teachers having high degrees
of personal contact with learners. The use of ICT in education lends itself to more student centered learning settings (Noor-Ul-Amin, 2014). Information and communications technologies education is basically our society’s efforts to teach its current and emerging citizens valuable knowledge and skills around computing and communications devices, software that operates them, applications that run on them and systems that are built with them. According to Education Scotland, (2016), we are living in a constantly evolving digital world. ICT has an impact on nearly every aspect of our lives – from working to socializing, learning to playing. The digital age has transformed the way young people communicate, network, seek help, access information and learn. As technology becomes more and more embedded in our culture, we must provide our learners with relevant and contemporary experience that allow them to successfully engage with technology and prepare them for life even after school. It is widely recognized that learners are motivated and purposefully engaged in the learning process when concepts and skills are underpinned with technology and sound pedagogy.

Statement of the problem

Teachers and students live in a rapidly changing technological world. Information and communications technology including hardware and personal digital devices, software, and systems that manage, store, process, create, produce and communicate information, has become an important part of everyday life. The integration of ICT capabilities in teaching, learning and assessment can lead to enhanced outcomes for both teachers and students and support the interactive process of teaching, learning and assessment in schools. This will also develop the knowledge, skill, understanding, attitudes and behaviours to assist students to live and work successfully in this 21st century. Integration of ICT can support a range of teaching, learning and assessment approaches that;

- Enhance learning opportunities through access to a range of resources, stimulus materials and learning tools.
- Provide increased opportunities for student engagement and motivation.
- Equip students with the necessary knowledge and skills to use ICT to support 21st century learning.
- Support the development of effective student research and evaluation skills.
- Promote critical and creative thinking skills
- Increase teacher and student efficiency
- Develop awareness of the public nature of online activity and related responsibilities.
- Increase opportunities to work collaboratively, locally nationally and globally.

Students and teachers have the opportunity to become competent, discriminating and creative users of ICT as they learn to use ICT effectively and appropriately when investigating, creating and communicating ideas and information. Students and teachers will learn about the ethics of nursing and teaching through technology. Irrespective of all the above perceived gains of using ICT in teaching and learning, many studies have demonstrated very low usage of ICT in institutions of learning where such is being used at all especially in some developing countries. In schools of nursing and midwifery in Benue State, it was observed that many teachers and students were not making use of ICT in teaching and learning thus hindering their ability to have faster access to recent clinical researches and methods of teaching which in turn is capable of enhancing evidence based practice which is the current clinical acceptable practice. This has prompted the researcher to go into investigation into knowledge and use of ICT in teaching and learning among teacher and students of Schools of Nursing and Midwifery in Benue State.

Objectives of the study

The general Objective of the study was to assess the knowledge and use of ICT in teaching and learning among teachers and students of schools of nursing and midwifery in Benue State. The specific objectives are:
1. To assess the availability of ICT facilities in the schools of nursing and midwifery.
2. To assess the knowledge of the teachers and students on the use of ICT facilities in teaching and learning.
3. To ascertain the extent to which the teachers and students make use of the available ICT facilities.
4. To assess the perceived usefulness of the ICT to teachers and students.
5. To determine factors hindering the availability and use of ICT facilities in the schools for teachers and students use.

**Hypothesis for the study**

The null hypothesis for the study is stated as follows:

1. There is no statistical significant difference between the knowledge of teachers in the use of ICT in teaching and their years of experience.
2. There is no statistical relationship between knowledge of students on the use of ICT facilities in learning and years spent in school.

**Literature review**

Information and communication technology have become within a very short time, one of the basic building blocks of modern society. Many countries now regard understanding ICT and mastering the basic skills and concepts of ICT as part of the core of education, alongside reading, writing and numeracy. However, the rapper to be a misconception that ICTs generally refers to computers and computing related activities (Noor-Ul-Amin, 2014). Pelgrum and Law (2003) stated that “near the end of the 1980s, the term computers was replaced by “IT” (Information technology) signifying a shift of focus from computing technology to the capacity to store and retrieve information. This was followed by the introduction of the term ‘ICT’ (information and communication technology) around 1992, when e-mail started to become available to the general public”. According to a United Nations report (1999) ICTs cover internet service provision, telecommunications equipment and services, information technology equipment and services, media and broadcasting, libraries and documentation centres, commercial information providers, network-based information services, and other related information and communication activities. According to UNESCO (2002), information and communication technology (ICT) may be regarded as the combination of informatics technology with other related technology, specifically communication technology. The various kinds of ICT products available and having relevance to education, such as teleconferencing, email, audio conferencing, television lessons, radio broadcasts, interactive radio counseling, interactive voice response system, audiocassettes and CD ROMs etc have been used in education for different purposes (Sharma, 2003, Sanyal, 2001; Bhattacharya and Sharma, 2007; Nguyen, Williams and Nguyen, 2012).

The 1990s was the decade of computer communications and information access, particularly with the popularity and accessibility of internet-based services such as electronic mail and the World Wide Web (www). At the same time the CD-ROM became the standard for distributing packaged software (replacing the floppy disk). As a result educators became more focused on the use of the technology to improve it. It is widely recognized that learners are motivated and purposefully engaged in the learning process when concepts and skills are underpriced with technology and sound pedagogy (Education Scotland, 2016).

**Availability of ICT facilities in the schools**

Hepp, Hinostroza, Laval and Rehbein (2004) claim in their paper “Technology in schools: Education, ICT and the knowledge society” that ICTs have been utilized in education ever since their inception, but they have not always been massively present. According to Bhattacharya and Sharma (2007) there exist infrastructure, socio-economic, linguistic and physical barriers in India for people who wish to access education. This includes infrastructure, teacher and the process quality. According to Adesote and Fatoki (2013) the
readiness of ICT in the sub-Saharan African is still very low with most countries experiencing strong lags in connectivity because of the insufficient development of ICT infrastructures. While the developed world continues to witness development of ICT, Sub-Saharan Africa is still lacking behind due to poor quality services (Global ICT chart Report: Guardian, Friday April, 2012 p.6 cited by Adesote and Fatoki, 2013). Study by Hamilton-Ekeke and Mbachu (2015) on “the place of information, communication and technology in teaching and learning in Nigeria tertiary institutions” revealed that basic ICT facilities like computers are unavailable, students are unable to afford personal laptop. This has grossly affected e-learning and e-communication channels like email, e-board, internet and organized networking system between staff and students.

Knowledge of teachers and students on the use of ICT in teaching and learning

Study by Tella, Tella, Toyobo, Adika and Adeyinka (2015) on “Assessment of secondary School Teachers uses of ICT’s: implication for further development of ICT’s use in Nigerian secondary schools” show that teachers generally have access to ICTs in their various except e-mail and internet because their schools are not connected. Technical support are lacking in the schools and teachers lack of expertise in using ICT was indicated as being the prominent factors hindering teachers readiness and confidence of using ICTs during lesson. According to Shyamal (2015) preparation of teachers to face the challenges of an ICT enriched teaching and learning environment is crucial. First, teachers need to be equipped with the fundamentals of ICT tools and sufficient understanding on the integration of these tools in teaching and learning and secondly efforts must be oriented towards changing mindset and developing positive attitudes towards ICT application in teaching and learning. Teachers need knowledge about technology, pedagogy and content in order to successfully support students’ learning with ICT. With technological pedagogical content knowledge teachers are able to utilize a range if ICT to support student’s learning (Teemu, Kati, Sini, Susanna, and Henriikka, 2012; Sangra and Gonzalez-Sanmamed, 2010).

Teachers need to learn new skills to teach students how to search for and use information from the internet safety issues the study show the need to organize workshops for both staff and students so that they acquire knowledge to effectively use the internet resources that are less used (Nwezeh, 2010; Osakwe, 2010).

Usefulness of ICT to teachers and students

According to Yusuf (2005), the field of education has been affected by ICTs, which have undoubtedly affected teaching, learning and research. A great deal of research has proven the benefits to the quality of education (Al-Ansari, 2006). ICTs have the potential to innovate, accelerate Erich, and deepen skills, to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow’s workers as well as strengthening teaching and helping schools change (Davis and Tearle, 1999; Lemke and Coughlin, 1998; Cited by Noor Ul-Amin, 2014).

ICT increases the flexibility of delivery of education so that learners can access knowledge every time and from anywhere. It can influence the way students are taught and how they learn as now the processes are learner driven and not by teachers. This in turn would better prepare the learners for lifelong learning as well as to improve the quality of learning in concept with geographical flexibility, technology facilitated educational programs also remove many of the temporal constraints that face learners with special needs. Students are starting to appreciate the capability to undertake education anywhere, anytime and anyplace. One of the most vital contributions of ICT in the field of education is easy access to learning. With the help of ICT, students can now browse through e-books, sample examinations papers; previous year papers etc. and can also have an easy access to resource persons, mentors, experts, researchers, professionals, and peers all over the world. Wider availability of best practices and course material in education, which can be shared by means of ICT, can
foster better teaching. ICT also allows the academic institutions to reach disadvantaged groups and new international educational markets.

ICT has the potential to remove the barriers that are causing the problems of low rate of education in any country. It can be used as a tool to overcome the issues of cost, less number of teachers, and poor quality of education as well as to overcome time and distance barriers (McGorry, 2002). People have to access knowledge via ICT to keep pace with the latest developments (Plamp, Pelgrum and Law, 2007). ICTs also allow for the creation of digital resources like digital libraries where the students, teachers and professionals can access research material and course material from any place at any time (Bhattacharya and Shama, 2007; Cholin 2005). Such facilities allow the networking of academics and researchers and hence sharing of scholarly material. This avoids duplication of work (Cholin, 2005)

According to Noor-ul-Amin (2014) ICTs especially computers and internet technologies enable new ways of teaching and learning rather than simply allow teachers and students to do what they have done before in a better way. ICT has an impact not only on what students should learn, but it also plays a major role on how the students should learn. According to Bransford et al (2000) Cited by Khalid (2000) several studies have reviewed the literature on ICT and learning and have concluded that it has great potential to enhance student achievement and teacher learning. According to Grabe and Grabe (2007), technologies can play a role in student skills, motivation, and knowledge, they argue that ICT can be used to present information to students and help them complete learning tasks. ICT can be integrated in the learning process so that learning takes place through the learner’s interaction with the facilities (Adesote and Fatoki, 2013). While delivering the class lectures, any innovative teacher needs to draw diagrams, show pictures, animate some objects to explain critical concepts, even play some video clipping of real time operation. All these multimedia applications can assure very productive, interesting, motivating, interactive and quality delivery of classroom instruction. Presentation software like power point can be a good choice for teachers for performing such tasks (Shyamal, 2015). According to EdTech Review (2014), ICT is very useful in that it helps the students to do assignments given to them by their teachers. It also helps to reduce the social disparities between students since they work in teams in order to achieve a given task.

Factors hindering the availability and use of ICT facilities in school for teachers and students use

According to Balanskat, Blamire and Kefala (2006), although educators appear to acknowledge the value of ICT in schools, difficulties continue to be encountered during the processes of adopting these technologies. According to Becta (2003) Cited by Khalid (2009) five factors influence the likelihood that good ICT learning opportunities will develop in schools: ICT resourcing, LCT leadership, ICT teaching school leadership, and general teaching.

Classification of the hindering factors: Different categories have been used by researchers and educators to classify hindering factors to the availability and use of ICT for teachers and student use. several studies have divided the hintering factors into two categories: extrinsic and intrinsic factors. however they differ in what they meant by extrinsic and intrinsic factors. Ertmer (1999) cited by Khalid (2009) referred to Extrinsic factors as first-order and cited access, time, support, resources and training and intrinsic factors as second-order and cited attitudes, beliefs, practices and resistance; whereas, Hendren (2000 as cited in Khalid, 2009) saw extrinsic barriers as pertaining to organizations rather than individuals and intrinsic barriers as pertaining to teachers, administrators, and individuals.

Another classification is teacher level barriers versus school-level barriers. Becta (2004) grouped the barriers according to whether they relate to the individual (teacher-level barriers), such as lack of time, lack of confidence, and resistance to change, or to the institution (school-level barrier) such as lack of effective training in solving technical problems and lack of access to resources. Another perspective presents the obstacles as pertaining to two kinds of
conditions: material and non-material. The material conditions may be the insufficient number of computers or copies of software. The non-material obstacles include teachers insufficient ICT Knowledge and skills, the difficulty of integrating ICT in instruction, and insufficient teacher time (Khalid, 2009).

- **Lack of teacher confidence:** Several researchers indicate that one barrier that prevents teachers from using ICT in their teaching is lack of confidence. According to Becta (2004), much of the research proposes that this is a major barrier to the uptake of ICT by teachers in the classroom. Balanskat et al (2006) found that limitations in teacher’s ICT knowledge makes them feel anxious about using ICT in the classroom and thus not confident to use it in their teaching study by Becta (2004) showed that many teachers who do not consider themselves to be well skilled in using ICT feel anxious about using it in front of a class of children who perhaps know more than they do.

- **Lack of teacher competence:** In Australian research Newhouse (2002) found that many teachers lacked the knowledge and skills to use computers and were not enthusiastic about the changes and integration of supplementary learning associated with bringing computer into their teaching practices. In Syria, teachers, lack of technological competence has been cited as the main barrier (Albirini, 2006). In Saudi Arabia, a lack of ICT skills as a serious obstacle to the integration of technologies into science education (Al-Alwani, 2005; Almohaissin, out in 27 European countries show that teachers who do not use computer in classrooms claim that “lack of skills” are a constraining factor preventing teachers from using ICT for teaching. Another world wide survey conducted by Pelgrum (2001), of nationally representation samples of schools from 26 countries found that teacher’s lack of knowledge and skills is a serious obstacle to using ICT in primary and secondary schools.

- **Resistance to change and negative attitudes:** Researches into barriers to the integration of ICT into education found that teacher’s attitudes and an inherent resistance to change were a significant factor (Gomes, 2005; Schoepp, 2005). Becta (2004) also identified resistance to change as an important carrier to teacher’s use of new technologies in education. Schoepp’s study (2005) found that, although teachers felt that there was more than enough technology available, they did not believe that they were being supported, guided, or rewarded in the integration of technology into their teaching. According Becta (2004) one key area of teachers’ attitudes towards the use of technologies is their understanding of low these technologies will benefit their teaching and their student’s learning.

- **Lack of time:** several studies have shown that many teachers have competence and confidence in using computers in the classrooms, but they still make little use of technologies because they do not have enough time (Schoepp, 2005; Sicilia, 2005). According to Sicilia (2005) most teachers reported lack of time to plan technology lessons, explore the different internet sites, or lack at various aspects of educational software as a common challenge. According to Al-Alwani (2005) lack of time is a barrier affecting the application of ICT in Saudi Arabia because of busy schedules. In another study Gomes (2005) show that one of the main reasons that teachers do not use ICT in the classroom is lack of the time required to accomplish the plans.

- **Lack of effective training:** Studies have shown that lack of effective training is one of the major factors militating against the use of ICT by the teachers (Schoepp, 2005; Sicilia, 2005; Toprakci, 2006; Ozden, 2007). Researches in Turkey have shown that the main problem with the implementation of new ICT by the teachers was the insufficient amount of in-service training programs for the teachers (Toprakci, 2006; Ozden, 2007). Balanskat et al (2006) found that inappropriate teacher training is not helping teachers to use ICT in their classrooms and in preparing lessons.
Lack of accessibility: Studies have identified lack of access to resources, including Horne access as another complex barrier that discourages teachers from integrating new technologies into education (Chalid, 2009). In a study by Sicilia (2005), teachers complained about how difficult it was to always have access to computers. Korte and Husing (2007) found that in European Schools, there are some infrastructure barriers such as broadband access not yet being available. Research on Syrian schools indicated that insufficient computer resources were one of the greatest impediments to technology integration the classroom (Albirini, 2006). A number of factors are said to have militated against the use of ICT in education in Nigeria these have included such factors as lack of funding to support the purchase of the technology, lack of training of teachers, lack of motivation on the part of teachers to adopt ICTs as teaching tools in the classroom instruction and soon (Adesote and Fatoki, 2013).

According to Fisseha (2011), limitation of ICT use in Education is technology related. The high cost of the technology and maintenance of the facilities, high cost of spare parts, virus attach of software and the computer, interruptions of internet connections, and poor supply electric power are among the technology related limitations of ICT use in education. the integration of ICTs in education systems may face various challenges with respect to policy, planning, infrastructure, learning content and language, capacity building and financing ICT enhanced education requires clearly stated objectives, mobilization of resources and political commitment of the concerned bodies. Study by Mathipa and Mukhari (2014) show that factors influencing the use of ICT in teaching and learning in South African urban schools includes: insufficient number of computers and lack of application programs, teacher generation gap, inadequate teacher training, lack of ICT skill and lack of confidence, teachers beliefs, poor school leadership and lack of public support.

Methodology

Research design

Cross-sectional descriptive survey design was used for the study to assess the knowledge and use of ICT in teaching and learning among teachers and students in schools of nursing and midwifery in Benue State.

Setting for the study

The study was conducted at the schools of nursing and midwifery in Benue State. Benue State has two schools of nursing and two school of Midwifery. One of the schools of nursing and one of the schools of midwifery is owned and is being managed by Nongo U Kristu U I Ser U Sha Tar (NKST), a local church and an offspring of the Sudan United Mission Christian Reformed church. The schools are located along Gboko Mkar-Katsina-Ala road. The schools has about 600 students in both arms (nursing and Midwifery). The other schools of nursing and midwifery located within the heart and metropolitan city of Makurdi, the capital of Benue State belong to the state government. The schools have about 450 students.

Study population

The target population consists of all the students at all levels of the schools and teachers in both schools of nursing and midwifery in Benue State, Nigeria. The total number of students in both schools is about 1050 students while the number of teachers in both schools is about 100 teachers handling different courses in the schools.

Sample and sampling techniques

A total of 50 teachers and 340 students were conveniently and disproportionately selected from the target population upon their willingness to participate in the study following detailed explanation of the rationale of the study to them after using stratifies sampling technique to group the students into homogenous subsets of classes/ levels of study. The researcher ensured that students from all the schools and at all levels participated in the study.
Method of data collection

Data for the study was collected through administered self-structured and validated questionnaire which was made up of different sections that were constructed with the aim of eliciting needed information capable of answering the research questions. The questionnaire was made up of both closed and open ended questions. A trained research assistant also assisted in the administration and collection of the questionnaire.

Method of data analysis

Data was analyzed after collection by the researcher using deceptive frequency distribution table which shows responses of the respondents and analyzed in percentage. Chi-Square was used in the analysis of the stated hypotheses.

Ethical consideration

Information obtained from subjects was for the research purpose only and was treated as strictly confidential; hence, study participants were not required to provide their names on the questionnaire. Participation in the study was voluntary after explaining the rationale and procedure of the study to the participants.

Results

Table 1. Socio-demographic characteristics of respondents (students)

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Variables</th>
<th>Frequency N 340</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-23</td>
<td>46</td>
<td>13.5</td>
<td></td>
</tr>
<tr>
<td>24-28</td>
<td>248</td>
<td>72.9</td>
<td></td>
</tr>
<tr>
<td>29-33</td>
<td>28</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>39 and above</td>
<td>18</td>
<td>5.3</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Educational qualification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSCE</td>
<td>312</td>
<td>91.8</td>
<td></td>
</tr>
<tr>
<td>OND</td>
<td>12</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>HND</td>
<td>10</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>BSC</td>
<td>6</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Level of studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 level</td>
<td>180</td>
<td>52.9</td>
<td></td>
</tr>
<tr>
<td>200 level</td>
<td>84</td>
<td>24.7</td>
<td></td>
</tr>
<tr>
<td>300 level</td>
<td>76</td>
<td>22.4</td>
<td></td>
</tr>
</tbody>
</table>

Table one above shows that 72.9% of the student respondents were between the ages of 24 and 28, 13.5% were between the ages of 18 and 23, 8.3% were between the ages of 29 and 33, while 5.3% were at the age of 39 and above. On their educational qualification, the table show that 91.8% had SSCE, 3.5% had OND, 2.9% of them had HND, while 1.8% had BSc. On the levels of study of the students respondents, 59.9% were in 100 level, 24.7% were in 200 level and 22.4% were in 300 level.

Table 2. Socio-demographic characteristics of respondents (teachers)

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Variables</th>
<th>Frequency N=50</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-25</td>
<td>4</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>26-30</td>
<td>9</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>31-35</td>
<td>13</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>36-40</td>
<td>24</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>41 and above</td>
<td>4</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Educational qualification</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
From table 2 above, 48% of the respondent teachers were between the ages of 41 and above, 26% between the ages of 36 and 40, 18% were between 31 and 35 years while 8% were between 26 and 30 years. The table also shows that 40% of the respondent teachers had BSc/BNSc, 24% had RN and RM, 12% had RM certificate only, and another 12% had masters degree while another 12% had RN certificate only. About the teaching experience, the table shows that 44% of the respondent teachers had 14 years and above teaching experience, 22% had experience of 10 to 13 years, 14% had experience of 7 to 9 years, 12% had experience of 4 to 6 years while 8% had experience of 1 to 3 years.

Table 3. Availability of ICT facilities in the schools

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Variables</th>
<th>Frequency N = 390</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Do your school have ICT facilities?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>390</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>If yes, what are the available facilities?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ICT centre with computers connected to the internet</td>
<td>80</td>
<td>20.5</td>
</tr>
<tr>
<td></td>
<td>ICT centre with computers not connected to the internet</td>
<td>180</td>
<td>46.2</td>
</tr>
<tr>
<td></td>
<td>Data projectors</td>
<td>140</td>
<td>35.9</td>
</tr>
<tr>
<td></td>
<td>Digital cameras</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Scanner</td>
<td>30</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>Video equipment</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Computer/laptops in the library</td>
<td>80</td>
<td>20.5</td>
</tr>
</tbody>
</table>

Table 3 above shows that 100% of the respondent said their schools have ICT facilities. Of this 100% who said the school have ICT facilities n=390, 46.2% said there school have ICT centre with computers not connected to the internet, 35.9% said the school have data projectors, 20.5% of the respondents said the school have ICT centre with computers connected to the internet and another 20.5% said the school have computers/laptops in the library while 7.7% said the school have scanner.

Table 4. Knowledge of students on the use of ICT facilities in learning

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Variables</th>
<th>Frequency N = 340</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Have you heard of ICT before?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>270</td>
<td>79.4</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>70</td>
<td>20.6</td>
</tr>
<tr>
<td>2.</td>
<td>If yes through what source?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>At School</td>
<td>266</td>
<td>98.5</td>
</tr>
<tr>
<td></td>
<td>Through Radio</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Through newspaper</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4. Knowledge of students on the use of ICT facilities in learning
Through friends/colleagues | 4 | 1.5
---|---|---
3. **Are you computer literate?**  
Yes | 60 | 17.6  
No | 280 | 82.4
4. **If yes, for how long have you been using computer?**  
1-2 years | 18 | 30  
3-4 years | 34 | 56.7  
5-6 years | 6 | 10  
7 years and above | 2 | 3.3
5. **What do you understand by ICT use in teaching & learning?**  
Using computers in browsing the internet | 260 | 76.5  
Using data projectors in teaching | 195 | 57.4  
Using cell phones in browsing the internet | 220 | 64.7  
Making video conferencing | 180 | 52.9  
Using computers in teaching | 260 | 79.4

Table 4 above shows that 79.4% of the students respondents, n=340, said they have heard of ICT before while 20.6% said they have not heard of ICT before. Of those who said they have heard of ICT before, n=270, 98.5% said they heard of it at school, while 1.5% said it was through friends/colleagues. The table also shows that 82.4% of the respondents said they were not computer literate while 17.6% said they were computer literate. Of those who said they were computer literate, n=60, 56.7% said they have used computer for 3 to 4 years, 30% said they have used computer for 1 to 2 years, 10% said they have used it for 5 to 6 years while 3.3% said they have used computers for 7 years and above. Assessing what they understand by ICT use in teaching and learning, n=340, 79.4% said it is using computers in teaching, 76.5% said it is using computers in browsing the internet, 64.7% said it is using cell phones in browsing the internet, 57.4% said it is using data projectors in teaching while 52.9% said it is making video conferencing.

Table 5. Knowledge of teachers on the use of ICT facilities in teaching and learning

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Variables</th>
<th>Frequency N = 50</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Have you heard of ICT before</td>
<td>Yes</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>If yes through what source?</td>
<td>At school</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Through radio</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Through workshop</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Through personal reading</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Through friends and colleagues</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Through newspaper</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>Are you computer literate?</td>
<td>Yes</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>28</td>
</tr>
<tr>
<td>4.</td>
<td>If yes, for how long have you been using computers?</td>
<td>1-2 years</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3-4 years</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5-6 years</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7 years and above</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>What do you understand by ICT use in teaching &amp; learning?</td>
<td>Using computer in browsing the internet</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Using data projectors in teaching</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Using cell phones in browsing the internet</td>
<td>32</td>
</tr>
</tbody>
</table>
Above table 5 shows knowledge of teachers on the use of ICT in teaching and learning as follows: n=50, 100% of the respondents said they have heard of ICT before. Of those who have heard it before, 50% said it was through personal reading, 36% said it was at school, while 14% said it was through workshop. The table also show that 56% of the teacher respondent said they are not computer literate while 44% said they are computer literate. Of those who said they are computer literate n=44, 54.5% said they have been using computers for 3 to 4 years, 27.3% said they have been using computers for 1 to 2 years, while 18.2% of the respondents said they have been using computers for 5 to 6 years. Assessing what the respondent teachers understand by use of ICT in teaching and learning, the table shows n=50, 100% of the respondent said it is using computers to browse the internet, using data projectors in teaching, and using the computers in teaching, 64% said it is using cell phones to browse the internet, while 48% said it is making video conferencing.

**Table 6.** Extent of use of ICT facilities by the teachers and students

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Variables</th>
<th>Frequency N = 390</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Are students and teachers allowed to use ICT facilities in the school?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>140</td>
<td>35.9</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>250</td>
<td>64.1</td>
</tr>
<tr>
<td></td>
<td>No, only teachers</td>
<td>260</td>
<td>66.7</td>
</tr>
<tr>
<td></td>
<td>No, only students</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>If no, what are some reasons?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Computers are not connected to the internet</td>
<td>242</td>
<td>96.8</td>
</tr>
<tr>
<td></td>
<td>Computers are very few</td>
<td>250</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Students are not taught how to use them</td>
<td>198</td>
<td>79.2</td>
</tr>
<tr>
<td></td>
<td>Inadequate time to make use of the ICT facilities</td>
<td>140</td>
<td>56</td>
</tr>
<tr>
<td>3.</td>
<td>If yes, how often do you make use of the ICT facilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Daily</td>
<td>3</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Once in few days</td>
<td>8</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>Once a week</td>
<td>5</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>Once in a month</td>
<td>4</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
<td>120</td>
<td>85.7</td>
</tr>
<tr>
<td>4.</td>
<td>What are your reasons for using ICT facilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Charting with friends</td>
<td>120</td>
<td>30.8</td>
</tr>
<tr>
<td></td>
<td>Browsing the internet, sourcing for information</td>
<td>150</td>
<td>38.5</td>
</tr>
<tr>
<td></td>
<td>Sending e-mail</td>
<td>94</td>
<td>24.1</td>
</tr>
<tr>
<td></td>
<td>To make video calls</td>
<td>120</td>
<td>30.8</td>
</tr>
<tr>
<td>5.</td>
<td>Apart from the school ICT do you make use of your cell phones to browse the internet? (Students only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>320</td>
<td>94.1</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>20</td>
<td>5.9</td>
</tr>
<tr>
<td>6.</td>
<td>If yes, for what reasons do you normally browse the internet?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do your assignments</td>
<td>316</td>
<td>98.8</td>
</tr>
<tr>
<td></td>
<td>Personal reasons</td>
<td>320</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Source for further information on what you were taught</td>
<td>310</td>
<td>96.9</td>
</tr>
</tbody>
</table>
Table 6 above shows 66.7% of the respondents said only teachers are allowed to use ICT facilities in the school, 64.1% said both teachers and students are allowed to use ICT facilities in school while 35.9% said both teachers and students are allowed to use ICT facilities in school. Of those who said both teachers and students are not allowed to use the ICT facilities in school, n=250, 100% said is due to computers been few, 96.8% said it is because computers are not connected to the internet, 79.2% said it is because students are not taught how to use the ICT facilities while 56% said inadequate time to make use of the ICT facilities is the problem. Of those who said both teachers and students are allowed to use the ICT facilities in school n=140, 85.7% said they never made use of the facilities, 5.7% said they use it once in few days, 3.6% said they use it once in a week, 2.9% said they use it once in a month while 2.1% said they use it daily. Of those who uses the ICT facilities, 38.5% said their reason for use is to browse the internet and source for information, 30.8% said their reason for use is to chat with friends and to make video calls, while 24.1% said their reason for use is to send mails. The table also shows n=340, 94.1% of the respondents (students) said apart from school ICT facilities they made use of their cell phones to browse the internet while 5.9% said they do not use their cell phones to browse the net. Of those who uses their cell phones to browse the internet, 100% said it was for personal reasons, 98.8% said it was for them to do their assignment while 96.9% said it was to source for further information on what they were taught.

Table 7. Perceived usefulness of ICT by teachers and students

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Variables</th>
<th>Frequency N = 390</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Do you think ICT is important in teaching and learning?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>382</td>
<td>97.9</td>
</tr>
<tr>
<td></td>
<td>NO</td>
<td>8</td>
<td>2.1</td>
</tr>
<tr>
<td>2.</td>
<td>If yes, what are some benefits of ICT in teaching and learning?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Motivates and engages students to learn</td>
<td>382</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Provides easy access for students to learn</td>
<td>370</td>
<td>96.9</td>
</tr>
<tr>
<td></td>
<td>Fosters better quality education and teaching</td>
<td>368</td>
<td>96.3</td>
</tr>
<tr>
<td></td>
<td>It helps to overcome distance barrier in aching and learning.</td>
<td>220</td>
<td>57.6</td>
</tr>
<tr>
<td></td>
<td>Helps both teachers and students to keep path with latest developments</td>
<td>380</td>
<td>99.5</td>
</tr>
<tr>
<td></td>
<td>It helps to prevent duplication of work</td>
<td>220</td>
<td>57.6</td>
</tr>
<tr>
<td></td>
<td>It enables new ways of teaching and learning</td>
<td>282</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>It enhances students achievements</td>
<td>280</td>
<td>99.3</td>
</tr>
<tr>
<td></td>
<td>It enables the students to complete their assignments faster and easily</td>
<td>382</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 7 above shows n=390, 97.9% of the respondents said they believe ICT is important in teaching and learning, while 2.1 said they do not believe ICT is important in teaching and learning. Of those who said ICT is important in teaching and learning, n=382, 100% said it motivates and engages students to learn; it enables new ways of teaching and learning; it enhances students achievements, 99.5% said it helps both teachers and students to keep pace with latest developments, 96.9% said it provides easy access for students to learn, 96.3% said it fosters better quality education and teaching, while 57.6 said it will help to overcome distance barrier in teaching and learning, and that it helps to prevent duplication of work.
Table 8. Factors hindering the availability and use of ICT in the schools

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Variables</th>
<th>Frequency N = 390</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>What are some factors hindering the availability of ICT in your school</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lack of funding for purchase of ICT facilities</td>
<td>335</td>
<td>85.9</td>
</tr>
<tr>
<td></td>
<td>High cost of maintaining ICT facilities</td>
<td>215</td>
<td>55.1</td>
</tr>
<tr>
<td></td>
<td>Frequent interruptions of internet connections</td>
<td>38</td>
<td>9.7</td>
</tr>
<tr>
<td></td>
<td>Poor electricity supply</td>
<td>360</td>
<td>92.3</td>
</tr>
<tr>
<td></td>
<td>Virus attack of the software’s</td>
<td>42</td>
<td>10.8</td>
</tr>
<tr>
<td></td>
<td>Anti-ICT policy being put in place</td>
<td>72</td>
<td>18.5</td>
</tr>
<tr>
<td></td>
<td>Lack of infrastructure for ICT facilities</td>
<td>298</td>
<td>76.4</td>
</tr>
<tr>
<td></td>
<td>Poor school leadership</td>
<td>310</td>
<td>79.5</td>
</tr>
<tr>
<td>2.</td>
<td>What are factors militating against the use of the existing ICT facilities?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teachers unwillingness to change their old idea</td>
<td>298</td>
<td>76.4</td>
</tr>
<tr>
<td></td>
<td>Inadequate training of teachers</td>
<td>210</td>
<td>53.8</td>
</tr>
<tr>
<td></td>
<td>Lack of ICT skills</td>
<td>380</td>
<td>97.4</td>
</tr>
<tr>
<td></td>
<td>Lack of time</td>
<td>170</td>
<td>43.6</td>
</tr>
<tr>
<td></td>
<td>Lack of teachers’ confidence and competence</td>
<td>367</td>
<td>94.1</td>
</tr>
<tr>
<td></td>
<td>Generation gap on the part of teachers</td>
<td>326</td>
<td>83.6</td>
</tr>
<tr>
<td></td>
<td>Insufficient number of computers</td>
<td>390</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Lack of motivation of teachers to adopt ICTs as teaching tool.</td>
<td>89</td>
<td>22.8</td>
</tr>
<tr>
<td></td>
<td>Poor/frequent fluctuation of internet</td>
<td>68</td>
<td>17.4</td>
</tr>
</tbody>
</table>

Table 8 above shows factors hindering the availability of ICT in the school as follows: n=390, 92.3% said is poor electricity supply, 85.9% said it is lack of funding for purchase of ICT facilities, 79.5% said it was poor school leadership, 76.4% said it was lack of infrastructure for ICT facilities, 55.1% said high cost of maintaining ICT facilities is to blame, 18.5% said anti-policy been put in place is the problem, 10.8% said virus attack of the software is the factor while 9.7% said frequent interruptions of internet connections is to blame. The table also shows that factors militating against the use of the existing facilities as follows: 100% said poor use of the existing facilities is due to insufficient number of computers, 97.4% said it is due to lack of ICT skills, 94.1% said it is lack of teachers confidence and competence, 83.6% said it is due to generation gap on the part of teachers, 76.4% said teachers unwillingness to change their old ideas is to blame, 53.8% said inadequate training of teachers is the problem, 43.6% said their inability to use the existing ICT facilities is due to lack of time, 22.8% said it is lack of motivation of teachers to adopt ICT as teaching tool while 17.4% said poor/frequent fluctuation of internet is the problem.

Test of Hypotheses

Table 9. Knowledge of students on the use of ICT facilities in learning

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Most students have heard about ICT</td>
<td>213</td>
<td>57</td>
<td>59</td>
<td>13</td>
<td>3.39</td>
</tr>
<tr>
<td>2.</td>
<td>The students have heard about ICT in School</td>
<td>241</td>
<td>67</td>
<td>29</td>
<td>3</td>
<td>3.61</td>
</tr>
<tr>
<td>3.</td>
<td>Most students are computer literate</td>
<td>4</td>
<td>56</td>
<td>83</td>
<td>197</td>
<td>1.61</td>
</tr>
<tr>
<td>4.</td>
<td>Most students have only used computer in their school from 100 to 300 level</td>
<td>211</td>
<td>86</td>
<td>32</td>
<td>11</td>
<td>3.46</td>
</tr>
</tbody>
</table>
5. Students take ICT as using computer in teaching 251 43 41 5 3.59

Table 10. Chi-Square test of students’ knowledge on use of ICT facilities

<table>
<thead>
<tr>
<th>O</th>
<th>E</th>
<th>(O-E)</th>
<th>(O-E)^2</th>
<th>(O-E)^2/E = x^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>213</td>
<td>184.0</td>
<td>29</td>
<td>841.00</td>
<td>4.60</td>
</tr>
<tr>
<td>57</td>
<td>61.8</td>
<td>4.8</td>
<td>23.04</td>
<td>0.37</td>
</tr>
<tr>
<td>59</td>
<td>48.8</td>
<td>10.2</td>
<td>104.04</td>
<td>2.13</td>
</tr>
<tr>
<td>11</td>
<td>45.4</td>
<td>34.4</td>
<td>1183.36</td>
<td>26.07</td>
</tr>
<tr>
<td>241</td>
<td>184.0</td>
<td>57.0</td>
<td>3249.00</td>
<td>17.66</td>
</tr>
<tr>
<td>67</td>
<td>61.8</td>
<td>5.2</td>
<td>27.04</td>
<td>0.44</td>
</tr>
<tr>
<td>29</td>
<td>48.8</td>
<td>19.8</td>
<td>392.04</td>
<td>8.03</td>
</tr>
<tr>
<td>3</td>
<td>45.4</td>
<td>42.4</td>
<td>1797.76</td>
<td>39.60</td>
</tr>
<tr>
<td>4</td>
<td>184.0</td>
<td>-180.0</td>
<td>32400.00</td>
<td>180.00</td>
</tr>
<tr>
<td>56</td>
<td>61.8</td>
<td>-5.8</td>
<td>33.64</td>
<td>0.54</td>
</tr>
<tr>
<td>83</td>
<td>48.8</td>
<td>34.2</td>
<td>1169.64</td>
<td>23.97</td>
</tr>
<tr>
<td>197</td>
<td>45.4</td>
<td>151.6</td>
<td>22982.56</td>
<td>506.22</td>
</tr>
<tr>
<td>211</td>
<td>184.0</td>
<td>27.0</td>
<td>729.00</td>
<td>3.96</td>
</tr>
<tr>
<td>86</td>
<td>61.8</td>
<td>24.2</td>
<td>585.64</td>
<td>9.48</td>
</tr>
<tr>
<td>32</td>
<td>48.8</td>
<td>-16.8</td>
<td>282.24</td>
<td>5.78</td>
</tr>
<tr>
<td>11</td>
<td>45.4</td>
<td>-34.4</td>
<td>1183.36</td>
<td>26.07</td>
</tr>
<tr>
<td>251</td>
<td>184.0</td>
<td>67</td>
<td>4489.00</td>
<td>24.40</td>
</tr>
<tr>
<td>43</td>
<td>61.8</td>
<td>-18.8</td>
<td>353.44</td>
<td>5.72</td>
</tr>
<tr>
<td>41</td>
<td>48.8</td>
<td>-7.8</td>
<td>60.84</td>
<td>1.25</td>
</tr>
<tr>
<td>5</td>
<td>45.4</td>
<td>-40.4</td>
<td>1632.16</td>
<td>35.95</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>922.24</strong></td>
<td></td>
</tr>
</tbody>
</table>

The calculated chi-square (X^2) = 922.24
Tabulated = 16.92

Since the Chi-square test (calculated) =922.24 is greater than the tabulated value =16.92. There is therefore no statistical evidence to reject the null hypothesis (Ho). This means that there is no relationship between students’ level of study and knowledge in the use of ICT.

Table 11. Knowledge of teachers on the use of ICT facilities in teaching and learning

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Most teachers have heard about ICT</td>
<td>29</td>
<td>17</td>
<td>3</td>
<td>1</td>
<td>3.48</td>
</tr>
<tr>
<td>2.</td>
<td>Most teachers have heard about ICT in the school they teach</td>
<td>25</td>
<td>18</td>
<td>5</td>
<td>2</td>
<td>3.32</td>
</tr>
<tr>
<td>3</td>
<td>Most teachers are computer literate</td>
<td>4</td>
<td>7</td>
<td>15</td>
<td>24</td>
<td>1.82</td>
</tr>
<tr>
<td>4.</td>
<td>Most teachers have been using ICT just about four years back</td>
<td>23</td>
<td>14</td>
<td>9</td>
<td>4</td>
<td>3.12</td>
</tr>
<tr>
<td>5.</td>
<td>ICT is the use of computer and for browsing the internet for teaching and learning</td>
<td>31</td>
<td>11</td>
<td>6</td>
<td>2</td>
<td>3.42</td>
</tr>
</tbody>
</table>

Cluster Mean 3.79
Table 12. Chi-Square test of teachers’ knowledge on the use of ICT facilities

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>(O-E)</th>
<th>(O-E)²</th>
<th>(\frac{(O-E)^2}{E}) = (x^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>22.4</td>
<td>6.6</td>
<td>43.56</td>
<td>1.94</td>
</tr>
<tr>
<td>17</td>
<td>13.4</td>
<td>3.6</td>
<td>12.96</td>
<td>0.97</td>
</tr>
<tr>
<td>3</td>
<td>7.6</td>
<td>-4.6</td>
<td>21.16</td>
<td>2.78</td>
</tr>
<tr>
<td>1</td>
<td>6.6</td>
<td>-5.6</td>
<td>31.36</td>
<td>4.75</td>
</tr>
<tr>
<td>25</td>
<td>22.4</td>
<td>2.6</td>
<td>6.76</td>
<td>0.30</td>
</tr>
<tr>
<td>18</td>
<td>13.4</td>
<td>4.6</td>
<td>21.16</td>
<td>1.58</td>
</tr>
<tr>
<td>5</td>
<td>7.6</td>
<td>-2.6</td>
<td>6.76</td>
<td>0.89</td>
</tr>
<tr>
<td>2</td>
<td>6.6</td>
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<td><strong>Total</strong></td>
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<td></td>
<td><strong>96.28</strong></td>
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\[\therefore \text{ Chi-Square value (X}^2\text{)} = 96.28\]

Tabulated value = 16.92

Since the Chi-square test (calculated) = 96.28 is greater than the tabulated value = 16.92. There is therefore no statistical evidence to reject the null hypothesis (Ho). This means that there is no relationship between years of teaching experience and knowledge in the use of ICT.

Discussion of findings

The age of the student respondents was between the age of 18 to 39 and above with the majority (72.9%) been between the ages of 24-28. 91.8% of the students respondents had SSCE as their highest qualification as shown in table 1. Same table shows that 52.9% of the student respondents were in 100 level, 24.7% in 200 level and 22.4% in 300 level. This shows that majority of the students had at least basic formal education and are within their youthful age. On the other hand, 48% of the respondent teachers were between the ages of 41 and above, 26% between the ages of 36 and 40. Also as shown in table 2, 40% of the teacher respondents had BSc/BNSc, 24% had RN and RM only. 44% of the respondents as shown in the table 2 had 14 years and above of teaching experience, while 22% had experience of 10 to 13 years and 14% had teaching experience of 7 to 9 years. This shows that majority of the teachers are in their late adulthood with good percentage of the teachers having had years of teaching experience.

Availability of ICT facilities in the schools

As shown in table 3, all the schools have ICT facilities as 100% of the respondents said they have ICT facilities in their schools. The table also show 46.2% of the respondents said they have ICT centre with computers not connected to the internet, 20.5% said they have their computers connected to the internet as well as have computers/ laptops in the library, and 35.9% said they have data projectors while only 7.7% said they have scanner in their school.
This shows that there is availability of ICT facilities in the schools even though not all items needed for proper ICT operation was available. Also the inability of the school to have their computers connected to the internet is a thing of concern.

This finding is in line with that of Hepp et al (2014) whose study showed that ICTs have been utilized in education ever since their inception but they have not always been massively present. The finding is also supported by that of Adesote and Fatoki (2013) whose study revealed that the readiness of ICT in the sub-Saharan Africa is still very low with most countries experiencing strong lags in connectivity because of the insufficient development of ICT infrastructures. The finding on the other hand slightly differ with that of Hamilton-Ekeke and Mbachi (2015) whose study on “the place of information, communication and technology in teaching and learning in Nigeria tertiary Institutions” revealed that basic ICT facilities such as computers were unavailable. The observed difference could be based on the institutions studied as ICT being in place has become one of the major requirements for re-accreditation of schools of Nursing and Midwifery in Nigeria.

Knowledge of teachers and students on the use of ICT in teaching and learning.

On the part of the students respondents n=340, 79.4% said they have heard of ICT before while 20.6 said they have not heard of ICT before. Of those who have heard it before n=270, 98.5% said school was the source through which they heard it as shown in table 4. The table also show 82.4% of the respondents said they are not computer literate while only 17.6% said they are computer literate. Of those who said they are computer literate n=60, 56.7% said they have been using computers for 3-4 years, 30% said they have been using for 1-2 years and 10% said they have used it for 5-6 years. The table 4 show good percentage of the respondents agree with all items that tested what they understand by ICT use in teaching and learning: using computers in teaching (79.4%), using computers in browsing the internet (76.5%), using cell phones in browsing the internet (64.7%), using data projectors in teaching (57.4%) and making video conferencing (52.9%).

This shows that the student respondents have some degree of knowledge on what is use of ICT in teaching and learning as majority of them said they have heard of ICT and correctly identified items that are involved in the use of ICT in teaching and learning, however, such knowledge is highly limited as most of the respondents are not computer literate. This finding is supported by Nwezeh (2014) and Osakwe (2010) whose studies showed the need for teachers to learn new skills to teach students how to search for and use information from the internet safety issues. The study also showed the need to organize workshops for both staff and students so that they acquire knowledge to effectively use the internet resources that are less used. This finding is also supported by study by Teemu et al (2012) which shows the need for the teachers to have the knowledge about technology, pedagogy and content in order to successfully support students’ learning with ICT. With technological pedagogical content knowledge, teachers are able to utilize a range of ICT to support students learning.

On the part of the teachers respondents, n=50, table 5 show 100% of the respondent said they have heard of ICT before out of which 50% said it was through personal reading, 36% said it was at school and 14% said it was through workshop. The table also show 56% of the respondent teachers said they are not computer literate while 44% said they are computer literate. Of those who said they are computer literate, 54.5% said they have used computers for 3 to 4 years, 27.3% said they have used it for 1 to 2 years while 18.2% said they have used it for 5 to 6 years. The respondents agree with all items testing their knowledge on the use of ICT in teaching and learning: using computers to browse the internet (100%), using data projectors in teaching (100%), using cell phones in browsing (64%) and making video conferencing (48%). This shows that the teachers even though they have heard of ICT and correctly identified items involved in the use of ICT in teaching and learning, they do not have an indepth knowledge of ICT use because majority of them were not computer literate. This finding is supported by Tella et al (2015) whose study on “assessment of secondary school teachers uses of ICTs: Implication for further development of ICTs use in Nigeria
secondary schools” show that technical support are lacking in the schools and teachers lack if expertise in using ICT was indicated as being the prominent factors hindering teachers readiness and confidence of using ICT during lesson”. This finding is supported by Shyamal (2015) that “first, teachers need to be equipped with the fundamentals of ICT tools and sufficient understanding on the integration of these tools in teaching and learning, and secondly, efforts must be oriented towards changing mindset and developing positive attitudes towards ICT application in teaching and learning.

Extent of use of ICT facilities by the teachers and students

As shown in table 6, 66.7% of the respondents n=390 said that only teachers were allowed to use the ICT facilities in the school, 64.1% said that both teachers and students were not allowed to use the facilities while 35.9% said both students and teachers were allowed to use ICT facilities in the school. Of those who said students and teachers are allowed to use the ICT facilities in the school, n=140, 85.7% said they do not use it at all, 5.7% said they use it once in few days, 3.6% used the facilities once a week while 2.1% use it on daily basis. The table also show respondents reasons for using ICT facilities as follows: 38.5% said is to browse the internet, sourcing for information, 30.8% said is to chat with friends and to make video calls while 24.1% said is to send e-mails. However, the table 6 also show that apart from school ICT facilities, 94.1% of the students respondents use their cell phones to browse the internet.

This shows that most of the teachers and students do not make use of ICT facilities even though some opportunity were there for them, and the very few who made use of the ICT were not consistent and regular in their use of the ICT facilities. This finding is in line with that of Adesote and Fatoki (2013) whose study show that the readiness of ICT in the sub-saharan Africa is still very low with most countries experiencing strong lags in connectivity because of the insufficient development of ICT infrastructures. The study is also supported by Nwezeh (2014) and Osakwe (2010) whose studies showed the need for teachers to learn new skills to teach students how to search for and use information from the internet safety issues. The study also showed the need to organize workshops for both staff and students so that they acquire knowledge to effectively use the internet resources that are less used.

Perceived usefulness of ICT by teachers and students

97.9% of the respondents n=390 said they believe that ICT is important in teaching and learning as shown in table7. The table also show respondents agree with all items that measures some benefits of ICT in teaching and learning as follows: motivates and engages students to learn (100%), it enables new ways of teaching and learning (100%), it enables the students to complete their assignments faster and easily (100%), helps both teachers and students to keep pace with latest developments (99.5%), it enhances students achievements (99.3%), provides easy access for students to learn (96.9%), fosters better quality education and teaching (96.3%), it helps to overcome distance barrier in teaching and learning (57.6%), and it helps to prevent duplication of work (57.6%). This shows that most of the respondents believe that with the application of ICT in teaching and learning, the general quality of teaching and learning will improve both for teachers and students.

This finding agrees with Bransford et al (2000) Cited by Khalid (2000) “several studies have reviewed the literature on ICT and learning and have concluded that it has great potential to enhance student achievement and teacher learning”. This finding also agrees with Grabe and Grabe (2007), who stated that “technologies can play a role in student skills, motivation, and knowledge; they argue that ICT can be used to present information to students and help them complete learning tasks”. The finding is also supported by Adesote and Fatoki (2013), that ICT can be integrated in the learning process so that learning takes place through the learner’s interaction with the facilities. The finding is further in agreement with EdTech Review (2014), “ICT is very useful in that it helps the students to do assignments given to them by their teachers”. According to Noor-Ul-Amin (2014) ICTs
especially computers and internet technologies enable new ways of teaching and learning rather than simply allow teachers and students to do what they have done before in a better way. This is in line with finding of the study.

Factors hindering the availability and use of ICT in the schools

As shown in table 8, good percentages of the respondents n=390 agree with most of the items that suggested hindering factors to the availability and use of ICT in the school. 92.3% said is poor electricity, 85.9% said is lack of funding for purchase of ICT facilities, 79.5% said is poor leadership, 76.4% said is lack of infrastructures for ICT facilities and 55.1% said high cost of maintaining ICT facilities is the factors. The table also show factors militating against the use of ICT facilities as follows: 100% said is insufficient number of computers, 97.4% said is lack of ICT skills, 94.1% said is lack of teachers’ confidence and competence, 83.6% said generation gap on the part of the teachers is the problem, 76.4% said is due to teachers’ unwillingness to change their old ideas, 53.8% said inadequate training of teachers is the factor, and 43.6% said lack of time is the militating factor. This finding shows that hindering factors to the availability and use of ICT in the schools is multifactorial and much is needed to be done to ensure effective use of ICT facilities in the schools. This finding is supported by Adesote and Fatoki, (2013) whose study showed a number of factors which are said to have militated against the use of ICT in education in Nigeria as; lack of funding to support the purchase of the technology, lack of training of teachers, lack of motivation on the part of teachers to adopt ICTs as teaching tools in the classroom instruction and so on. This finding is also in line with Sicilia (2005), whose study found teachers complained about how difficult it was to always have access to computers. The finding is also supported by that of Albirini, (2006) whose study on Syrian schools indicated that insufficient computer resources were one of the greatest impediments to technology integration in the classroom. Study by Mathipa and Mukhari (2014) also supported the finding of this study. Their finding show that factors influencing the use of ICT in teaching and learning in South African urban schools includes: insufficient number of computers and lack of application programs, teacher generation gap, inadequate teacher training, lack of ICT skill and lack of confidence, teachers beliefs, poor school leadership and lack of public support.

Conclusion

Based on the findings of the study and statistical analysis, the following conclusion were reached: there is availability of ICT in the schools, however, not all items needed for smooth running of ICT were available and the existing ones are insufficient. The study also show that both the teachers and the students have some degree of knowledge about ICT but such knowledge is seriously limited as most of the teachers and students were not computer literate which is one of the major criteria for one to effectively make use of ICT facilities. It was found that most teachers and students were not making use of the available ICTs in the school and those who made use of it were inconsistent in their use of the ICT facilities even though most of them believed that ICT use in teaching and learning is very essential for better and quality education. Factors hindering the availability and use of ICT facilities in the schools were multifactorial as shown in the study. This findings show the serious need for the leadership of the schools to ensure adequate provision of ICT facilities as well as ensure that both teachers and students are trained and retrained on the use of the ICT facilities to enhance the quality of teaching and learning in the schools.

Recommendations

Following the findings of the study, the researcher hereby recommends the following:
1. Management and leadership of the schools should put more effort to ensure provision of adequate ICT facilities for teachers and students’ use as this will enhance the quality of the teaching and learning in the school.
2. Government should make use of ICT facilities in teaching and learning mandatory in all schools even as they assist schools who cannot afford it to secure adequate ICT facilities for teachers and students use.

**Suggestion for further studies**

The researcher suggests further studies on the following topics:
1. The use of ICT in Nigerian tertiary institutions: challenges and prospects
2. Use of ICT in teaching and learning as it affects the performance of student nurses and midwives.

**Acknowledgement**

My profound gratitude goes to the management of Schools of Nursing and Midwifery in Benue State for their immense contribution towards the success of this research work.

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Harmonization of Thyroid Stimulating Hormone; an Alternative Approach

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Abstract

Introduction: Comparison of TSH values by analysis of retrospective data obtained from daily internal quality control (IQC) runs performed concurrently on Architect i2000 and cobas e601; the two platforms used to run TSH test for patient samples at The Nairobi Hospital, Kenya.

Method: Data analysis was carried out using R project version 3.2.3. Data was analyzed both in combination (N=590) and segregated as Level 2 (N= 297) and level 3 (N=293).

Results: Shapiro-Wilk normality test returned normal distribution for level 2, abnormal distribution for level 3 and combined data on both platforms. Paired T-test for level 2 and Mann–Whitney U -Wilcoxon signed rank test for level 3 and combined data, indicated that the alternative hypothesis: true location shift is not equal to 0. Deming and Passing-Bablok regression analysis for level 2 and 3 showed a significant deviation in values between the two methods by a constant. Concordance correlation of the individual levels 2 and 3 is poor.

Discussion: The data demonstrates that there is a constant systematic error between the two methods, with cobas values reading higher each time, and that this difference is significant at both levels.

Conclusion: Regression analysis shows transferability of results from one method to another, however, the difference in means and the poor concordance correlation obliges a consideration of the TSH value results given by the lab especially so in the subclinical range (5 – 10) mIU/ml.

Keywords: Thyroid Stimulating Hormone, TSH, Architect i2000SR, Cobas e601

Introduction

A practical approach to harmonization of patients’ TSH results, in a hospital where approximately 15000 TSH tests are run annually, on two different platforms. Both in and outpatient samples of varying demographics (age, gender, race etc) and purpose (diagnostic, monitoring or general medical checkup) are tested.

Credible method comparison studies are virtually non-existent in Kenya currently, in spite of the presence of a wide range of testing platforms in both public and private labs. At The Nairobi Hospital (TNH), a 350 bed hospital with a plan for further expansion; the lab receives inpatient and outpatient samples of all ages; in 2015 TNH laboratory ran an average of 1,315 TSH tests per month. A summary of TSH patient results from 13/1/2015 to 13/1/2016 as follows

A total of 15,784 patient samples tested for TSH of which:
- 750 results tested < 0.25 mU/L
- 14283 results were normal (0.25 – 5.0) mU/L
- 941 results > 5.0 mU/L

TSH is now concurrently run on either Roche’s cobas e601 (electrochemiluminescence) or Abbott’s Architect i2000SR (chemiluminescence). The decision to run a patient sample for TSH on either platform is random; both cobas and architect have a quality assurance program including daily IQC and EQA. A third party IQC material is used for daily IQC runs; Randox Premium Immunoassay Plus levels 2 and 3. The lab participates in the RIQAS program for both immunoassays and clinical chemistries.
The presence of two platforms in the lab, allows one to backup the other when confirming abnormal results. Prone to supplier inconsistencies in provision of reagents, the use of two different platforms has assisted in continuity of service. However, over time, two observations have emerged from running the tests on both platforms;

- IQC values differ in range for all levels of IQC and EQA
- Some abnormal high patient values when run on the other platform would give a different numerical value.

A dilemma is met when subclinical high or low TSH values are encountered where values from one platform reflect abnormality while the other is normal. Currently the course of action involves review of previous thyroid tests done, the result from the platform that performed the previous test is the one released for consistency in patient management. The lab has also not established its own reference ranges from the local population therefore uses those recommended by the manufacturers (0.25 to 5.0) mU/L. Each platform has a different range. The reference range used for patients is a combination of the two platforms; however the actual numerical value of patient tests has not been tackled. At any given time a patient test run on both platforms will have a different numerical value and this value is released but the question remains which one of the two values is a true reflection of the patient clinical status and if it is a follow up what is the impact of these values in managing thyroid disorders.

In the past twenty years, diagnostics as part of evidence based medicine has witnessed an exponential increase in lab users’ expectations in terms of turnaround times and quality results. This has led to increase in testing capacity/menus and patient volumes. Supplier dynamics also have an important impact in the lab’s decision on the type of equipment procured. All these factors combined have led to the existence of several platforms in the lab. The current trend in automation is geared towards high-throughput, modular, robotic systems that incorporate both immunoassay and clinical chemistry analyzers into one instrument. Most recently, liquid chromatography-tandem mass spectrometry (LC-MS/MS) methods have been developed to measure total and free thyroid hormones as well as Thyroglobulin. These techniques however are technically complex and cannot be automated because they involve specimen pretreatments. Tests for TT4, TT3, THBR, TSH, Tg, TPOAb and TgAb using non-isotopic (primarily chemiluminescent) signals are currently available on a variety of immunoassay analyzer platforms that employ bar-coding, multiple-analyte random-access, primary tube sampling, auto-dilution, STAT testing and computerized data output.

Laboratories primarily select an analyzer to perform thyroid testing on the basis of instrument menu and operating costs, and only secondarily recognize that there are differences in the functional performance of different methods. Although the move to automation is seen as cost-effective, the consolidation of a diversity of immunoassay tests onto one platform has led to a transfer of thyroid testing from small, specialized laboratories to the general chemistry laboratory setting. This centralization has resulted in a loss of laboratory expertise for the clinical interpretation of thyroid tests. This has negatively impacted the ability of laboratory staff to discuss reasons for discordant test results with physicians(Spencer, 2013)

**General objectives**

Generally this study sought to harmonize TSH test in TNH laboratory for better clinical management of thyroid disorders in patients that use the lab’s services

**Specific objectives**

- To gather and analyze IQC TSH data sets, run concurrently on Architect i2000 and COBAS e601 platforms
- To compare the two methods currently in use for testing patients and
- To recommend a course of action for the better management of thyroid disorders
Literature review

Following is a review of comparisons made for TSH on different platforms by other studies. The review will also highlight the importance of consistency in results for patient management.

The thyroid is one of the glands of the endocrine system. The TSH test is the most accurate test for diagnosing both hyperthyroidism and hypothyroidism. Thyroid hormones affect metabolism, brain development, breathing, heart and nervous system functions, body temperature, muscle strength, skin dryness, menstrual cycles, weight, and cholesterol levels. Thyroid function tests (TFTs) are used to diagnose thyroid disorders. Following an abnormal TFT result, a combination of imaging tests, such as ultrasound of the thyroid, a thyroid scan, or a radioactive iodine uptake test, can also be used to find the cause of thyroid disorders. Hyperthyroidism is caused by the presence of excess thyroid hormone in the bloodstream; thyroid hormones include free (FT3) or total tri-iodothyronine (TT3) and free (FT4) or total thyroxine (TT4). Symptoms of hyperthyroidism include increased speed of bodily functions leading to weight loss, sweating, rapid heart rate, and high blood pressure, among other. Hypothyroidism is a disorder that occurs when the thyroid doesn’t make enough thyroid hormone for the body’s needs. Without adequate thyroid hormone, many of the body’s functions slow down. People may have symptoms such as fatigue, weight gain, and cold intolerance((NIDDK), 2014)

Harmonization in the broad sense is the overall process of achieving comparability of results among clinical laboratory measurement procedures that measure the same parameter.

The first generation of TSH assays used between 1965 and 1985 were based on radioimmunoassay (RIA) methodology that had limited functional sensitivity (~ 1.0 mIU/L)(Odell et al., 1965, Utiger, 1965, Yalow and Berson, 1996) Because these RIA-era TSH methods were too insensitive to detect TSH in all euthyroid subjects, their clinical utility was limited to the diagnosis of primary hypothyroidism. The more sensitive immunometric assay (IMA) methodology (also called “sandwich” or “noncompetitive” methodology) became available in the mid-1980s. These IMA techniques are based on the excess antibody approach of Miles and Hales originally reported in the 1960s but did not become widely adopted until advances in monoclonal antibody technology allowed the large-scale production of specific antibodies in the 1980s. Mechanistically, these IMA methods employed an excess of TSH monoclonal antibody, bound to a solid support (bead, tube, magnetic microparticle or adsorption gel) that captured TSH from the serum specimen during a 20 to 120 minute incubation period. A different poly- or monoclonal TSH antibody targeted to a different TSH epitope(s) and labeled with an isotopic (I-125) or non-isotopic signal was then added followed by a further incubation and removal of unbound constituents by washing. The signal bound to the solid support was quantified as being directly proportional to the serum TSH concentration in the test sample. Later modifications to this basic concept included the use of chimeric monoclonal antibodies to reduce interference by heterophilic antibodies and the use of Avidin-Biotin and magnetic particle separation techniques. By 1990, IMA non-isotopic methods had replaced most TSH RIA methods and as a result of inherently greater assay sensitivity and specificity resulted in narrowing the TSH reference range by reducing glycoprotein hormone cross-reactivity and improving precision. Currently, most TSH testing is performed on automated immunoassay platforms employing advanced IMA technology.

The first IMA methods that used a radioisotopic signal (I-125) were designated “immunoradiometric assays”, or IRMAs. Subsequent IMA methods adopted a variety of non-isotopic signals that gave rise to a lexicon of terminology to distinguish between assays using different signals. For example, immunoenzymometric assays (IEMA) used enzyme signals; immunofluorometric assays (IFMA) used fluorophors as signals, immunochemiluminometric assays (ICMA) used chemiluminescent molecules as signals and immunobioluminometric assays (IBMA) used bioluminescent signal molecules. This explosion of methodology led to a range of IMAs with competing claims for sensitivity. Initially, the IMA methods were designated as “sensitive”, “highly sensitive”, “ultrasensitive” or “supersensitive” assays – terms used to distinguish the new IMA methodology from the older insensitive RIA methods then still in use. This descriptive nomenclature
was confusing and led to a debate concerning the meaning of “sensitivity”. After it became evident that it was the between-run precision of the method that was the best determinant of assay sensitivity, a new parameter “functional sensitivity” became adopted. Functional sensitivity has been defined as the TSH value associated with a 20 percent coefficient of variation (CV) established from assays run over a 6 to 8 week period (a typical clinical interval used to assess TSH changes in an out-patient setting) (Baloch et al., 2003) Both manufacturers and clinical laboratories have now adopted this functional sensitivity definition as the lowest reporting limit for TSH assays. The new nomenclature also defines each generation as having a ten-fold difference in functional sensitivity. For example, RIA methods with functional sensitivities between 1 and 2 mIU/L are designated as “first generation”. IMA methods with functional sensitivities between 0.1 and 0.2 mIU/L are designated as “second generation”. Third generation TSH methods with functional sensitivities between 0.01 and 0.02 mIU/L are typically automated and non-isotopic and have become recognized as necessary to meet the current standard of care (Spencer, 2013)

In the last two decades, TSH assay sensitivity has been further enhanced by the adoption of non-isotopic (chemiluminescent and fluorescent) signals that are inherently more sensitive than I-125 and offer the additional advantage of being easier to automate. By 1990, IMA non-isotopic methods had replaced most TSH RIA methods and as a result of inherently greater assay sensitivity and specificity resulted in narrowing the TSH reference range by reducing glycoprotein hormone cross-reactivity and improving precision. Currently, most TSH testing is performed on automated immunoassay platforms employing advanced IMA technology (Spencer, 2013)

The Abbott Architect i2000SR uses chemiluminescence 2-step assay method while the Roche cobas e601 uses electrochemiluminescence one step assay method. "Chemiluminescent" processes entail the creation of luminescent species by chemical transfer of energy while "Electrochemiluminescence" entails creation of luminescent species electrochemically (Williams, 2015)

The Architect i2000SR chemiluminescence method incorporates an acridinium derivative tracer; using microparticles as solid phase. After exposure to pre-trigger and trigger reagent, the acridinium undergoes a decomposition reaction and the emitted light is amplified and processed. The Cobas e601 incorporates an electrochemiluminescence detection cell. The streptavidin-coated paramagnetic beads are coupled to the ruthenium-labeled antigen-antibody complex. After the addition of tripropylamine, a voltage is applied, and the resulting luminescence is measured (Sarkar, 2014)

Difference in values on platforms using third generation assays is now a point of focus in harmonization of TSH and standardization of thyroid hormones (Sarkar, 2014, Williams, 2015, Serdar et al., 2015)

In a study on an Indian urban subpopulation, specifically comparing 1,615 patient TSH values on these two analyzers, it was found that a systematic difference existed between the two. The study also suggested that if the instrument factor of Cobas (which normally is 1.0) is put as 0.783, the TSH values would be correspondingly lower and would match those of Architect. Conversely, if the instrument factor of Architect is changed to 1.277 (=1/0.783), its TSH values would match with those of Cobas. Changes in values of quality control specimen and Levey–Jennings charts must be interpreted accordingly. The main drawback of this method is that it assumes that one of the two instruments is generating correct values and the other is not (Sarkar, 2014)

In a different study; data sets obtained from four different immunoassay analyzers, poor and statistically different correlation was observed between analyzers at TSH values ranging from (1.0 to 10.0) uIU/mL compared with FT4. The study concluded that these variations between analyzers may affect the clinical decisions especially in the evaluation of subclinical hypothyroidism, clinicians and laboratory specialists should be aware of these situations (Hendriks et al., 2000)

A reference method should be chosen for the comparative method. Reference method infers a high quality method whose results are known to be correct through use of a reference method procedure (RMP). Any differences between a test method and a reference method are assigned to the test
method, i.e., the errors are attributed to the test method because the correctness of the reference method is well documented. In the absence of RMP for TSH, a comparative method will be used.

The term “comparative method” is a more general term and does not imply that the correctness of the method has been documented. Most routine laboratory methods fall into this latter category. Any differences between a test method and a routine method must be carefully interpreted. If the differences are small, then the two methods have the same relative accuracy. If the differences are large and medically unacceptable, then it is necessary to identify which method is inaccurate. Recovery and interference experiments can be employed to provide this additional information (Westgard et al., 1999)

**Methodology of study**

Analysis of retrospective data obtained from daily IQC runs performed concurrently on Architect i2000 and Cobas e601. IQC material used is Randox premium immunoassay plus levels 2 and 3.

Statistical analysis of data involved data sets obtained for both IQC levels separately and combined. The data was tested for normality using the Shapiro test, followed by the OLS method for IQC level 2 which showed normal distribution but was of minimal use when comparing all the data. Levels 2, 3 and the combined data were analyzed using both Deming and the Passing-Bablok regression methods. Deming method takes into consideration measurement errors of both methods while Passing-Bablok assumes no special considerations for the data when calculating. Confidence intervals and ‘P’ values were generated. Lastly concordance correlation was also calculated.

**Study area**

This study was carried out at The Nairobi Hospital’s main laboratory where TSH testing is done on Architect i2000 by the chemiluminescence method (CLIA) and Cobas e601 by the electrochemiluminescence method (eCLIA) (Table 1)

**Study population**

Only IQC data was handled for the study; however mention was be made of some patient data on which observations led to this study. The target population of the study is the patients that present for testing at TNH laboratory.

**Study duration**

Data included IQC run on a daily basis for about one and a half years (January 2015- June 2016)

**Sampling method and size**

Using the EQA sample RIQAS immunoassay cycle 43 sample 9, specifically chosen for the mean value’s closeness to the subclinical upper limit of TSH in patients, the following information was extracted from the results returned and used to calculate p value for level of significance when comparing mean values from the two instruments (Table 2)

Comparison of the two means for level of significance produced a p value of < 0.001, this justifies that a sample size N=590 used for this study, is sufficient to demonstrate whether a difference exists or not.

**Collection of data**

590 data sets were obtained by retrieving TSH values of daily IQC runs on both analyzers from concurrently run IQC material over a period of about one and a half years. The IQC material is run once daily therefore data sets were distributed over several events during the period, including different IQC lot numbers, reagent lots, calibrations carried out during lot changeovers, after instrument preventive maintenance and as corrective action for QC outliers.

Over the period that data was collected, three different IQC lots had been used for level 2 and two different lots for level 3. Standard Westgard warning and rejection rules were applied for IQC runs on
each analyzer. EQA data shows TSH passed and consistent results obtained for both analyzers during the period.

Data analysis

Data analysis was carried out using R project version 3.2.3 (R core team, 2015). 590 paired data sets were obtained and analyzed both in combination (N=590) and segregated as Level 2 (N= 297) and level 3 (N=293). Shapiro test was used to determine distribution patterns. Significance of difference was measured using paired T-test for level 2 and Mann-Whitney U-Wilcoxon test for level 3 and combined data. Regression analysis for the combined data and individual levels 2 and 3 was carried out using Deming method which takes into consideration measurement errors of both methods and Passing-Bablok method which assumes no special considerations for the data; in addition OLS method was used for regression analysis of level 2 since it exhibited normal distribution. Based on this analysis Bland-Altman plots were constructed for each data group; level 2, level 3and combined. Concordance correlation coefficient (CCC) was calculated to test level of agreement between the paired data.

Observations and findings

Distribution

Shapiro-Wilk normality test, using R, returned normal distribution for level 2 and abnormal distribution for level 3 and combined data on both platforms (Table 6).

Significance of difference

Paired T-test to measure the significance of difference for level 2 indicated that the alternative hypothesis: true difference in means is not equal to 0 and the mean of the differences = 0.46 (Table 6).

Mann–Whitney U-Wilcoxon signed rank test for level 3 and combined data, indicated that the alternative hypothesis: true location shift is not equal to 0 in both cases (Table 6).

The difference between the two analyzers is significant at both levels 2 and 3.

Regression analysis

Regression analysis was conducted using Methcomp package in R (Bendix Carstensen, 2015).

An analysis of level 2 using the OLS method gave an intercept = 1.83, slope = 0.33, Residual standard error: 0.1038 on 291 degrees of freedom, Multiple R-squared = 0.1096, adjusted R-squared= 0.1066, p-value: 6.33e-09. As architect values increase by 1 cobas values increase by 0.33 units and when the TSH value on architect is zero the value on cobas is 1.83. This means the readings of the two methods differ by a constant.

Since OLS method is not applicable to values that are not normally distributed, Deming and Passing-Bablok methods were applied to all the three data sets to better interpret the comparison.

Deming regression for level 2 gave an intercept of 0.55 and slope of 0.96, level 3 an intercept of 2.34 and slope of 0.96, and combined data returned an intercept of 0.28 and a slope of 1.10; this signifies a significant deviation in values between the two methods by a constant; this constant is higher at level 3 than level 2. Of note though is that for all three data sets the slopes are close to 1, meaning there is no great shift from the 45° line.

Passing-Bablok method, for level 2 returned an intercept of 0.46 and slope of 1, level 3 an intercept of 3.12 and a slope of 0.9, and the combined data an intercept of 0.29 and a slope = 1.08.

These findings are summarized in Table 4.

Concordance

The data was also examined for concordance correlation coefficient (CCC) using R (Lawrence and Lin, 1989, Lin, 2011). See Table 5.
The correlation coefficient of two variables in a data sample is a normalized measurement of how the two are linearly related. If the correlation coefficient is close to 1, it would indicate that the variables are positively linearly related and the scatter plot falls almost along a straight line with positive slope. For -1, it indicates that the variables are negatively linearly related and the scatter plot almost falls along a straight line with negative slope. And for zero, it would indicate a weak linear relationship between the variables. (Yau, 2009-2016).

Bland–Altman plots, where the differences between the two techniques are plotted against the averages of the two techniques, were obtained (Figure 1).

Discussion

Constant systematic errors are systematic deviations estimated as the average differences between the 2 methods. The presence of a constant systematic error indicates that one method measures consistently higher or lower in comparison with the other method. Proportional systematic error means that the differences between the 2 methods are proportionally related to the level of measurements (Jensen and Kjelgaard-Hansen, 2006).

The data clearly demonstrates that there is a constant systematic error between the two methods, with cobas values reading higher each time, and that this difference is significant at both levels. The constant error is demonstrated by the intercepts obtained by the regression analysis by different methods returning values that differ slightly, due to the difference in the calculation formula of each and considerations taken into account for each method, but showed positivity towards Cobas values (Table 3)

OLS method was only applied for level 2 since it is normally distributed, the result depicts a positive linear relationship between the two methods with positivity towards cobas values; this means cobas values are higher than architect values by a constant.

Concordance correlation of the individual levels 2 and 3 is poor. Even though the combined data gives a strong correlation; this is not of clinical significance since the range under consideration is the sub-clinical level of TSH where symptoms are not yet apparent in the patient. It is therefore more prudent to consider the differences between the levels individually.

Results returned by Deming show a slope of almost one for both the combined data and the two levels separately; this means both methods are in agreement however the intercepts show a y-leaning proportional deviation i.e. cobas values are higher than architect values.

Similarly, regression results by Passing-Bablok method returned slope values of almost 1 for all the data sets showing no constant difference but the intercepts indicate a significant y-leaning proportional deviation of all the values i.e. cobas values are higher than architect values.

The Bland Altman plots show the values distributed away from the equality line “0” and are all below zero signifying that for all paired data, again this is a demonstration that cobas values were higher (Figure 1)

Interestingly the BRI of architect is reported slightly higher than that of cobas (Table 1), it is beyond the scope of this study to further investigate how these values were obtained but they are now questionable in view of the results of this and other similar studies.

Conclusion

Both regression models show minimal constant deviation but a significant proportional deviation towards cobas values and these are the same conclusions Sarkar (2014) made, further inferring that much as the regression analysis shows transferability of results from one method to another, the difference in means and the poor concordance correlation obliges a consideration of the practicality in patient management of thyroid disorders especially so in the subclinical range.

Considering the current normal range (0.25 - 5.0) UlU/ml, it is clear that patient management will differ according to the value reported; this is especially significant in TSH values up to 10UlU/ml, considered the subclinical range where symptoms of hypothyroidism are not yet apparent and can only be detected by the lab test.
Subclinical thyroid disease is, by its very nature, a laboratory diagnosis. Patients with subclinical disease have few or no definitive clinical signs or symptoms of thyroid dysfunction. Thus, it is critically important that the normal reference range for TSH be standardized and that laboratories engage in appropriate quality control procedures to ensure that the results they report are accurate and reproducible (Surks et al., 2004).

Currently the laboratory has the appropriate quality assurance program in place; this study shows that there is a significant difference between the two methods evidenced by the poor correlation and the significant proportional deviation towards cobas values. Furthermore even patient values show the same pattern of difference that eventually led to this study.

**Figures and tables**

**Table 1.** Performance specification of Architect i2000SR and Cobas 6000 as adopted from (Sarkar, 2014)

<table>
<thead>
<tr>
<th>Performance indicator</th>
<th>Architect</th>
<th>Cobas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical sensitivity (value lying 2 SD above the zero calibrator in a repeatability study)</td>
<td>0.0025 µIU/mL</td>
<td>0.005 µIU/mL</td>
</tr>
<tr>
<td>Functional sensitivity (lowest analytic concentration that can be reproducibly measured with a across-run precision of 20% CV)</td>
<td>0.0036 µIU/mL</td>
<td>0.014 µIU/mL</td>
</tr>
<tr>
<td>Analytical specificity</td>
<td>&lt;10% Cross-reactivity in human serum samples containing TSH in the normal range was observed with FSH ≤ 500 mIU/mL, LH ≤ 500 mIU/mL, and hCG ≤ 20000 mIU/mL.</td>
<td>For the monoclonal antibodies used, the following cross-reactivities were found: LH 0.038%, FSH 0.008%, hGH and hCG no cross-reactivity.</td>
</tr>
<tr>
<td>Analytical measurement range</td>
<td>0.0025-100 µIU/mL (for up to 1.000 µIU/mL, for 10 fold diluted samples)</td>
<td>0.005-100 µIU/mL (for up to 1.000 µIU/mL, for 10 fold diluted samples)</td>
</tr>
<tr>
<td>Precision</td>
<td>Within run –1.1 to 5.9% CV, across runs –1.9 to 5.3% CV</td>
<td>Within run –1.1 to 3.0% CV, Across-runs –3.2 to 7.2% CV</td>
</tr>
<tr>
<td>Accuracy (as per evaluations through one year on a commercial 3rd party EQA programme)</td>
<td>1.3–4.6%</td>
<td>1.2–5.6%</td>
</tr>
<tr>
<td>Interferences</td>
<td>&lt;10% Interferences were observed by haemolysis up to 500 mg/dL of Hb, lipaemia up to 5000 mg/dL of triglycerides, icterus up to 20 mg/dL of bilirubin and 12 g/dL of protein. No significant interferences were observed by haemolysis up to 1 g/dL of Hb, lipaemia up to 1500 mg/dL of triglycerides, icterus up to 41 mg/dL of bilirubin, up to 25 g/dL of protein, 2 g/dL of fG, 0.5 g/dL of fS and 3.250 U/mL of rheumatoid factors.</td>
<td></td>
</tr>
<tr>
<td>Biological reference intervals</td>
<td>0.35–4.04 µIU/mL (α = 549)</td>
<td>0.27–4.30 µIU/mL (α = 516)</td>
</tr>
</tbody>
</table>

**Table 2.** EQA RIQAS immunoassay cycle 43 sample 9 data used for estimation of sample size

<table>
<thead>
<tr>
<th>RIQAS Cycle43 sample 9</th>
<th>ARCHITECT i2000 SR</th>
<th>COBAS e601</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>6.451</td>
<td>7.371</td>
</tr>
<tr>
<td>SDI</td>
<td>-1.10</td>
<td>0.06</td>
</tr>
<tr>
<td>N (sample size from which the mean was calculated)</td>
<td>125</td>
<td>148</td>
</tr>
</tbody>
</table>

**Table 3.** A summary of the data as obtained from Microsoft Excel 2007

<table>
<thead>
<tr>
<th></th>
<th>ARCHITECT</th>
<th>COBAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>8.55</td>
<td>9.66</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.27</td>
<td>0.30</td>
</tr>
<tr>
<td>Median</td>
<td>12.61</td>
<td>14.54</td>
</tr>
<tr>
<td>Mode</td>
<td>14</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Level 2</td>
<td>Level 3</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>6.57</td>
<td>7.20</td>
</tr>
<tr>
<td>Sample Variance</td>
<td>43.18</td>
<td>51.83</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-1.85</td>
<td>-1.88</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.08</td>
<td>0.06</td>
</tr>
<tr>
<td>Range</td>
<td>18.91</td>
<td>20.79</td>
</tr>
<tr>
<td>Minimum</td>
<td>1.67</td>
<td>2.21</td>
</tr>
<tr>
<td>Maximum</td>
<td>20.58</td>
<td>23</td>
</tr>
<tr>
<td>Count</td>
<td>590</td>
<td>590</td>
</tr>
<tr>
<td>Confidence Level(95.0%)</td>
<td>0.53</td>
<td>0.58</td>
</tr>
</tbody>
</table>

**Table 5** Regression analysis findings

<table>
<thead>
<tr>
<th></th>
<th>Level2</th>
<th>Level 3</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size (n)</td>
<td>293</td>
<td>297</td>
<td>590</td>
</tr>
<tr>
<td>Deming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passing-Bablok</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.55</td>
<td>0.46</td>
<td>2.34</td>
</tr>
<tr>
<td>95% CI of intercept</td>
<td>-0.10</td>
<td>0.06 to</td>
<td>1.25</td>
</tr>
<tr>
<td>Slope</td>
<td>0.96</td>
<td>1</td>
<td>0.96</td>
</tr>
<tr>
<td>95% CI of slope</td>
<td>0.64</td>
<td>0.84 to</td>
<td>0.89</td>
</tr>
<tr>
<td>Pearson’s r</td>
<td>0.33</td>
<td>0.84</td>
<td>0.98</td>
</tr>
</tbody>
</table>

**Table 5.** Concordance correlation (Lawrence and Lin, 1989); A bias correction factor measures how far the best-fit line deviates from a line at 45 degrees. No deviation from the 45 degree line occurs when C.b = 1

<table>
<thead>
<tr>
<th></th>
<th>Level 2</th>
<th>Level 3</th>
<th>Combined data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>293</td>
<td>297</td>
<td>590</td>
</tr>
<tr>
<td>Concordance Correlation Coefficient (CCC)</td>
<td>0.03</td>
<td>0.50</td>
<td>0.98</td>
</tr>
<tr>
<td>CCC Range</td>
<td>0.02- 0.05</td>
<td>0.45 – 0.55</td>
<td>0.976 – 0.981</td>
</tr>
<tr>
<td>Pearson’s r (precision)</td>
<td>0.33</td>
<td>0.84</td>
<td>0.996</td>
</tr>
<tr>
<td>Bias Correction factor (accuracy)</td>
<td>0.10</td>
<td>0.60</td>
<td>0.98</td>
</tr>
</tbody>
</table>
Table 6. A summary of the initial statistical analysis of the data. Shapiro test for distribution pattern, paired T-test for significance of difference in normally distributed data (level 2) and Mann-Whitney U-Wilcoxon analysis for data not normally distributed (level 3 and the combined data)

<table>
<thead>
<tr>
<th>Method</th>
<th>Architect</th>
<th></th>
<th>Cobas</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Level 2</td>
<td>Level 3</td>
<td>Combined</td>
<td>Level 2</td>
<td>Level 3</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>293</td>
<td>297</td>
<td>590</td>
<td>292</td>
<td>297</td>
</tr>
<tr>
<td>Shapiro-Wilk normality test</td>
<td>W</td>
<td>1.0</td>
<td>0.78</td>
<td>0.76</td>
<td>1.0</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>p value</td>
<td>0.5023</td>
<td>&lt;2.2e-16</td>
<td>&lt;2.2e-16</td>
<td>0.2469</td>
<td>&lt;2.2e-16</td>
</tr>
<tr>
<td>Distribution</td>
<td>Normal</td>
<td>Not Normal</td>
<td>Not Normal</td>
<td>Normal</td>
<td>Not Normal</td>
<td>Not Normal</td>
</tr>
<tr>
<td>Paired T-test for Level 2</td>
<td>T</td>
<td>62.39</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Df</td>
<td>292</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p value</td>
<td>&lt;2.2e-16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CI</td>
<td>95%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mann-Whitney U-Wilcoxon</td>
<td>NA</td>
<td>V</td>
<td>44228</td>
<td>V</td>
<td>174210</td>
<td></td>
</tr>
<tr>
<td></td>
<td>p value</td>
<td>&lt;2.2e-16</td>
<td></td>
<td>p value</td>
<td>&lt;2.2e-16</td>
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</tr>
<tr>
<td></td>
<td>true</td>
<td>not zero</td>
<td></td>
<td>true</td>
<td>not zero</td>
<td></td>
</tr>
<tr>
<td></td>
<td>location</td>
<td>shift</td>
<td></td>
<td>location</td>
<td>shift</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1. Passing-Bablok regression analysis and bland altman plots for level 2, 3 and combined data

Acknowledgement

No study, no matter how brief, is really achieved single handed. I might have worked alone in gathering information, data and putting together the final report, but was in constant consultation seeking advice from Drs. Christopher Gontier in writing the report and all it entails, and Dr. Paul Makau for introducing and teaching me the statistical application R and the referencing application Endnote. It is with immense gratitude that I acknowledge their support and help. I thank The Nairobi Hospital (TNH) for my job and opportunity to carry out the study, the TNH Bio-Ethics and Research Committee for permission to use hospital data, my supervisor in special chemistry Mr. John Mugo for supporting the data with his own observation and experience, my biochemistry supervisor Mrs Felister Wazome for organizing time off for me to attend exams and live sessions during the coursework, my colleagues for their moral support and my family for believing in me. A special thanks to all the student coordinators at Texila American University for their online support. Full online learning is not easy without such support. Above all I thank God for allowing me the inspiration, capacity and energy to do it all.

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The Capacity of Maids Training Centres to Train House Maids for Infant Care in Lusaka, Zambia

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Abstract

The study aims at finding out the capacity of maids training centres in Lusaka to training housemaids for infant care. Using both qualitative and quantitative approach a collective case study was conducted. Questionnaires, interviews and document analysis were designed and used to collect data. The interviews were two types: in-depth interviews were held with ten housemaids randomly selected from the twenty maids training centres. The maids training centres were purposefully selected. The second interview was a focus group discussion where the remaining ten house maids took part. The discussion was recorded and later transcribed. This was subjected to thematic analysis. Document analysis was also conducted to establish the type curriculum and how it was implemented.

The findings from the data revealed that the housemaids were not trained to take care of infants and that there is need to include the component of infant care in the house maids training curriculum. It was clear from the findings that maids training centers are not registered, their curriculum is not approved by any organization and no quality assurance policy in place. These training centers are run by former housemaids whose educational levels are low. The instructional materials are inadequate, classes over crowded, and the training duration too short (averaging 2 weeks). It was established that house maids are not trained to take care of infants.

Keywords: maids training centres, house maids, infant care, curriculum, capacity, training

Introduction

According to Glâveanu and Gherghi (2014) the challenges of the modern-day society requires that mothers work long hours, upgrade themselves by attending training programmes in order to adjust to the professional demands. This trend has seen an increase in the number of women occupying executive positions. In addition many households, especially in Lusaka an extra income is needed to meet the sustenance needs of families. The women sell on the streets, run saloons, makes clothes, work in other people's gardens among other income generating activities. This situation makes it imperative for mothers with very young children to employ house maids to help them with infant care and house chores. Most working women in Zambia prefer to employ house maids from maids training centres as they are cheap and with traceable records. However, there have been no studies in Zambia on the capacity of maids training centre to train house maids for infant care.

This collective case study aims at understanding the capacity of maid training centres to train housemaids for infant care. In Zambia there are no crèches and nursery schools in places of work or in market places where nursing mothers could leave their infants to be cared for while they work. There are also very few crèches and nursery schools where mothers could leave their infants to be taken care of while they engage in income generating activities. Most of these crèches and nursery schools when available, are very expensive and beyond the income levels of most families. Many working mothers, therefore, find it cheaper and convenient to employ house maids. These housemaids take the place of the mothers and they inherit all the responsibilities of the mother in ensuring that the infant is healthy and thriving, developing and learning the right things a situation called alloparenting (Lombrozo, 2014).
There exists, in Zambia, public and private maids training centres. The public maids training centres are run by the Ministry of Local Government and Housing (MLGH). However, the extent to which they prepare house maids to take care of infants is unknown. The content of the curriculum, length of the program and the capacity of these maid training centre have not been documented and therefore of interest to this study.

**Research questions**

This collective case study aimed at answering the following research questions:

1. What is the capacity of maids training centers to train housemaids for infant care?
2. How relevant is the curriculum used by maids training centres for infant care?
3. How well do housemaids performance their duties after training?

**Limitation of the study**

This study was not without limitations. Some of the most outstanding ones were the lack of a platform to make comparison in methodology, procedures, designs, variables or literature as no similar study has been done in Zambia. There was no documented study on the capacity of maids training centres to train house maids for infant care in Zambia. Therefore, there were no studies to compare results with.

**Methodology**

In order to answer the research questions, quantitative and qualitative research approaches were used. The first four types of questionnaire were used in order to collect quantitative data. These were: 1) questionnaire for mothers; 2) questionnaire for trainers; 3) questionnaire for housemaids; and, 4) questionnaire for owners and managers of the training centres. The questionnaires had three main sections: a) background information; b) training; and, c) performance. The second instrument used to collect data was the interview. The interview was in two forms that is personal interview, in-depth interview in the form of focus group discussion. The FGD was recorded and later transcribed. Third in order to establish the ability of curriculum implementation, a document analysis was conducted. The different methods of data collection were used in order to triangulate the information obtained.

**Results**

**Qualifications of trainers**

A study conducted by Obe (2014) revealed significant difference between performance of students taught by professional teachers and non-professional teachers. It was considered important to point out the academic qualifications of the trainers of housemaids in this study in order to create an understanding as to the level of theoretical knowledge the trainee housemaids receive in the maids training centres. This was based on the understanding that the more academic qualifications a trainer has, the more capable they are in imparting relevant theoretical knowledge to trainee housemaids.

**Table 1.** Distribution of the highest level of education attained by trainers

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 7</td>
<td>3</td>
<td>5%</td>
</tr>
<tr>
<td>Form 2</td>
<td>4</td>
<td>6.67%</td>
</tr>
<tr>
<td>Grade 9</td>
<td>12</td>
<td>20%</td>
</tr>
<tr>
<td>Form 3</td>
<td>2</td>
<td>3.33%</td>
</tr>
<tr>
<td>Grade 12</td>
<td>21</td>
<td>35%</td>
</tr>
<tr>
<td>Certificate</td>
<td>15</td>
<td>25%</td>
</tr>
<tr>
<td>Diploma</td>
<td>3</td>
<td>5%</td>
</tr>
<tr>
<td>Bachelor degree</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>
The numbers of trainers involved in this study were three per each maids training centre. This gave a total of 60 respondents in this category. The study revealed that out of 60 trainers 21 (35%) have grade 12 school leaving certificates, 15 (25%) have tertiary certificates, 12 (20%) have grade 9 school leaving certificates, 4 (6.7%) form 2 (an equivalent of the current grade 9), 2 (3.33%) have form 3 school certificate, 3 (5%) have diplomas and 3 (5%) have grade 7 school certificate. None of the trainers have undergone systematic training or studies in early childhood teaching methodology caregiver’s training programmes. The implications of this is that lack of training, in both the theory of infant care and pedagogy in the courses offered in the maids training centres results in poor teaching. This, as Obe (2012) puts it, result in poor skill and knowledge acquisition by housemaids. The trainers with this academic background cannot impart relevant theoretical knowledge that can has significant impact on their practical care of infants.

Focus group discussion

The in-depth interview was conducted as a focus group discussion. Ten house maids randomly chosen from all the maids taking part in the study took part in this exercise. They were asked to meet at Graka Maids Centre in Presidential Housing Initiative (PHI) at 09:00 hours 16th April, 2016. The housemaids coming from far off places were given transport refunds. An introduction over the nature and confidentiality of the exercise was made. Focus group members were informed that all the discussions would be recorded and the recordings would be played for them to listen to. This process is called member check and is a strategy used for quality control in qualitative research (Harper & Cole, 2012). This was to ensure that the housemaids were comfortable with the exercise while they understood exactly what was taking place. It also gave them chance to review their statements for accuracy. The focus group discussion took 45 minutes and was recorded. The recordings were transcribed and the following were the main findings:

Many housemaids choose to become housemaids due to lack of education and a need for income for their sustenance. One house maid said, “I needed money for my child”. Another said, “Working as a house maid is better than staying at home”. Yet another put it this way “At least I have money for my basic needs like soap and I can pay rent”. “I am not educated so the only job that I can do is that of the house maid”.

The in-depth interview revealed that on average the length of training was one month and eight (40%) of the centres had more than 40 leaner’s per class and 120 per cohort. All housemaids agreed that they only required a National Registration Card (NRC) as an entry requirement for training. Most housemaids (65%) did their practical work in homes while 25% had theirs in lodges, guest houses and hotels and 10% in schools. The curriculum that was used for training was approved by the owners and certificates are also issued by the owners of the maids training centres. There is no government body that quality assures the curriculum or issues certificates except the Local Government and Housing Department of Social Welfare, which runs only two centres in Lusaka.

The curriculum content is: Home Economics; Housekeeping, Home Management, catering. None of the housemaids in the focus group discussion indicated that they had any training or lessons in infant management or care. But they were required to take care of infants when their employers have infant(s). This was supported by one mother who said, “One doesn’t need to train on how to take care of an infant. It is just interest in infants that matters”. Another one said:

“All human beings naturally know how to take care of infants. They do not need theories or school to know how infants should be taken care of. Look at our parents and grandparents, they did a good job and here we are today very strong and hardworking”.

<table>
<thead>
<tr>
<th>Post graduate</th>
<th>0</th>
<th>0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>60</td>
<td>100%</td>
</tr>
</tbody>
</table>
However, the focus group discussion revealed that 90% of the House maids would have loved to be trained in infant care as this would have made them more knowledgeable and efficient. House maids indicated that they would normally do house chores first before attending to the needs of the infant. Their reason being that if their employers find the house dirty, clothes unlaunhered and food uncooked they would “shout at us”.

**Document analysis**

The document analysis was conducted in order to establish the curriculum content as well as its implementation. Document or documentary analysis is a social research method and is an important research tool in its own right. It is a significant part of most methods of triangulation. It refers to the various procedures involved in analysing and understanding data produced from the analysis of documents and records applicable to a particular study (Robson, 2011).

Data was collected from attendance registers, examination/test papers and results, student practical/internship records, timetables, lesson plans, schemes of work, teaching files. Other sources of secondary data were affiliation documents, names of current and former trainees, records of placement of these trainees after training, inspection reports and other documents related to the qualifications of trainers; owners and centre managers. The analysis of documents included documents that show ownership of the centre buildings and financial records.

The document analysis revealed that 82% of the maids training centres visited do not have attendance registers and 90% did not have class lists. This notwithstanding, the owners, who also acted as accounts clerks, kept records of all the trainees who paid for the maids training programme. The timetables were not there and planning of daily activities was done in the morning of each day. The verbal plans were not segmented according to hours and subjects but a day could be allocated for just laundry and other days for cleaning windows or floors. There was no day set aside for learning anything in infant care nor were there any lecture notes showing theoretical knowledge being imparted. There was no evidence of trainees’ written work. There were no schemes of work, lesson plans, lecture notes or evaluation reports. No tests are written but they conducted orally and practically. The training is described as practical and hands-on.

The document analysis showed no evidence of theoretical work being carried out or assessed. Trainees confirmed that all teaching was verbal accompanied by demonstrations. The trainees were expected to repeat what the trainers demonstrated. In all the centres visited trainees passed and were allocated work places by the centres.

The document analysis displayed no lesson planning, no schemes of work and poor assessment and test preparation. Most of the assessment was done by giving oral instructions and trainees performed tasks practically. The trainers observed the performance and intervened with a demonstration if the trainee was failing to carry out a task satisfactorily. Most of the trainers found themselves into this career of training purely by chance and in pursuit of some income generating activities. With no strict regulation and monitoring in this sector, from either the Ministry of General Education or the Ministry of Local Government and Housing, the housemaids who graduate from these maids training centres are not trained for infant care both in theory and in practice but are expected to give age appropriate care and stimulate learning in the infants.

Document analysis also revealed poor record keeping as the records of previous trainees who had graduated from the centres were either absent or on pieces of unfiled papers. The continuous assessment records of the current trainees were not recorded. 90% of the maids training centres had no attachment reports and no records of the final examination results, inventory of teaching/learning resources which they had.

These findings were triangulated by finding out what housemaids, trainers and the owners and managers of the maids training centres thought were the qualifications of the trainers. In addition, documents such as school and college certificates, workshop participation and attendance certificates were looked at. The findings are summarised below.
**Professional qualification of trainers**

The trainers were asked to indicate their professional qualifications as this was considered to be very important in determining the quality and nature of training the trainees housemaids were receiving. The study conducted by the European Centre for the Development of Vocational Training (2013) confirms that qualifications play a critical role in determining the minimum level of knowledge, skills and competence required for an occupation or job. The results are presented below:

![Figure 1: Professional qualifications of trainers](image)

The graph in figure 1 clearly shows that none of the trainers/instructors in the maids training centres did early childhood education or child caregiver programmes or even nanny programmes. This shows that theories of child development and child pedagogy are not imparted to the learners who upon graduation are supposed to take care of infants of their employers. It is therefore, not surprising that these components are missing in the curriculum used to train maids.

**Importance of training house maids**

Sass and Harris (2008) observes that, it is generally acknowledged that promoting teacher quality is a key element in improving education. One of the primary goals of the *No Child Left Behind law* in United States of America is to have a “highly qualified teacher” in every classroom. Since learning starts immediately after birth, it can be said the quality of the caregiver, in this case the house maid is important in fostering infant development and learning. Training of housemaid was one factor used in this study to establish the theoretical knowledge acquired by or possessed by house maids. The theoretical knowledge in infant care is obtained through teaching and studying. The data on how housemaids perceive the importance of training as it relates to their work is given below.

<table>
<thead>
<tr>
<th>Very important</th>
<th>Important</th>
<th>Somewhat important</th>
<th>Not important</th>
<th>Extremely unimportant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mothers</td>
<td>50%</td>
<td>25%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>Housemaids</td>
<td>45%</td>
<td>40%</td>
<td>0%</td>
<td>15%</td>
</tr>
</tbody>
</table>

*N=20 house maids  
N= 20 Mothers*

Both mothers and housemaids agree that training house maids was very important or important. Some mothers put it this way: “*training helps the maids to be more efficient.***” “*Helps them to know why they are house maids***”. “*It helps them to cook nutritious foods***”; “*They clean the house thoroughly well***”.  

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None of the mothers or housemaids mentioned training as predictor of good infant care.

**Trained housemaids perform better than untrained housemaids**

According Berument (2013), some of the maids when employed in homes do not have any kind of training but largely depend on the experience they have by doing house chores in their homes and also taking care of their children in their homes.

Mothers were asked to rate the level of agreement on whether trained maids perform better than untrained housemaids and the result were as follows:

<table>
<thead>
<tr>
<th>Table 3. Rating on the level of agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
</tr>
<tr>
<td>30%</td>
</tr>
</tbody>
</table>

The results reveal that 50% of the mothers think trained housemaids perform better than the untrained ones while the other 50% disagree with the statement. One of the mothers said “It is not necessary to be trained in order to know how to clean a house”. None of the mother made reference to infant care.

**House maids are sufficiently trained in infant care**

Mothers were asked the rate their agreement with this statement and the results were as follows.

<table>
<thead>
<tr>
<th>Table 4. Rating on sufficiency of training in infant care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
</tr>
<tr>
<td>0%</td>
</tr>
</tbody>
</table>

All the mothers disagreed with the statement that maids training centres sufficiently train housemaids in infant care. They said maids training centres focus on housing keeping and not on infant care.

**Rating on the effectiveness of training of housemaids in enhancing the performance.**

Mothers were asked to rate the effectiveness of the training on activities related to infant care and general house chore. The results revealed that training was very effective in preparing housemaids for carrying general house chores and not infant care as the results below show.

<table>
<thead>
<tr>
<th>Table 5. Rating on the effectiveness of training of housemaids in enhancing performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task</td>
</tr>
<tr>
<td>Bath infant</td>
</tr>
<tr>
<td>Feed infant</td>
</tr>
<tr>
<td>Sing to the infant</td>
</tr>
<tr>
<td>Play with the infant</td>
</tr>
<tr>
<td>Change diapers</td>
</tr>
<tr>
<td>Talk to infant</td>
</tr>
<tr>
<td>Put infant to sleep</td>
</tr>
<tr>
<td>House chores</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Percentage</td>
</tr>
</tbody>
</table>

76.9% of the respondents felt the training was ineffective in preparing housemaids for infant care. This is a reflection of the fact that the programme of the maids training centres is not focused or designed for preparing housemaids to take care of infants but on house chores.
Rating on the frequency of application of knowledge acquired from training in selected activities.

The respondents were asked how frequently they applied the knowledge they acquired during training to their daily work and the result show that the knowledge was rarely applied to activities related to infant care. However, the results show that the knowledge was found useful and was always and often used by housemaids’ in house chores. The results are shown in the table below:

Table 6. Ratings on the frequency of the application of knowledge acquired from training in selected activities

<table>
<thead>
<tr>
<th>Task</th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Not at all</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bath infant</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Feed infant</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Sing to the infant</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Play with the infant</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Change diapers</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Talk to infant</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>14</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Put infant to sleep</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>House chores</td>
<td>17</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>4</td>
<td>7</td>
<td>57</td>
<td>69</td>
<td>160</td>
</tr>
<tr>
<td>Percentage</td>
<td>15%</td>
<td>0.625%</td>
<td>4.375%</td>
<td>35.625%</td>
<td>43.125%</td>
<td>100%</td>
</tr>
</tbody>
</table>

The results revealed the majority (78.76%) of the respondents rarely or do not use the theoretical knowledge to assist them with the activities related to infant care.

Availability of instructional resources for training housemaids

Adeogun (2001) found that there was a strong positive significant relationship between teaching resources and academic performance of the learners. Training institutions endowed with more resources performed better than those with less. These results were in agreement with the study of Babayomi (1999) which discovered that schools with adequate teaching and learning resources performed better in national examinations in Nigeria. Adeogun (2001) further argued that effective learning cannot take place if basic instructional resources are not adequate.

The house maids, trainers and mothers were asked to indicate what type of instructional resources that were available, whether they were appropriate for training maids in infant care. Their aggregate responses are presented below:

Table 7. Availability of instructional resources

<table>
<thead>
<tr>
<th>Facility</th>
<th>Very Adequate</th>
<th>Adequate</th>
<th>Inadequate</th>
<th>Very Inadequate</th>
<th>Not Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text books</td>
<td>0%</td>
<td>0%</td>
<td>40%</td>
<td>50%</td>
<td>10%</td>
</tr>
<tr>
<td>Stationery</td>
<td>0%</td>
<td>15%</td>
<td>53%</td>
<td>32%</td>
<td>0%</td>
</tr>
<tr>
<td>Teaching/Learning aids</td>
<td>0%</td>
<td>20%</td>
<td>60%</td>
<td>20%</td>
<td>0%</td>
</tr>
<tr>
<td>Computers</td>
<td>0%</td>
<td>0%</td>
<td>5%</td>
<td>95%</td>
<td>0%</td>
</tr>
<tr>
<td>Assorted toys</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>70%</td>
<td>30%</td>
</tr>
<tr>
<td>Materials for infant care</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Ironing boards</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Cooking utensils</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>5%</td>
<td>95%</td>
</tr>
<tr>
<td>Cleaning materials</td>
<td>0%</td>
<td>75%</td>
<td>25%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Furniture</td>
<td>0%</td>
<td>13%</td>
<td>80%</td>
<td>7%</td>
<td>0%</td>
</tr>
</tbody>
</table>
The results obtained indicate that the majority (90%) of the respondents said the text books were either inadequate or very inadequate. On the other hand 10% said they were unavailable. Learning and teaching aid were considered inadequate and very inadequate by 80% and only 20% thought they were adequate. The computers were said to be inadequate by 5% while 95% said they were very inadequate. Overall the findings show that only cleaning materials were considered adequate (75%) as can be seen from the table. A follow up interview with the house maid indicated that 35% of the resources available were brooms, washing basins and mops, 25% indicated air fresheners, soap, cobweb removers and window cleaning materials, 15% indicated pressing irons and needles, 15% indicated stoves and fridges 10% indicated shining brushes and buckets. All the respondents indicated that there were no toys or infant care or feeding equipment. Most of the available resources have no relevancy to teaching, learning and infant care.

Appropriateness and adequacy of instructional materials refers to acceptable quality and quantities of material resources, physical facilities and human resources. According to DFID (2007), adequacy of instructional materials such as textbooks, which is the main instruction material is the most cost effective input affecting learners’ performance. In this context, acquisition of theoretical knowledge by housemaids. The adequacy of supply is usually assumed to be a minimum of one textbook for every three learners. According to Padmanabhan (2001) adequacy of instructional resources determines the efficiency of the training institution. In order for learners to effectively learn and for instructors to effectively teach, textbook and resource materials are basic tools, their absence or inadequacy makes instructors or teachers handle subjects in an abstract manner resulting in poor performance by the learners.

From the obtained results, it is clearly evident that maids training centres lacked adequate facilities and learning resources. The status of instructional materials, equipment and facilities are inadequate, and unsuitable for preparing competent house maids for infant care. The state of affairs raises concern about the quality of house maids from these centres. The proliferations of maids training centres in such conditions are a manifestation of the ineffectiveness of the systems of monitoring and regulation of maids training centres. Inadequate instructional materials and resources for teaching and learning prevent the maids training centres from contributing to the production of up-to date and specialized knowledge for their trainees.

During the FGD the respondents indicated that due to financial difficulties or challenges that most of the centers are experiencing it is hard to obtain many of the required resources during the training of housemaids. For instance, the respondents indicated that it is hard to find some of the expensive learning resources needed such as washing machines, cooking appliances, electrical polishers, refrigerators and sometimes even simple resources needed like washing powder are usually hard to find. When they are available they are not enough to cater for the number of trainees available (Aruna and Rajah, 2011).

Curriculum used in maids training centres

According to Bilbao, Lucido, Iringan, and Javier (2008) the term curriculum means different things to different people. Here are some definitions of what constitutes curriculum as presented by different people: a) the total learning experience provided by a learning institution e.g. a school or training centre (Kelly, 2009). It includes the content of courses (the syllabus), the methods used (strategies), and other aspects, like norms and values, which relate to the way the school is organized. b) The total number of courses of study given in a learning environment (Braslavsky, 2003). The courses are arranged in a sequence to make learning a subject easier. c) Curriculum can refer to the entire program provided by a classroom, school, district, state, or country (Hancock, Dyk, & Jones, 2012).

A comprehensive curriculum is that which offers expanded daily support, guidance, and inspiration to instructors or teachers and housemaids as caregivers of infants. The curriculum in maids training centres should be adequate for preparing trainees to give holistic care and facilitate learning and holistic development to infants.
The maids and trainers were asked to say and write the curriculum content of the maids training centres and the results are presented below and in figure 4.3 below.

**Figure 2.** Curriculum used in maids training centres

The results obtained indicate that most (50%) of the maids training centres do not have a specific written down curriculum that they follow. For those that have (mainly an oral one) (37.5%), they focus mainly on housekeeping (Cleaning), which supports the earlier results presented where there were no instructional materials for infant care but only for carrying out house chores. The results also show that their no timetables or daily schedules displayed. The trainers do not write lesson plans or assessment reports.

**Designing the curriculum used in maids training centres.**

According to Taba (1962):

> "Curriculum design is a statement which identifies the elements of the curriculum, states what their relationships are to each other, and indicates the principals of organization and the requirements of that organization for the administrative conditions for which it is to operate. A design of course needs to be supported with and to make explicit a curriculum theory which establishes the sources to consider and the principals to apply (p. 421)".

Curriculum design takes into account not only the development of cognitive faculties of the learners but character development too. The curriculum design is always linked to selected philosophies of those who are involved in the design and development process. The developers of the curriculum for the maids training centres should have all these factors in mind as they embark on the task.

The housemaids and trainers were asked name the designers of the curriculum which they are using in the training programme for the house maids, the results are presented below:
Most of the maids training centres do not have a specific curriculum that they follow 50%. However, for those that have, it is prepared by the owners (62.5%), trainers (25%) and the directors of the centre (12.5%). The content of these curricula are not subjected to quality control by any institution and the training centre have no internal quality control policies. Having in mind that 70% of the maids training centres visited are owned and run by former house maids, the just replicate what they went through while training. Most of the training centres (68%) do not follow written down curriculum and do not indicate the expected outcomes of the training or the numbers of hours that should be spent on each subject. The Lusaka City Council (LCC), the Ministry of Tourism (MOT) and Ministry of General Education (MOGE), do not inspect these centres nor quality assure the curricula.

It was difficult to generalise the extent to which the curriculum meets the intended outcome since the curricula are designed (and in most cases (89%) unwritten) for individual maids training centres and the intended outcome are also not written down anywhere.

The duration of the training

The trainers and trainee housemaids were asked how long their training was and the results displayed below.

The duration of the training is averages 2.3 weeks as given by 57.14% of the respondents. It is my considered view that this period is too short to cover the theory and practice of infant care, child development, Health Nutrition and safety, learn how to prepare daily schedules among other essential courses which helps the caregiver to give quality care. The justification for the short period of training was that most of the training was hands-on. It is can be, concluded then, that trainees in maids training centres do not receive theoretic knowledge in infant care.
This is also supported by lack of past examination papers, assignment questions or written notes given to students by the trainers. All the students testified to the fact that they spent only two days in class.

**Ratings on the relevance of the curriculum to infant care**

In training, a curriculum is generally defined as the sum total of learners’ experiences that take place in the learning process. The term often refers precisely to a planned sequence of instruction, or to a view of the learner's experiences in terms of the instructor’s or institutional goals. According to Reys, Reys, Lapan, Holliday and Wasman (2003) curriculum is a set of learning goals pronounced across grades that outline the intended content and process goals at particular points in time. Curriculum may include the planned interaction of learners with instructional content, materials, resources, and processes for evaluating the attainment of educational objectives.

House maids, mothers and trainers were asked whether the curriculum in maids training centres was relevant to infant care. The result presented below.

<table>
<thead>
<tr>
<th>Relevance of curriculum in terms of:</th>
<th>Very relevant</th>
<th>Relevant</th>
<th>Not sure</th>
<th>Not relevant</th>
<th>Very irrelevant</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant care</td>
<td>5%</td>
<td>10%</td>
<td>0%</td>
<td>70%</td>
<td>15%</td>
<td>100%</td>
</tr>
<tr>
<td>House chores</td>
<td>70%</td>
<td>30%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
</tbody>
</table>

The results indicate that the majority of the respondents (85%) considered the curriculum not relevant and very irrelevant to infant care. This therefore, means that the training of housemaids does not give them theoretical knowledge infant care which could in turn influence infant care when they give employed. On the other hand, despite not having a comprehensive written down curriculum, the results indicated that the trainees benefit from the training in relation to house chores: cleaning, laundry, cooking.

**Allocation of time for classroom, field work and practical work**

According to Jones and George (2005) training is a planned method by which knowledge or skills are acquired for a definite purpose. The main aim of training is to change the behaviour of those trained. This means that the trainees acquire new manipulative skills, technical knowledge and skills on the job. (Archieve, 2008).

Grobler et al. (2006) described training as the use of specific means to instill specific learning, using techniques that can be identified and described. Training therefore is a deliberate effort to teach specific skills, knowledge and attitudes to serve a specific purpose (Archive, 2008).

According to Craig, Kraft and Plessis (1998) there are, programmes for teachers education that have worked well with a duration ranging from fifteen days as in the BRAC schools in Bangladesh, twenty-five days in the rural community schools in Egypt, two-year programs in Botswana. He argues that success depends on how the courses are structured and what support accompanies them. Since house maids are expected to care and educate infants, they can be considered as teachers.

The house maids and trainers were asked to rate the adequacy of time allocated for classroom, field work, and practical work. The result is presented below.
The results show that time allocated for classroom teaching is considered inadequate by 85% of the housemaids but adequate (85%) from the perspective of the trainers. On probing each group further it was discovered that both the housemaids and the maids training centres wanted to work and off load housemaids to the market quickly respectively. The maids training centres hire out the maids they train. This means the shorter the period the more maids they hire and the more money they make. The housemaids also look forward to being hired out so that they can start earning a wage. This also explain why there are no trainees who fail in the maids training centres.

**Time allocated for field work**

Field work comprises activities which are done outside of the training centre and the classroom. This however, should relate to and add-on the content being taught in that course or programme. Field work includes observation in a classroom setting, tutoring trainees, taking care of infants, cleaning (hotels, restaurants, schools homes, banks) interviewing owners of these premises in a supervised setting. Field work ends with trainee working or on internship which should be completed during the trainees’ final term of their training programme.

The housemaids and trainers were asked to rate the adequacy of the time allocated for field work and the results are presented below.

| Table 9. Ratings on the adequacy of time allocated for field work |
|-------------------------|-----------------|-----------------|-----------------|-----------------|
|                         | Very adequate   | Adequate        | Fairy adequate  | In adequate     | Very inadequate |
| House maids             | 20%             | 28%             | 10%             | 15%             | 20%             |
| Trainers                | 66.7%           | 8.3%            | 8.3%            | 10%             | 6.7%            |

The trainers (73.3%) indicated that the time for the field work was very adequate to fairy adequate while the housemaids (58%) think the time is very adequate to adequate. Probing those who thought the time is not adequate revealed that many areas like knowing the family cultural of the houses they were doing their internship needed substantial time for them to do a good job and learn at the same time. The same was true for those on attachment in restaurants, hotels, schools, and banks. The one that needed more time are those that found themselves on attachment in homes where there were infants. They needed to take care of the infants even when this was not covered in their training programme. They stated that they needed more time to establish a relationship with infant.

**Table 10. Rating on adequacy of time allocated for practical work**

<table>
<thead>
<tr>
<th></th>
<th>Very adequate</th>
<th>Adequate</th>
<th>Fairy adequate</th>
<th>In adequate</th>
<th>Very inadequate</th>
</tr>
</thead>
<tbody>
<tr>
<td>House maids</td>
<td>80%</td>
<td>10%</td>
<td>10%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Trainers</td>
<td>83.3%</td>
<td>8.3%</td>
<td>8.3%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Analyzing the results show an agreement between the housemaids and trainers that the time allocated for practical work both at the training centre and the attachment period was adequate. This is in agreement with the earlier notion put across that the training of house maids was more practical approach than theoretical and was focused on house chore than on infant care.

From the results presented above, it is clear that the majority of the trainers have done hotel, catering and teaching courses at certificate level and psycho-social counselling. These are short courses mostly organised by extension studies of the University of Zambia and some NGOs. The certificate in teaching is at primary teacher education level that that does not include infant care. The implication is that they have not received systematic training in infant care, theories of infant development and learning. This therefore, makes them unqualified to impart skills and knowledge in this area to trainee house maids.

**Conclusion**

The main findings for the study on the capacity of maids training centres to train house maids for infant care in Lusaka have been presented. Questionnaires, interviews and document analysis were used. The different methods of data collection were used in order to triangulate data obtained. The results however, show that the maids training centres had no capacity to train maids for infant care. The human and instructional resources were found to be inadequate. The curriculum was found to be unwritten and was not quality assured. It also had no elements of infant care. The study revealed that the main focus of maids training centres was not theory and practice of infant care but housekeeping. This, therefore, means that the effect of theoretical knowledge on the practical care of infants could not be established.

**Recommendations**

1. The government should:
   a) Provide policy guidelines for the registration and operations of maids training centres in Zambia;
   b) Provide a standardized maids training curriculum for infant care;
   c) Recognize infant care as a special field;
2. The maids training centres should:
   a) Meet the minimum standards for training housemaids in infant care;
   b) Have a library for students to study and improve their theoretical knowledge
   c) Invest in instructional materials such as computers, printers, photocopiers, scanners, text books, overhead projectors, material for practical work, and communication gadgets among others;

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Electronic waste and management

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Abstract

E waste management should be globally accessed to improve ecological balance in the world. The valuable materials should be recycled using rudimentary techniques. There must be a treaty signed between developing and developed countries to further improve functional areas in environment and health implications caused due to the ill effects of E waste. Since the technology is increasing more the E waste is also generated. It is a serious issue to be concerned for further changes in the developing countries. We must refer the western waste management principles and international recycling technology that must be promoted for further assistance.

Keywords: reuse, recycle, refurbishment

Introduction

Electronic products such as discarded computers, televisions, fax machines, electronic lamps, Cell phones and audio equipment if not properly disposed can affect soil and underwater by creating toxins. Current practiced lead to economic stimulus. Most of the developing countries lack the infrastructure for sound hazardous waste management include recycling or regulatory framework for hazardous waste management. There must be an international cooperation to promote new ideas for the promotion of business and investment on E waste projects. So many aftereffects of E waste management could be solved.

How is affecting our life

Electronic products accumulate the toxic substances including heavy metal such as lead, nickel, chromium, mercury, persistent organic pollutants (pop) such as polychlorinated biphenyls and brominated flame retardants.

- Acids leaching operation and sludge obtained from melting computer chips disposed on the ground causes acidification of soil
- Incineration of e wastes can emit toxic fumes and gases thereby polluting the surrounding air.
- Disposing of e waste is not affecting human but even animals Health effects of certain constituents in E wastes

Mercury is in relays, switches and gas discharge lamps. Batteries contain mercury, Cadmium and lithium. Plastics contain brominated flame retardants; cathode ray tubes contain 2 to 3 kilograms of lead. PCB and PDBEs when mixed with water and exposed to sunlight dispersed with the complex chemistry of soil. Lead used in solder of printed circuit boards, glass panels, and gaskets in computer monitors. It causes damage to central and peripheral nervous systems, blood systems and kidneys and affects the brain development of children. A cumulative toxicant that affects multiple body systems including the neurological, gastrointestinal, cardiovascular and renal systems. Mercury used in relays, switches, and printed circuit boards. It is elemental and methyl-mercury are toxic to central and peripheral nervous system. Inhalation of mercury vapor can produce harmful effects on the nervous, digestive and immune systems, lungs and kidneys, and may be fatal. The inorganic salts of mercury are corrosive to the skin, eyes and gastrointestinal tract, and may induce kidney toxicity if ingested. Lithium is used in rechargeable batteries. It is extremely hazardous in case of ingestion as it passes through the placenta. It is hazardous and an irritant of the skin and eye, and when inhaled. Lithium can be excreted in maternal milk. Barium in front panel of CRTs. It causes muscle weakness and damage to heart,
liver and spleen. It also produces brain swelling. Beryllium used in Motherboards of computers. It causes lung cancer and inhalation of fumes and dust can cause chronic beryllium disease or berylliosis and skin diseases such as warts. Cadmium in chip resistors and semiconductors. It has toxic, irreversible effects on human health and accumulates in kidney and liver. Has toxic effects on the kidney, the skeletal system and the respiratory system, and is classified as a human carcinogen.

Managements steps taken in E management

- There must be seminars and awareness programs conducted in various areas of the country. The government should practice norms and regulations used in developed countries. There must be strict policies forming a regulatory framework in different electric and electronic industries. The government should send representatives to the various developed countries to study and research how they handle the recycling cycle. Technologies should be build and laid foundation in such a way it is cost reliable. Various research programs should be conducted to promote new ideas and get innovation. There must be scientific evaluation for strengthening collaboration and data sharing network should be initiated. There must be a link with various protocols and should assign a scientific online site to clear doubts of e waste management for various industries. Protocols like strategic approach to international chemical managements, basel action network is to form a chemical free world. There must be enterprise organized for recycling, upgrading networks and for monitoring the works. There must be protection of workers for occupational health and safety guidelines.

- An environmental sound e waste recycling chain contains the following steps.
- De manufacturing into subassemblies and components-this involves manual disassembly of a device or component to recover value depollution-the removal and separation of certain materials to allow them to be handled separately to minimize impacts, including batteries, fluorescent lamps and cathode ray tubes materials separation-manually separating and preparing material for further processing mechanical processing of similar materials-this involves processing compatible plastic resins, metals or glass from CRTs to generate market trade commodities.
• Mechanical processing of mixed materials-this involves processing Whole units followed by a series of separation technologies.
• Metal finishing or smelting-after being sorted into components or into shredded streams, metals are sent to refiners or smelters. At this stage, thermal and chemical management process are used to extract metals

Benefits of recycling

Environmental benefits

Protects environment: The chemicals are less released into surrounding soil water and air. It promotes sound management of toxic chemicals through reuse, recycle, refurbishment of e waste. Conserves natural resources: Recycling recovers valuable metals thus, reducing the need to mine new raw materials. It protects this metals for future use. Reduces energy consumption: This makes the production process, Cost effective. We can conserve energy which would be used

In manufacturing plants. Reduces amount of waste to landfills: This helps in reducing water and land pollution. Through cycling we can effectively reduce the portion of the land which is used as landfill space.

Reduces pollution: E waste cycling contributes to eliminating ten percent of air pollutants and eight major categories of water pollutants.

Reduces global warming: Recycling produces less greenhouse gases As industries burn fewer fossil fuels for eco-friendly products. It minimizes the harmful impact on environment.

Judicious and sustainable use of resources: We can preserve all precious resources for our future generation without any compromise In the present.

Economic benefits

Provides good business opportunities: By using both the resources and manpower it would earn benefits in the form of incentives and raw materials. It is a great venture that is bound to prosper if recycling plants are there in developing countries.

Scope of research: It provides a promising subject for industry and environment research too. This makes the e waste recycling process worldwide. This will act as a motivation for those who want to safeguard our ecosystem.

Create green jobs: Many skilled workers could get reputable jobs. The poor people could also generate source of income thereby avoiding poverty and raising betterment of living.

Cost minimization: The indigenous e waste recycling facilities will only save the domestic costs but also reduce burden on the foreign country where the scrap was supposed to dumped otherwise.

Helping others: Donating your used electronic benefits your community by passing on ready – to-use refurbished equipment those who need it.

Electronics recycling helps protect public health and environment: By the use of reuse, recycle, refurbishment of electronic goods it safely helps in keeping the hazardous materials from harming humans to the environment.

Current trends in e waste management

• The basel Convention network has identified E waste hazardous and developed a framework for controls on transboundary movement of such waste. Waste electrical and electronic equipment(wee), it is one of the fastest growing fractions in recycling. Extended producer Responsibility is being propagated as a new paradigm in waste management. The national strategy for electronics stewardship has resulted in building greener electronics by promoting chemical free world. Bureau of International is the gateway to the international.

Recycling business

Obstacles found in developing countries.
Lack of public awareness.
Absent or inadequate legal framework.
Illegal shipments of e-waste.
Increasing volumes of e-scrap arising of domestic origin.
Informal sector bad practices e.g. open burning, acid leaching, uncontrolled dumping of hazardous elements and hazardous wastes.
Hindrances to controlled movement of e-scrap to Environmentally Soundly Managed Facilities.

Solutions found in developing countries.
Increase public awareness.
Duplicate best practice legal framework.
Encourage private sector collection, otherwise implement EPR.
Ban landfill of e-scrap.
Institutionalise inspections and enforcement.
Integrate informal sector in collection System-only ESM facilities-otherwise rely on EPR.
Government & Agencies need to be encouraged to manage the e-scrap controls at the speed of business.

World e-waste management market segmentation
Top factors affecting e waste management

- Rare and noble in e waste are collected separately, the new concept of rare metal recovery complex is now derived.
- Urban mining which enables the minimum use of energy and reagents required for crushing/shredding, separation and purification process of rare metals
- World loop receives corporate finding to support a range of electronics recycling programs and it facilitates overseas recycle printed circuit boards, transformers and leaded glass.
- It has helped to extract gold and other valuable metals from the printed circuit boards.
- Developing countries are shipping more e waste to developed countries and develop a new era of business.
- Mobile e waste technology has been split between computers/laptops category and the telecom device category.
- Use of conveyor belts in E waste logistics and waste stream sorting operations.
- Cadmium and battery dismantling are used in rechargeable nickel-cadmium batteries.
There has been a strong movement towards the removal of poisonous lead from consumer electronics.
Further processing such as smelting or pulverization is introduced.
Processing methodologies- approaches such as waste stream sorting, waste logistics, dismantling or disassembly, chemical separation efforts are taken.

**Conclusion**

For E waste management, many technical solution are available but to be adopted in the management system Perquisite conditions such as legislation, collection system, logistics and manpower should be prepared. This may require research and evaluation studies. Zero waste initiatives should be gathering speed in developing countries. There is a proper mantra used by many recycling advocates “Reduce, Reuse and Recycle, this must be our motto to build a chemical free environment.

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Disclosure and Non-Disclosure of HIV Positive Status to Partners among Pregnant Women at a Regional Hospital in Swaziland

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Abstract

Individuals diagnosed with HIV often have difficulty disclosing their status to others, yet hiding the diagnosis can have serious implications. Disclosure of HIV status involves a process of decision-making, based upon numerous factors. This study was done to explore the reasons why some women disclose and some do not disclose their HIV status.

The study was conducted in a regional hospital in Manzini. The researcher employed the qualitative descriptive phenomenological methodology. Convenience and purposive sampling were utilized, and the data collection methods were in-depth Interviewing methods. A total of 15 pregnant women attending antenatal care were interviewed.

Most prominent reasons for disclosure of the HIV status by pregnant women attended to for the PMTCT program were that of the need to practice safer sex. Some felt the need to disclose because it would make their sexual partners to protect the unborn babies and to reduce the chances of re-infection. Most women who disclosed stated that they were so hurt by finding themselves HIV positive yet, they knew that they were faithful to their sexual partners. Some stated that they needed somebody to share the pain with. Some women stated that they did not disclose their HIV statuses out of fear of lack of support and probably domestic violence.

Keywords: Disclosure, HIV, PMTCT, domestic violence, SWAGAA, antenatal care.

Introduction and background information

It is well known that individuals diagnosed with HIV often have difficulty disclosing their status to others. This is particularly relevant for women in developing countries (Sethosa & Peltzer, 2005) where they are often economically, culturally and socially disadvantaged and may fear abuse or abandonment once their diagnosis is known and increasing numbers of pregnant women discover that they are HIV-positive during pregnancy. This can be particularly traumatic for a woman. Yet hiding her diagnosis can have serious implications. Disclosure of HIV status involves a process of decision-making, based upon numerous factors.
An HIV Test conducted for PMTCT at VCT centre in Swaziland (AMICAALL –SWAZILAND)

Accessed 05-07-13

Statistically, developed world rates of HIV status disclosure to sexual partners ranges from 42% to 100%, developing world rates range from 16.7% to 86%; disclosure rates to current and/or steady partners is 49% in developing and in developed countries- (79%). The lowest rates among pregnant women tested in antenatal care (ANC) in sub-Saharan Africa (16.7%-32%).

Medley et al., (2004) identified the following barriers for not disclosing the HIV status among women in developing countries; fear of accusations of infidelity, abandonment, rejection, discrimination and violence, disruption of family relationships, emotional and physical abuse and, fear of loss of economic support from a partner. Barriers stem from an awareness of stigma associated with HIV/AIDS (UNAIDS, 2004). Some research studies show that while fears of disclosure are legitimate, consequences are often less severe than anticipated. Medley’s review of disclosure (2004) found few women reported negative consequences and many respondents reported positive outcomes.
Clearly women must weigh the likelihood of an expected negative reaction with the possibility for a positive outcome when considering to whom to disclose. The researcher explored and described reasons for disclosing and not disclosing to sexual partners among Swazi women who test HIV-positive during pregnancy for a programme on Mother-To-Child Prevention of HIV transmission (PMTCT).

**Women waiting for delivery**
Methodology

Research design

In this study the researcher employed the qualitative descriptive phenomenological methodology. Phenomenology is a science whose purpose is to describe particular phenomena, or the appearance of things, as lived experiences (Streubert & Carpenter 1999:43). It develops an understanding of people’s opinions about their lives and the lives of others. It also helps the researcher to generate an in-depth account that will present a lively picture of the research respondents’ reality.

Sampling

Convenience and purposive sampling were used in the present study. In convenience sampling, participants are included in the study because they happen to be in the right place at the right time (Burns & Grove 1998:217; Polit&Hungler2007:305). The sample in this study was determined by data saturation and it consisted of 15 women who had tested HIV positive for the PMTCT programme.

Data collection methods

In-depth interviewing

In-depth interviews are usually initiated with a broad or general question. After the interview has begun, the role of the researcher is to encourage the participant to continue talking, using techniques such as nodding the head or making sounds that indicate interest. In some cases, the participant may be encouraged to further elaborate on a particular dimension of the topic of discussion (Burns & Grove 2006:307) by using probes. The interviewer is obliged to follow up cues during an in-depth interview in order to get to the ‘true’ meaning of a phenomenon. The whole interview was tape-recorded and the researcher abstracted data from the material after the interview was over. In doing so, the researcher analysed the information on the tape and translated the interviewees’ responses into meaningful descriptions (Themes and categories).

Results

Graphic demographic presentation

Figure 1. Marital status n=15
Figure 2. Employment Status of participants n=15

Figure 3. Educational level n=15
Results

Themes and categories

1. Disclosure
   Theme 1.1: Anger
   Category 1.1.1: Hurt by the diagnosis
   Data chunks
   - “I told him that I was HIV positive when I came back from the clinic because I was so hurt; I wanted somebody to share the pain with”.
   - “I was badly hurt; it was not easy for me to accept, I decided to tell him and ask him so that he could explain where it came from”.
   - “I was so sad and I knew it was because of his behavior that I am HIV positive”.
   - “I was haunted by the diagnosis and I needed to cough it out so as to feel better”.

   Theme 1.2: Acceptance
   Category 1.1.2: Practice safer sex
   Data chunks
   - “I wanted to make him aware and to start using condoms in our relationship”.
   - “I want us to practice safer sex and protect the baby from getting HIV”.
   - “I wanted us to start using condoms and to avoid increasing the infection load”.
   - “I wanted to protect him from getting the HIV from me”.

   Category 1.1.3: Protect the unborn baby
   Data chunks
   - “I wanted us to protect our baby from getting HIV”.
   - “I wanted him to know so that we could prevent HIV from infecting our child”.
   - “I was concerned about the health of the child”.

2. Non-Disclosure
   Theme 2.1: Denial
   Category 2.1.1 Fear
Data chunks

- “I am afraid my partner may decide to dump me and I will lose the financial support”.
- “I don’t know how my husband can react towards the diagnosis that uncertainty makes me scared to open up”.
- “I am afraid that he might decide to leave me because we are not married yet”.

Category 2.1.2 Loss of financial support

- “Everything might change after disclosure, if I lose him,
- I might not get financial support to raise the child”.
- “I am afraid my partner may decide to dump me and lose the support from him”.

Discussion of results

Disclosing the HIV status to sexual partners, friends and family members can be very difficult. Most prominent reasons for disclosure of the HIV status by pregnant women attended to for the PMTCT programme were that of the need to practice safer sex. Some felt the need to disclose because it would make their sexual partners to protect the unborn babies and to reduce the chances of re-infection. Most women who disclosed stated that they were so hurt by finding themselves HIV positive yet, they knew that they were faithful to their sexual partners. Some stated that they needed somebody to share the pain with, while others said the diagnosis haunted them and wanted to cough it out so as to feel better. Some women stated that they did not disclose their HIV statuses out of fear of lack of support and probably domestic violence. According to Worth, Patton, and Goldstein 2008, lack of disclosure has been legally described as fraud, criminal negligence, nuisance and many other charges in addition to jurisdictions. Numerous research studies demonstrate that there are many valid cultural reasons individuals do not disclose their HIV status, such as fear of domestic violence, fear of familial or partner abandonment, and community rejection.

Recommendations and conclusion

There commendations are that programmes and policy approaches should be developed that have been recommended to increase HIV status disclosure rates and support individuals through the disclosure process. If women disclose and experience violence or mention the fear of any abuse during the post-test counseling session as a reason that they are afraid to disclose their HIV status to their partners, HIV counselors should: Address this when discussing disclosure, and be prepared to refer these women to domestic violence services like Swaziland Action Group Against Abuse (SWAGAA). The development of support groups for infected women can provide an avenue for ongoing support that may help women work through their disclosure processes. More research is needed to identify disclosure factors so counseling tools can be developed to identify individuals less likely to disclose and counsel them accordingly.

Conclusion

This research has successfully fulfilled the stated objectives and aims. Even though HIV status disclosure is difficult for some women, a significant number of women disclose their status to sexual partners and it is encouraging to note that some men are very supportive to their partners. Therefore women must weigh the likelihood of an expected negative reaction with the possibility for a positive outcome when considering disclosing.

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Anticolitis Activity of Myrobalan Powder via Regulating Colonic Enterochromaffin Cells and Serotonin

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Abstract

Objective: To investigate whether Myrobalan powder has an anti-inflammatory effect on colonic inflammation and to explore the mechanism involved.

Materials and Methods: Myrobalan powder was orally administrated to trinitrobenzene sulfonic acid (TNBS)-induced colitis mice at the dose of 3, 6, and 12 g/kg/d for 7 consecutive days. Body weight, stool consistency, histopathological score, and myeloperoxidase (MPO) activity were tested to evaluate the effect of Myrobalan powder on colonic inflammation while colonic enterochromaffin (EC) cell density and serotonin 5-hydroxytryptamine (5-HT) content were investigated to identify the effect of Myrobalan powder on colonic 5-HT availability.

Results: The results showed that the body weight of colitis mice was markedly decreased by 10, 12, 14, and 17% at 1, 3, 5, and 7 days (P< 0.05), whereas stool consistency score (3.6 vs. 0.4, P< 0.05), histopathological score (3.6 vs. 0.3, P< 0.05), and MPO activity (2.7 vs. 0.1,P< 0.05) in colitis mice were significantly increased compared to that of the normal mice; Myrobalan powder treatment dose-dependently increased the body weight (7–13% increase) and decreased the stool consistency score (0.4–1.4 decrease), histopathological score (0.2–0.7 decrease), and MPO activity (0.1–0.9 decrease) in colitis mice. Colonic EC cell density (70% increase) and 5-HT content (40% increase) were markedly increased in colitis mice (P< 0.05), Myrobalan powder treatment dose-dependently reduced EC cell density (20–50% decrease), and 5-HT content (5–27% decrease) in colitis mice.

Conclusion: The findings demonstrate that the anti-inflammatory effect of Myrobalan powder on TNBS-induced colitis may be mediated via reducing EC cell hyperplasia and 5-HT content. The important role of Myrobalan powder in regulating colonic EC cell number and 5-HT content may provide an alternative therapy for colonic inflammation.

Keywords: Colonic inflammation, enterochromaffin cell, serotonin, ulcerative colitis

Introduction

Ulcerative colitis (UC), a chronic intestinal inflammatory disease, is characterized by severe diarrhea, pain, fatigue, and weight loss. Based on the statistical analysis data, the incidence of UC has been increasing throughout the world, especially in the developing countries, this increasing trend in UC epidemiology may increase the healthcare burden and hinder economic development. Although the causes of colonic inflammation have not been clearly identified, it is believed to have a correlation with genetic susceptibility, immune imbalance, and alterations in commensal microbiota. Increased intestinal immune cells, such as T-cells, macrophages, enterochromaffin (EC) cells, as well as the altered cytokines and chemokines are associated with immune imbalance of gut and has been considered as the therapeutic targets for the treatment of colonic inflammation.

It is well known that nearly 95% of the body's serotonin 5-hydroxytryptamine (5-HT) comes from the gut, with large amount stored in EC cells. As a neurotransmitter and intercellular signaling molecule, 5-HT activates both intrinsic and extrinsic primary afferent neurons, therefore, regulates the gastrointestinal
activity. Increased intestinal EC cell number and 5-HT bioavailability have long been reported to play an important role in intestinal symptoms generation, such as visceral pain, motility dysfunction, and the altered barrier permeability. Recently, several studies have shown that 5-HT may contribute to the initiation of intestinal inflammation. It is reported that increase of 5-HT content in intestinal tissue by knocking out 5-HT reuptake transporter can exaggerate the severity of trinitrobenzene sulfonic acid (TNBS)-induced colitis and spontaneous colitis that arises from interleukin-10 deletion while decrease in the production of mucosal 5-HT by selectively inhibiting or knocking out the rate-limiting enzyme responsible for 5-HT synthesis can markedly attenuate experimental colitis in mice. Given the important role of 5-HT in intestinal inflammation, it is proposed that strategies that aim at decreasing intestinal 5-HT bioavailability may provide an alternative therapeutic target to ameliorate symptoms of colonic inflammation.

Until now, no guaranteed curative therapeutic regimen has been developed for colonic inflammation. The currently used management, such as corticosteroids, anti-inflammatory drugs, as well as immunomodulators, primarily focus on promoting remission and preventing relapse. In view of the side effects of conventional therapeutic medicines, more and more colitis sufferers seek the help of Traditional Ayurvedic Medicine. Nowadays, Traditional Ayurvedic Medicine is not only used by colitis patients across Asia, but also by various proportions of Western patients with colitis, ranging from 23% to 49%. Myrobalan powder is a traditional Ayurvedic Medicine, which has been widely prescribed to treat bacterial infection, allergic rhinitis, as well as respiratory infection in India and Other countries surrounding India. According to the theory of Ayurvedic medicine, Myrobalan powder can invigorate and consolidate the body's defensive ability, which has been considered as an anti-inflammatory and immune-regulatory agent. Recently, results from one clinical study showed that Myrobalan powder had a therapeutic effect in children with persistent diarrhea, the underlying mechanism may have a correlation with its immunomodulatory function.

In this study, we hypothesized that Myrobalan powder can attenuate colonic inflammation in experimental UC induced by intracolonic TNBS instillation. While colonic EC cell density and 5-HT content were also investigated in order to identify whether the therapeutic effect of Myrobalan powder on colonic inflammation have a correlation with its effect on regulating colonic 5-HT availability.

**Materials and methods**

**Materials**

TNBS, hexadecyltrimethylammonium bromide, o-dianisidinedihydrochloride, and pentobarbital sodium were purchased from Kartikeya Chemicals, Telangana, India. Myrobalan powder was purchased from Priya Trading Company, Jharkhand, India. Methanol was of high-performance liquid chromatography (HPLC)-grade Alpha Chemika, Andheri, India. All other reagents and solvents were of analytical grade and were commercially available.

Animals’ Male Swiss albino mice (aged 8 weeks with a body weight around 22 g) were obtained from the Mahaveera Enterprises, Telangana, India. All the mice were maintained at 25°C under 12 h-12 h alternating light-dark cycle with free access to food and water. Studies were carried out in accordance with the proposals of the Committee on the Ethics of Animal Experiments of Saraswati college of Pharmacy, Mumbai.

**Development of colitis model**

Mice were fasted overnight and then anesthetized by pentobarbital sodium intraperitoneal administration (50 mg/kg). A plastic catheter was inserted into the colon at a depth of 4 cm from the anus. TNBS solution (2.5 mg in 50% ethanol, 100 μl) was instilled slowly into the colon, after that the catheter
was gently removed. The mice in the control group were given with 100 μl saline instead of TNBS solution. All the mice were left on a warm pad until they recovered from anesthesia. At 1 and 3 days post TNBS administration, body weight and stool consistency were evaluated and recorded, the mice that showed soft or diarrhea stool with body weight decrease were selected as the colitis mice.

**Study design**

The colitis mice were randomly divided into five groups. Group 1 (n = 3) was set as the colitis model group, mice in this group were orally treated with water. Mice in group 2, 3, and 4 (n = 3 per group) were orally treated with Myrobalan powder at the dose of 3, 6, and 12 g/kg, respectively, the dosage was selected based on the previous study. Group 5 (n = 3) was set as the positive control, mice in this group were orally treated with sulfasalazine (SASP) at the dose of 500 mg/kg. Group 6 (n = 3) was set as a normal control, mice in this group were orally treated with water. The body weight change and stool consistency (0: Normal; 2: Soft; 4: Diarrhea) was scored according to previous methods at 1, 3, 5, and 7 days after drugs administration. All the drugs were administered for consecutive 7 days and after the final drugs administration, the mice were sacrificed. A 3 cm long proximal colon was collected and divided into 2 parts, one part was fixed in formalin and embedded in paraffin for EC cell counting, and the other part was frozen at −20°C for 5-HT content determination. A 3 cm long distal colon was collected and divided into 2 parts; the proximal was fixed in formalin for inflammation evaluation; the distal part was frozen at −20°C for myeloperoxidase (MPO) activity determination.

**Histopathological evaluation**

The colon sections (5 μm thick) were stained with hematoxylin and eosin. All sections were observed by a pathologist blinded to the group setting. The severity of colonic inflammation was recorded according to previous macroscopic and histological scoring criteria. Five random fields were selected in each slide; all the scoring data were analyzed using Image J NIH software.

**Myeloperoxidase activity determination**

MPO activity was determined by the modified method described as full. Briefly, the colon tissues were homogenized in 0.5% hexadecyltrimethylammonium bromide 0.5 mL/50 mg of colon tissue; then the homogenates were centrifuged at 18,000 g at 4°C for 15 min. Aliquots of 40 mL supernatant were mixed with 60 μL potassium phosphate buffer (50 mmol, pH 6.0) with o-dianisidine dihydrochloride and hydrogen peroxide. MPO activity was obtained from the rate of absorbance alteration in 1 min at 460 nm.

**Immunohistochemistry and enterochromaffin cell counting**

Tissue sections were de-paraffinized and rehydrated for immunostaining. Antiserotonin primary antibody (1:4000, Sigma) was incubated at 4°C overnight. After that, sections were labeled streptavidin biotin. The primary antibody was omitted as a negative control. Five fields at ×20 magnifications were captured for each section by a pathologist blinded to the group setting. The areas of colonic mucosa were measured using ImageJ NIH software, and EC cell density was expressed as the number of EC cells per mm 2 of the mucosal area.

**Statistical analysis**

Data are presented as a mean ± standard error. Differences between two groups were analyzed by Student's t-test. Data were analyzed using one-way analysis of variance followed by the Student-Newman-Keuls test. Differences were considered significant when P< 0.05.
Results

Effects of Myrobalan Powder on Body Weight and Stool Consistency in Colitis Mice: The body weight in colitis mice was decreased about 10, 12, 14, and 17% at 1, 3, 5, and 7 days, respectively, when compared to that of the control, and SASP treatment markedly elevated the body weight in colitis mice after 5 and 7 days' drug administration (P < 0.01). After Myrobalan powder administration, the body weight in high (12 g/kg) and median (6 g/kg) dose treated mice were significantly elevated after 3, 5, and 7 days' drug treatment when compared to that of the colitis mice (P < 0.05). Consistent with the findings from body weight change, the results from stool consistency score also found that colitis mice showed elevated score when compared to that of the control, SASP treatment, as well as Myrobalan powder treatment at high and median dose markedly decreased the stool consistency score when drugs were administered for 5 and 7 days (P < 0.05).

Effects of myrobalan powder on inflammation severity in colitis mice

The results from histopathological evaluation and MPO activity assay showed that TNBS colonic administration induced acute inflammation in the colon tissue of mice with markedly increased histological score and MPO activity (P < 0.01), whereas SASP treatment significantly decreased both histological score and MPO activity when compared to that of the colitis mice (P < 0.01), suggesting that SASP had anti-inflammatory effect on TNBS-induced colitis. Myrobalan powder treatment dose-dependently decreased histological score and MPO activity in colitis mice. There were significantly difference (P < 0.05) in both high (12 g/kg) and median (6 g/kg) dose of Myrobalan powder-treated mice when compared to that of colitis mice, indicating that Myrobalan powder can reduce the severity of colonic inflammation in TNBS-induced colitis.

Effects of Myrobalan Powder on Colonic Enterochromaffin Cell Density and 5-hydroxytryptamine Content in Colitis Mice

The colonic EC cell density and 5-HT content were both significantly increased in colitis mice (about 70% increase in EC cell density, about 40% increase in 5-HT content) when compared to that of the control (P < 0.05), suggesting the occurrence of EC cell hyperplasia in the colon of colitis mice. Compared with the colitis mice, SASP treatment slightly decreased the EC cell density and 5-HT content, but no significant difference was found between SASP treated mice and colitis mice. Myrobalan powder treatment dose-dependently decreased the colonic EC cell density (20–50%) and 5-HT content (5–27%) in colitis mice, but only the mice that treated with high (12 g/kg) and median (6 g/kg) dose of Myrobalan powder showed significant difference when compared to that of the colitis mice, suggesting that Myrobalan powder can reduce colonic EC cells hyperplasia and 5-HT content in colitis mice.

Discussion

Myrobalan powder has been widely prescribed in India to treat bacterial and respiratory infection. As an anti-inflammatory and immune-regulatory agent, Myrobalan powder is recently found to have a therapeutic effect on chronic colitis in patients, but the underlying mechanism has not been clarified. This study investigated the anti-inflammatory effect of Myrobalan powder on colonic inflammation using the TNBS-induced, colitis model. Our study provides the first evidence that Myrobalan powder can effectively attenuate colonic histological score and MPO activity via reducing colonic EC cell density and 5-HT content in colitis mice. The findings from this study confirmed that Myrobalan powder can be used as an alternative herbal agent in attenuating intestinal inflammation.

Considering the large amount of body's 5-HT located in the gastrointestinal tract, the role of 5-HT in regulating gastrointestinal activity has been investigated widely. Nowadays, it is found that increased colonic 5-HT bioavailability play a vital role in gastrointestinal symptoms generation, i.e., visceral pain,
motility dysfunction, increased barrier permeability, and the initiation of intestinal inflammation. Evidence also showed that EC cell number and 5-HT content are elevated in inflamed intestinal mucosa from Crohn's disease patients and in animal models of inflammatory bowel disease. The discovery of the important role of 5-HT in intestinal inflammation has attracted more attention about intestinal 5-HT bioavailability. We all known that intestinal 5-HT is mainly stored EC cells, so the number and function of EC cells are considered to play a critical role in intestinal inflammation. Results from this present study showed that Myrobalan powder can dose-dependently attenuate colonic inflammation, suggesting Myrobalan powder has a potential therapeutic effect on colitis. Our results also found that Myrobalan powder can markedly and dose-dependently reduce colonic EC cell density and 5-HT content in colitis mice, indicating that the reduced EC cell number and intestinal 5-HT level in Myrobalan powder-treated mice may contribute to the anti-inflammatory effect of Myrobalan powder in colitis mice.

It is not very clear how does 5-HT signaling modulate the process of intestinal inflammation. 5-HT is well known for its immune-modulatory effect, for there are many 5-HT receptors expressed on lymphocytes, monocytes, macrophages, and dendritic cells. It is possible that the elevated 5-HT level may modulate overly active immune response or dysfunctional inflammatory process, which may partially explain the role of 5-HT in driving intestinal inflammation. Moreover, 5-HT is also known as a neurotransmitter, which activates intrinsic and extrinsic primary afferent neurons, and thus regulates the gastrointestinal function, such as sensitivity, motility, permeability, and secretion. It is possible that the increased intestinal 5-HT level during inflammation may also contribute to the symptoms exaggeration in colitis, such as visceral pain, diarrhea, and even urgency.

Myrobalan powder is a Indian Ayurvedic medicine commonly used to treat respiratory tract diseases. This study found that Myrobalan powder had anti-colitis activity in TNBS-induced colitis mice, this finding was consistent well with previous results which showed that Myrobalan powder could shorten the duration of disease and reduce diarrheal recurrence rate, and the underlying mechanism may have correlation with its immunomodulatory function. Myrobalan powder has been commonly considered as an anti-inflammatory and immune-regulatory agent, it has been found to promote proliferation of spleen cells and balance the ratio of helper (Th) 1/Th2 cells in allergic airway disease model in mice. Knowing that there are numerous components in Indian Ayurvedic medicine, even though the bioactive components that responsible for the anti-inflammatory and immune-regulatory effects of Myrobalan powder have not been identified, the pharmacological effects of many components of Myrobalan powder have been reported previously. To further explore the bioactive components and the mechanism of Myrobalan powder on colonic inflammation, as well as intestinal 5-HT bioavailability, more studies are still needed in the future.

**Conclusions**

This study reveals that Indian Ayurvedic medicine Myrobalan can dose-dependently attenuate colonic inflammation in the mice model of colitis, and the underlying mechanism may be mediated via reducing colonic EC cell density and 5-HT content. These data support Myrobalan powder as a potential therapeutic formula for the treatment of colitis.

**References**


Knowledge and Attitude of Tutors on Active Teaching and Learning in Health-Training Institutions

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Abstract

The study assessed tutor’s knowledge and attitude on active teaching and learning (ATL) approaches in health training institutions. It established and recommended supportive strategies that promote implementation of ATL process.

The study used descriptive and cross sectional survey designs for data collection in October 2016, using a questionnaire from 40 respondents selected using purposive, and random sampling techniques, analysed using SPSS and presented in tables and figures.

The study found 34 (85 %) respondents knew the meaning of ATL, 6 (15%) tutors and clinical instructors did not understand ATL: tutors perceived ATL positively than clinical instructors, 32(89%) were using lecture method. Therefore, study concludes that, tutors and clinical instructors are not well sensitized on ATL leading to continued use of traditional methods, hence less practice of ATL.

The researcher recommends that ATL be introduced to all teachers through Continuous Professional Development (CPD) and Refresher Programs to effectively implement ATL.

Introduction

Introduction of study

Globally, there has been a realization that many health professionals cannot effectively manage the health problems of their patients and communities because they are not adequately trained in some essential competencies required for their jobs. Gaps in key competencies, including effective communication skills to patients and families as well as professionalism, were described in medical education programmes. This led the institutions adopting Competency-Based Medical Education (CBME), that was to be achieved through use of active teaching and learning approaches, (Kiguli S, 2014).

Teaching and learning seem to have not yielded good fruits because it is not focusing on provoking learners’ independent reasoning, problem solving and critical thinking,(Byabazaire, Oyo, & Mijumbi, 2013). Therefore, education in schools and colleges with greater emphasis on health training institutions is changing rapidly, because there is mounting evidence that supplementing or replacing teachers with active teaching and learning strategies and engaging students in discovery and scientific process improves learning and knowledge retention, (Byabazaire, et al., 2013).

In teacher –centred classroom, teachers are the primary source of knowledge; rote learning or memorizing teacher notes or lectures is the norm. Learner centered learning, on the other hand, allows learners to actively participate in learning processes, it promotes distinctive learning styles, and requires students to make their own meaning’ of what they are learning.

Learner-centred learning is based on constructivism. Constructivist learning theories see learning more and more as an active process whereby the learner constructs the knowledge in interaction with his/her surroundings, (Wang & Ha, 2013).

The ministry of education and sports developed the 10 year BTVET strategic plan dubbed skilling Uganda, emphasizing a paradigm shift in the BTVET sector. Prior to the implementation of the plan,
existing technical and vocational training programmes were theoretical and not relevant to the world of work and hence students acquired certificates and not skills, (MOE&S, 2014).

According to Kock, (2004), educational quality improvement includes a shift from the traditional teacher centered teaching towards a learner-centered approach. And Angele, (2010) argues that, the interaction between teachers and students greatly influence learning and motivation.

The government has introduced competence based education and training hinged on a modular curriculum that ensures that the content is relevant to the world of work and assessment is based on industrial work standards, (MOE&S, 2014).

Therefore, this research sought to find out if tutors have knowledge and attitude of active teaching and learning (ATL) in four of the health-training institutions in Kampala District, in order to address the demand of producing quality of health workers.

Problem statement of study

Globally, there has been a realization that many health professionals cannot effectively manage the health problems of their patients and communities because they are not adequately trained in some essential competencies required for their jobs. Gaps in key competencies, including effective communication skills to patients and families as well as professionalism, were described in medical education programmes. This led the institutions adopting Competency-Based Medical Education (CBME), that was to be achieved through use of active teaching and learning approaches, (Kiguli S, 2014).

Four of the major goals of science and technology education today are to promote student’s active learning as a way to improve student’s conceptual understanding and thinking skills. Although there is a clear evidence for the benefits of active teaching and learning, most tutors in higher education still adhere to traditional teaching methods, (Miri & Wiser-Biton, 2009). This is because they passive the method as time consuming and not applicable to the high number of student in classes among many other reasons.

Specific objectives

1) To establish the tutors knowledge level on active teaching and learning process in the health training institutions in Kampala District.

2) To determine the tutor’s attitude towards active teaching and learning process in the health training institutions in Kampala District.

Justification of the study

Literature showed gaps in the researches done regarding active teaching and learning in health training institutions of Uganda despite the development of competence based curriculums hinged on modular system, Matua, (2013). The study aimed at establishing if tutors have clear knowledge on ATL, and assess their attitude. Therefore, the study will contribute in promoting effective use of ATL at every point of lesson preparation and teaching with purpose to improving education for better learning in the HTIs.

Literature review

Introduction

This chapter presents the review of literature related to Active teaching and learning from previous researchers. Literature was reviewed under the Knowledge and Attitude of tutors on ATL approaches. This literature has been obtained by searching from different sources like; journal articles, books and edited books.
Knowledge of tutors’ on active teaching and learning approaches

According to Stewart, Mayers & Culley,(2009), tutors’ knowledge on active teaching and learning approaches from an innovation point of view, changes the pace of the classroom, and are on creative way to increase students’ involvement, motivation, excitement, attention and perceived helpfulness and applicability of the class. Bonwell, (2009), in his research adds that from a cognitive perspective, experientially taught students may engage in higher-order thinking such as analysis, synthesis, and evaluation. They are also able to identify the concept in the real world, manipulate phenomena for their own purposes, think about the material in new and complex ways, comprehend phenomena conceptually and recall, retain and memorize the material better, (Donovan, 2009).

Eison, (2010), asserts that knowledge on active teaching and learning equips teachers with a vast arsenal of active teaching and learning techniques at their disposal, perhaps without even being aware of them. For example:- asking questions, structured activities, journaling, small group discussions, quizzes, interactive lecture cues, videos, humorous stories, taking field trips and games to get students involved and active in the learning process. Reflecting on this it shows that the teachers are having knowledge of ATL only that they are not well aware.

Similarly Nickerson, (2007), in a research conducted on teacher’s content knowledge drew a conclusion that teachers with higher content knowledge and pedagogical knowledge might be more likely to think at a deeper level about the conceptual aspects of a learner’s comprehension difficulties.

Attitude of tutors’ towards active teaching and learning approaches

Fuller, (2010), in his argument supports the fact that ATL approaches do aid in increasing learning as in-class activities lead to higher overall scores.

Jim (2010), in his research on using Active Learning Instructional Strategies to create excitement and enhance learning, found out that, the major concerns that affect tutor’s attitude towards use of ATL approaches are; the approaches are time consuming during the preparation of the lesson and in classroom in that the tutor cannot cover as much content in the time available. However, some instructors consider active teaching and learning approaches to be time consuming, labor intensive and applicable to small numbers of students. This has made some instructors develop negative attitude towards such approaches.

Most instructors think of themselves as being good lecturers and therefore see no reason to change from lecture method to ATL. Heppner, (2007). And lack of materials or equipment needed to support active teaching and learning could be a barrier to the use of some ATL approaches (Jim et al, 2010). The attitude of participants in active teaching and learning approaches is greatly influenced by the tutor’s positive attitude and the fact that, the approaches are tools which propel student centred learning (Driscoll, 2010).

Summary

In conclusion, the chapter has provided an insight on the review of literature in accordance with the study objectives. The need for health training institutions to improve on their teaching and learning approaches, by placing the students at the center of the teaching and learning process through focusing on student’s needs, abilities, background and interests with teacher serving primarily as a guide and facilitator for learning; The literature has revealed that teaching effectiveness is vast; therefore, some tutors have the knowledge on what is supposed to be done as far as ATL is concerned, that is; methods and approaches used like; group discussions. However their attitude is still negative as they pointed out many reasons of note using ATL like, it is time wasting. Furthermore, ATL requires enough content and pedagogical knowledge as well as determination of tutors to put in practice all the ATL strategies in order to attain student centered learning. Therefore, in answering the study objectives, comparative analysis of the study findings with the reviewed literature will be carried out.
Methodology

Introduction

This chapter presents the methods which were used for data collection process. It addresses the following areas: the study design, research area, study population and sample size determination, inclusion criteria, sampling method, study variables and procedure, ethical considerations, data analysis.

Study design

The study used descriptive, and cross sectional research designs. The research designs were used because the research was both qualitative and quantitative in nature. Descriptive research design addressed objective two and analyzed data on the attitudes of the tutors on ATL. While objective one, the researcher employed cross-sectional research design and analyzed the tutors knowledge of ATL.

The study was qualitative because, it is a process that enabled the researcher elicits information from the selected population, described and documented aspects of the situation as they occurred in the population. Participants filled survey questionnaire (appendix II) as well.

The research design is preferred because it is economical, time saving. Appropriate statistical techniques and simple quantitative tools like frequencies, and percentages with the help of SPSS were used.

Study area

The study was conducted in four of the health training institution in Kampala District regardless of their founding bodies. Three of the institutions were private not for profit training institutions (PNFP), and one was a private for profit institution (PFP). These Health training institutions each is composed of three schools in one that is: Nursing school, Midwifery school and Laboratory technology school. The reason for choosing these Institutions was that they had a large staff that would provide opportunity to get required number of participants for the study and they were fairly near and accessible.

Study population

Population is the complete collection of all the elements that are of interest in a particular investigation, (Efuetngu, 2005). The study targeted the 4 Principals and 12 Principal tutors, 24 Tutors of whom 8 are Nurse tutors, 8 Laboratory tutors and 8 midwifery tutors and then 5 Clinical instructors. That made up a target population of 45 tutors. These were chosen for the study because they are directly charged with teaching and learning process addressing the issue of ATL in HTI.

Inclusion

Respondents had to be part of the HTI that is; Principles, Principal tutors, Tutors and Clinical instructors of the training institutions under study. The selected respondents were supposed to be present during the period when the study was conducted at the institution. The respondents had to consent to their participation in the study.

Exclusion criteria

Those who were not part of the HTI that is; Principles, Principal tutors, Tutors and Clinical instructors, but of other training institutions not under study were not considered as part of the study even if they were present at the time of data collection. The respondents who had been selected but were not around during the period when the study was conducted were eliminated. The respondents who did not consent to their participation in the study were also excluded.
Sample and sampling procedures

Sample size

According to Hill, 1998) rule of thumb, a sample size of 30-500 is appropriate for most studies. However, to be more specific, the researcher adopted Krejcie & Morgan,(1970) simplified in Sekaran, (2000), and selected a sample size of 40 respondents from a total population of 45 tutors to participate in the study. (Appendix III). The researcher, choose to use Krejcie and Morgan because of its simplified form.

Sampling techniques

The study employed random, purposive, and convenience sampling technique.

Study Variables

Independent Variables: According to this study, independent variables included: age, sex, qualification, working experience.

Dependent variable: In this study the dependent variables included: knowledge, and Attitude.

Research Instruments

The study used self-administered questionnaires. The instrument used contained closed-ended questions and structured questions, according to the study objectives and research questions and with Likert Scale type questions.

Data collection methods

Having selected the informants purposefully, they filled questionnaires that were distributed to them, and this was designed to capture desired information in relation to study objectives.

Data collection procedure

After obtaining permission, the researcher identified the principals, principal tutors, tutors and clinical instructors, according to the study population as well as focusing on their respective specialties. The researcher obtained the respondents consent, assured them confidentiality, and finally distributed the questionnaire to the respondents. The respondents were given two to three days to ensure that the questionnaires are fully filled, then collected from them by the researcher.

Quality control methods

Reliability

If the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable. The instrument was pre-tested in other schools that are not included in the study with similar population characteristics.

Validity

The validity of the questionnaire was tested using the Content Validity Index (CVI) (Amin, 2005; Odiya, 2009). The researcher used CVI which is a scale developed by computing or rating the relevant items in the instrument or questionnaire by checking their clarity.

Data management and processing

Data management, after collecting data, the researcher checked the information for relevancy and accuracy before leaving the study areas. Therefore, the researcher got only the useful data depending on the research items of the study.

Data analysis

Data was analyzed manually and by use of computer, Quantitative data was analyzed by use of SPSS soft ware while Qualitative data was analyzed manually using analytical approach including
tallying of responses, summarizing and expressing it in percentages by the researcher and results presented in tables and figures.

**Ethical considerations**

The participants’ names were not used except code numbers.

All the participants’ voluntarily consented to participation in the study. For confidentiality, the data and materials were kept under key and lock.

Ethical issues that arose were; anxiety and discomfort because most teachers felt it was a supervision exercise and majority of them were scared because they were not using ATL supported lessons. To mitigate these issues tutors had assurance that participation was voluntary, safe and flexible as they were free to withdraw from the study at any stage.

**Dissemination of study results**

Research report of this study shall be submitted to Health Tutors College- Mulago (HTC), to the schools which were studied and finally to the Ministry of education and sport.

**Results and discussion**

**Introduction**

This chapter presented study findings of the data according to specific study objectives and demographic data.

Therefore, the analysis was made based on the responses obtained from these groups of respondents and these were the key findings of the study.

**Demographic characteristics of respondents**

The demographic information of sex, age and Qualification is illustrated in Table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Responses</th>
<th>Frequency= 40</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>21-30</td>
<td>21</td>
<td>52.5</td>
</tr>
<tr>
<td></td>
<td>31-40</td>
<td>13</td>
<td>32.5</td>
</tr>
<tr>
<td></td>
<td>41-50</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>51+</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>23</td>
<td>57.5</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>17</td>
<td>42.5</td>
</tr>
<tr>
<td>Years of service</td>
<td>1-5yrs</td>
<td>30</td>
<td>75.0</td>
</tr>
<tr>
<td></td>
<td>6-10yrs</td>
<td>7</td>
<td>17.5</td>
</tr>
<tr>
<td></td>
<td>11-15yrs</td>
<td>3</td>
<td>7.5</td>
</tr>
<tr>
<td>Specialization</td>
<td>Nursing</td>
<td>15</td>
<td>37.5</td>
</tr>
<tr>
<td></td>
<td>Midwifery</td>
<td>14</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Laboratory technology</td>
<td>11</td>
<td>27.5</td>
</tr>
<tr>
<td>Subject</td>
<td>Microbiology</td>
<td>3</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>Clinical teaching (practical)</td>
<td>4</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>Anatomy</td>
<td>3</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>Hematology</td>
<td>4</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>Blood transfusion</td>
<td>4</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>Obstetrics &amp; Gynecology</td>
<td>10</td>
<td>25</td>
</tr>
</tbody>
</table>
In Table 1; 57.5% of the respondents were male and 42.5% of them were female. Regarding age of the respondents, 52.5% of them were between 21 to 30 years and the remaining 47.5% of respondents were above 30 years. It can be concluded that the majority of the tutors joined teaching at the right age (25 years) for teaching as required by Ministry of Education and Sports. The study further revealed that, 30 (75%) out of 40 respondents had served for 1 to 5 years, 17.5% of them served for 6 to 10 years and 7.5% served for 11 to 15 years. The study further found that 7.5% of tutors were teaching microbiology, 10% practical, 7.5% anatomy, 10% hematology, 10% blood transfusion and 25% Obstetrics. This indicates that there is relative equal number of tutors who were taken from four schools. This was due to the fact that the total numbers of tutors in the four schools were almost equal.

### Tutors’ knowledge about active teaching and learning

The results of tutors’ responses on ATL definition are presented in Table 2.

**Table 2.** Tutors’ and clinical instructor’s understanding of active teaching and learning

<table>
<thead>
<tr>
<th>Variable</th>
<th>Response</th>
<th>Trained or Non trained tutor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Trained tutor at degree level</td>
<td>Trained tutor at diploma level</td>
</tr>
<tr>
<td>Active teaching and learning is the process of engaging students in active learning</td>
<td>True</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>False</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>13</td>
<td>22</td>
</tr>
</tbody>
</table>

In Table 2; 34 (85%) respondents had clear understanding of the meaning of ATL. The study also revealed that 1 (2.5%) trained tutor at degree level was not conversant with the definition of ATL, followed by 2 (5%) trained tutor at diploma level, and 3 (7.5%) non-trained or clinical instructor. Therefore, from the responses, one can deduce that trained tutors seem to have a clear knowledge on ATL.

**Table 3.** Trained and non trained tutors responses on the advantages of ATL to students

<table>
<thead>
<tr>
<th>Variable</th>
<th>Different advantages given by the respondents</th>
<th>Responses of Trained or non trained tutor</th>
<th>Total and percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Trained tutor at degree level</td>
<td>Trained tutor at diploma level</td>
</tr>
<tr>
<td>Advantages of active teaching &amp; learning to students</td>
<td>Summarises the concepts taught</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Gives ability to ask questions</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Allows interactions with others</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Encourages students to repeat</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 3: It was clearly revealed that the tutors at degree level gave more responses about advantages of ATL to students (20), followed by tutors at diploma level with (15) responses about different advantages of ATL to students. However, the clinical instructors gave only (5) advantages of ATL to students. This confirm that trained tutors were knowledgeable compared to non-trained (clinical instructors). The discrepancy in knowledge may be due to Lack of training in teaching methods or pedagogy. This is supported by Esse, (2013) who found that 59 trained tutors studied in Nigeria were well knowledgeable about the benefits of ATL to their students and were implementing it than non-trained.

Table 4. Trained and non trained tutors responses on the advantages of ATL to tutor

<table>
<thead>
<tr>
<th>Variable</th>
<th>Different advantages Given by the respondents</th>
<th>Responses of trained or non trained</th>
<th>Total &amp; percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages of active teaching &amp; learning to tutor</td>
<td>Allows interaction with learners</td>
<td>Trained tutor at degree level: 4</td>
<td>trained tutor at diploma level: 2</td>
</tr>
<tr>
<td></td>
<td>Helps to get immediate feedback</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Helps to know students weakness and strength</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Teacher becomes a facilitator</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Simplifies work</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>23</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 4: the tutors at degree level gave more responses about the advantages of ATL to tutors (23), followed by tutors at diploma level with (12) responses about the different advantages of ATL to tutors. However, the clinical instructors gave only (4) responses about the advantages of ATL to tutors. This gives an insight that, the trained tutors are knowledgeable as far as ATL is concerned. The finding of this study is supported by Bagman, (2009) who found that 70% trained tutors in Kenya were well knowledgeable about the advantages of ATL to tutors than 30% clinical instructors.

Tutors’ attitude towards active teaching and learning

The results of tutors’ responses to the attitude items were analyzed and presented in Table 5.
Table 5. Tutor’s and Clinical instructors’ attitude on active teaching and learning

<table>
<thead>
<tr>
<th>Variable</th>
<th>Trained or Non trained tutor N= 40</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trained tutor at degree level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trained tutor at diploma level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non trained or clinical instructor</td>
<td></td>
</tr>
<tr>
<td>Preferred method of teaching.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lecture method</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td>Student centered method</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>ATL improves student engagement in learning</td>
<td>Yes</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1</td>
</tr>
<tr>
<td>Can you use your own materials to promote ATL</td>
<td>Yes</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>6</td>
</tr>
<tr>
<td>A you able to sensitize other tutors about ATL</td>
<td>Yes</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0</td>
</tr>
</tbody>
</table>

The tutors’ and clinical instructors’ attitude in regard to ATL, were analyzed basing on four items. To this effect, the data in the table 5 indicate that clinical instructors had less positive attitude towards ATL than tutors. In the same table, 80% of the respondents believed that ATL improves students learning. Moreover, 34 (85%) of the respondents believed they can sensitize other tutors about ATL. The table also reveals that a large number 32(80%) of the participants are still comfortable to teach using lecture method. To summarize, the aggregate responses of the participants, the researcher found out that majority of tutors have a favorable attitude towards ATL than clinical instructors and this could be because of difference in training in medical education. This is supported by Berhanu, (2008) who reported that clinical instructors who were trained in pedagogy usually apply ATL in their school in Nigeria than those who had not got an opportunity to be trained in teaching skill.

![Figure 1](image.png)

Figure 1. Reasons given for tutor’s use of lecture method

Figure 1, reveals why tutors are comfortable with lecture method. The major reasons given by the respondents 44% was convenient for instructing large group of students, 18% reported that students receive information from real expert, 10% argued that they cover lengthy syllabus within short period of time, 10% said that no equipment or other materials required, and 10% said it increases teachers knowledge, reading and writing kills. This could be explained from the fact that majority of tutors were taught using lecture method and think there is no other teaching method better than lecture method. This is supported by Cannon, Kelly, Lyng & McGrath, (2009), who suggested that tutors or
instructors who are led to teach the way they were taught are believed to be unskilled in active teaching and learning theory.

Conclusion and recommendations

Introduction

In this chapter is presented the Conclusion and Recommendations of the study.

Conclusion

The analysis of the questionnaire items filled by tutors and clinical instructor indicated that, almost all of the participants seem to have good knowledge about active teaching and learning.

With regard to the attitude of tutors towards active teaching and learning, the study revealed that, though they did not practice active teaching and learning, their attitude seem to be positive. Therefore, it can be concluded that, though tutors did not implement active teaching and learning, their attitude towards active teaching and learning seem to be positive.

Recommendations

Tutors and clinical instructors need to be sensitized more on the methods, techniques and benefits of active teaching and learning through continuous professional development and workshops.

Since it has been found out that tutors have a positive attitude towards use of active teaching and learning, HTIs’ administrator need to motivate and encourage tutors to use ATL.

Tutors should be encouraged to improve on their lesson planning, because this will enable them address the issues like; ATL being considered as time wasting, not fit for massive numbers and many others as named in chapter four.

Limitations of the study

Some respondents were un co-operative due to misinterpretation of the study purpose. The researcher clearly explained the purpose of the study to the respondents and made clarification where necessary.

Non-responsive and biased response, where a respondent wanted to respond according to a particular characteristic or set of characteristics in relation to the outcome. The researcher boldly explained the purpose of the study to the respondents.

Loss or misplacement of questionnaires by respondents; some respondents misplaced the questionnaire and the researcher gave them extra copies of questionnaires.

Absence of respondents; the researcher used convenience sampling technique and administered questionnaires to those tutors who were present at the time data collection.

References


Virtualization of Infrastructure as a Service (IAAS): Redundancy Mechanism of the Controller Node in OpenStack Cloud Computing Platform

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Abstract

In last twenty years IT world has come across a dramatic change particularly in the field of communications and IT Infrastructure. The Infrastructure as a Service (IaaS) service of cloud computing is becoming more popular day by day due to its overwhelming technical and financial offerings. OpenStack Networking is a standalone service. The main process of the OpenStack Networking server is quantum-server that is responsible for managing user requests to Compute Node, Storage Node and to other components in the entire network. Therefore, a pin-point in an OpenStack network platform is that after received the instruction through the dashboard the entire instruction set is directed in the network developed only through the Controller Node. It is considered a crucial point in the whole network as if for any reason the link is broken to the Controller Node no instruction to pass through to the intended node. This will result in a complete downtime of the network. Keeping this point in mind a standby Controller Node is proposed with addition of a Link Node for managing the controllers and thus maximum uptime is ensured.

Introduction

Over the past few years, there have been significant development achieved in the IT industry especially in the field of virtualization techniques which triggered to more reliable services in cloud computing. Cloud computing concept and virtualization techniques together ensured Infrastructure as a Service (IaaS) more affordable and as a result many organizations are leaning to this cloud service. IaaS is a service where the service provider deliver the computer infrastructure as a service. Infrastructure as a service offers computing capabilities and basic storage as standardized services over the network. Servers, storage systems, switches, routers, and other systems are reserved and made available to the user through the internet. In this norm there have been evolved quite a few IaaS Service Providers providing services with its unique architectural infrastructure. Out of the few cloud operating systems available at this time one is the OpenStack Cloud OS. In the OpenStack Cloud OS the Network Architecture involves one Network node. The concentration of this article is to introduce redundancy option of the Network Node in the OpenStack cloud computing platform to ensure minimal service downtime.

The OpenStack platform is a virtual network and the network connectivity and addressing is managed by a set of API. OpenStack Networking is a standalone service. The main process of the OpenStack Networking server is quantum-server that is responsible for managing user requests to Compute Node, Storage Node and to other components in the entire network. Therefore, a pin-point I feel in an OpenStack network platform is that after received the instruction through the dashboard the entire instruction set is directed in the network developed only through the controller Node. It is considered a crucial point in the whole network as if for any reason the link is broken to the controlermode no instruction to pass through to the intended node. This will result in a complete downtime of the network. Keeping this point in mind it is proposed that a redundant controller Node is to be added in the structure instead of one available now which will ensure minimal network downtime.
Cloud computing

Since the early nineties till present days the IT world has come across a drastic change especially in the field of communications and IT Infrastructure. First we observed the introduction of distributed computing followed by grid computing and until recently the evolution of cloud computing. When it comes to cloud computing in parallel comes the term Internet. There have been enormous development occurred in the internet technology particularly the way it is made available to the use and mostly now the price of making it available to grass root level. All these factors made it possible for even a small company to think about adopting cloud for their day to day IT operations regardless it is SaaS, PaaS or IaaS, which implies to more or less all of the cloud services available in the market.

In a general term, cloud computing is considered as a process of storing and accessing data and programs over the Internet instead of in a hard drive of a computer. The cloud is just a metaphor for the Internet. Cloud technology replaces the conventional gigantic server-frame infrastructure with a set of devices arranged in a way that the devices are not dedicated but used as per requirement of the user floating in the cloud network. Cloud is not about having a dedicated network attached to a storage hardware or server in residence. For it to be considered as cloud computing it is necessary that to access any data or application it needs to be done over the Internet, or at the very least, have that data synced with other information over the Web. In a large server-frame based network it is that the mapping of whole network are known upfront. The end result is the same: with an online connection, cloud computing can be done anywhere, anytime.

Cloud computing architecture

Cloud computing architecture refers to the components and subcomponents required for cloud computing. (fat client, thin client, mobile device), back end platforms. When comes the discussion on cloud computing system, it can be divided in two parts - the front end platform (fat client, thin client, mobile device) and the back end platform (servers, storage). These two parts in general are linked through the Internet. The front end of the system is the user (the computer from which the client access to the cloud system).

Depending on the cloud computing systems there exist different types of user interfaces. Say in one system the client can log in to the cloud portal through web browsers like Google Chrome, Internet Explorer etc. where in the same time some providers provide customized applications that provide network access to clients. In general, a central server is responsible for managing the whole system structure. The components involved in the network are managed with a set of network protocols. The network protocols which can be considered as a set of instructions control and ensure communication of different components within the network. In the process of server virtualization it takes numerous sets of instructions among the controller node, network node, compute node and of course block storage and object storage.
Cloud infrastructure software services

The benefits of IAAS include fast seamless provisioning of resources, ability to scale amount of services received and service billable is only as per use. For any organization regardless its size one of the most important and challenging task is to keep capital expenditures under control. The IaaS service could be the solution by migrating in house IT infrastructure to the cloud. The biggest vendors like Amazon AWS, Microsoft, IBM, VMware, HP, EMC, RackSpace Hosting, Red Hat, and Salesforce are few to mentions that are providing IaaS services. Different vendors have adopted different types of Network Infrastructures, however, most of those mentioned have adopted the network infrastructure based on OpenStack Cloud Platform. There exist quite a few cloud softwares in the market and below is a brief overview of the most common cloud software services:

Amazon web services (AWS): AWS is considered as a highly scalable complete cloud platform. Amazon Web Services (AWS) is a suite of cloud computing services offered by Amazon. AWS offers scalable and flexible IAAS, PAAS, storage, networking, and management platforms. It is supported by a global 12-region infrastructure.

Microsoft azure: When it comes to IAAS and PAAS computing for development, deployment, and management Microsoft Azure comes to the top as an option. This is an open, flexible cloud platform that enables users to build, deploy and manage apps across a global network of Microsoft-managed datacenters. Azure offers both PaaS and IaaS services, it supports Multi-language environment and it also offers a strong controlling tools and frameworks.

Google cloud platform: Google has a private cloud that it uses for delivering many different services to its users, including email access, document applications, text translations, maps, web analytics, and much more. It is considered as a developer products and cloud technologies hosted by Google. Google Cloud Platform is a computing platform that provides developers with products to build structures, including simple websites and complex web applications. Google Cloud Platforms offers hosting, computing, cloud storage, Big Data, and API services.

IBM cloud: An unparalleled software for business operations. The IBM Cloud includes IaaS, SaaS, and PaaS offerings on public, private and hybrid cloud platforms. Softlayer partnered with the
IBM Cloud offers a comprehensive cloud ecosystem, offering management, virtualization, storage, and computing platforms.

**Rackspace**: Well known for dedicated servers and infrastructure services. The Rackspace provides cloud computing product and services in different categories and all the services are billed on utility computing basis. They have a very robust platform which does a good job of making the process simple and keeps the client's solution functional. Rackspace products and services are: Cloud Files, Cloud Servers, Cloud Sites.

**VMware**: It is considered for virtualization public cloud with hybrid capabilities. vCloud of VMware offers users a platform to run, manage, and secure applications. vCloud Air is VMware's flagship infrastructure public cloud platform. IBM has partnered with VMware for virtualization and hybrid cloud management solutions with SoftLayer providing the cloud infrastructure to enterprise level demands.

**Redhat**: They are one of the leader of open cloud technology for enterprise clients. Red Hat provides cloud offerings on their open-source software platforms and is easily integrated with other major cloud services. Red Hat has offerings for infrastructure creation and deployment, cloud management, and platform development.

**Oracle cloud**: This is an integrated public cloud solution for business applications. The Oracle cloud offers a variety of cloud computing and networking tools. The Oracle Cloud IaaS offers a set of core infrastructure capabilities, such as elastic compute and storage for enterprise clients.

**Verizon cloud**: This is a Managed enterprise solution through Verizon's global network. Verizon Cloud, formerly Terremark, is a cloud platform offering managed hosting, disaster recovery, data storage, and cloud computing services. The Verizon Cloud is supported by the Verizon infrastructure for enterprise clients.

**OpenStack**

OpenStack is a collection of open-source software projects developed by individual groups which are used to develop and manage the IT infrastructure of an organization. These are the individual set of project also responsible for virtualization aspects of both private and public clouds and as well as hybrid clouds practiced by different organizations. The OpenStack software controls large pools of server sets, computes, storages and as well all other networking resources involved within a large network architecture. All the components involved in the network are managed through a controller known as Dashboard in the OpenStack Platform through a set of APIs. OpenStack is considered as a heterogeneous infrastructure due to its ability to adopt with many open source technologies.

OpenStack software controls large pools of compute, storage, and networking resources throughout a datacenter, managed through a dashboard or via the OpenStack API. OpenStack works with popular enterprise and open source technologies making it ideal for heterogeneous infrastructure.

The OpenStack platform is a virtual network and the network connectivity and addressing is managed by a set of API. The operation is ensured though a very powerful set of APIs (Network, Subnet and Port). It allows the user to use different types of network technologies to setup the cloud network. A network is developed using different categories of network topologies and the instruction sets are used to attach different types of virtual devices to build a complete network as per requirement of the user-group. It is a very difficult task to convert a conventional network to a cloud network. Conventional networks are not designed in a way that it will configured automatically when switched to could. In the OpenStack platform a set of networking APIs are used to implement a complete IP table.
Networking option 2: Self-service networks

Out of the few cloud architectures adopted by the industry the OpenStack Cloud Platform is the one got some more edge and as a result it is widely accepted by the providers and as well the users. The self-service networks option increases the provider networks option with routing services (layer-3) which ensures that self-service networks are enabled using VXLAN overlay segmentation method. Basically what happens here is using NAT it routes virtual networks to physical networks and also it builds the foundation for advanced services such as LBAAS and FWAAS. The network is built on concentric to the controller node as shown in figure 3. All the nodes involved in the network are interconnected through network components.

known as switch and router. Switches are used to enable packets to be sent from node to node. Switches are Multi-Input Multi-Output (MIMO) devices that connect hosts that belong to the same layer-2 network. Packets are received in one port as input and directed to another desired node.
through another port as output. Switches enable forwarding of the packet received on one port as input to another port as output. Packets forward the traffic based on the destination Ethernet address in the packet header. Routers are used to enable packets to travel from one layer-3 network to another. Routers enable communication between two nodes on different layer-3 networks that are not directly connected to each other. Packets forward the traffic based on the destination IP address in the packet header.

When it comes to cloud environment it is obvious that there exist a lot of mix-matches and in this point the OpenStack got the advantage as it is adoptable more or less with all types of architectures and applications. In this platform as shown in the figure 3 that all the instruction flow is centralized to the controller node. For some reason if any instruction is failed through this node that will result in a downtime of one of the components associated in the network. That may result in a temporary outage of service and depending on the severity it could result in to a complete network connectivity breakdown. This situation may trigger to complete service outage which could be disastrous to an organization running its day to day operation depending on the service provided by that particular cloud IAAS service provider.

**Proposed architecture for openstack networking**

It is observed that with the current approach there may occur downtime in the network which will result in cloud service outage. We have put an effort to bring out a logic which will ensure a redundancy mechanism for the controller node to make the platform more reliable and fast and robust. The research was concentric to the current version of the OpenStack Cloud Platform which is known as NEWTON.

There is a minimal requirement of hardware setup required for a scalable network. It could be set up even with two custom made computers to create the OpenStack environment, standard recommendation though is to use sixteen computers for a scalable network. However, in our proposed solution we have used seven custom made computers involved which found to be sufficient to implement the logic. Two computers are used for the Controller Node, two computers are used for Compute Node, and one router is used as the link node which is considered for the monitoring of the controller nodes. Apart from these there are two computers used as Blocks Storage and two computers used as Object Storage respectively. Virtualization of the components has been ensured with KVM technology which is an embedded part of the OpenStack OS.
The research was concentric to the development of the Controller Node redundancy of the OpenStack Cloud Platform. From this consideration concentration was on the applications involved in the Controller Node and Compute Node respectively.

**Physical diagram of the proposed OpenStack architecture**

The architecture proposed has made the OpenStack architecture more reliable as with this approach network downtime will be minimal and this approach have ensured maximum uptime. When all the components are connected together the complete network comes as shown in figure 5 below. The components used are as stated below:

- Mikrotic Router
- Controller Node CPU 1-2, 8 RAM GB, 100 GB Storage, 2 NIC
- Compute Node 1 2-4+ CPU, 8+ GB RAM Storage 100 + GB 2 NIC
- Block Storage Node 1 1-2 CPU, 4 GB RAM, Storage 100+ GB 1 NIC
- Object Storage Node 1 1-2 CPU, 4 + GB RAM, Storage 100 + GB 1 NIC
- Object Storage Node 1 1-2 CPU, 4 + GB RAM, Storage 100 + GB 1 NIC

How does our proposed physical system works

OpenStack Networking is considered as a standalone servicelike other OpenStack services such as Compute, Image Service, Identity service, and the OpenStack Dashboard. An OpenStack Networking often involves deploying several processes on a variety of hosts. In OpenStack networking architecture a quantum-server is the main process which consists of a set of OpenStack Networking API that are responsible for defining network connectivity and addressing of the resources through plug-in. In our deployment a controller host is considered to run centralized Openstack Compute components and the OpenStack Networking server is managed within the controller node. Therefore, in our system controller is the key point for total system integration. A dashboard is installed from which a user can operate the different services of cloud system such as Image create, network create, instance create and customize etc. In our system, we have introduced an additional stand by controller as backup. The purpose of the standby controller is in the case the first controller is down then the standby controller will give support and synchronization of both node in running for data update. The
Mikrotic router is introduced to monitor both the controllers and act based on signal from the controllers. With such setup it is ensured that no downtime is experienced. In the compute node the scheduler service decides how to dispatch requests for more or less resources necessary by a user. The compute node maintains a queue through which the scheduler obtains the data and take decision for resource allocation. In block storage service user can create volume and takes snapshot of instances. In object storage user can use storage service and can store large scale data. Link Node

In our proposed system we add a stand by controller node that can be used for redundancy of the controller node. We have added an additional standby controller in the system. For some reason if the first controller becomes unavailable then the standby controller gives support and synchronization of both nodes for data update and Mikrotik router will always monitor which controller is up. Hence maximum data connectivity is ensured.

Virtualization components with KVM in OpenStack OS

Virtualization is the creation of a virtual -- rather than actual -- version of something, such as an operating system, a server, a storage device or network resources.
OpenStack Compute to host and manage cloud computing systems. OpenStack Compute is a major part of an Infrastructure-as-a-Service (IAAS) system. The main modules are implemented in Python.

OpenStack Compute interacts with OpenStack Identity for authentication; OpenStack Image service for disk and server images; and OpenStack dashboard for the user and administrative interface. Image access is limited by projects, and by users; quotas are limited per project (the number of instances, for example). OpenStack Compute can scale horizontally on standard hardware, and download images to launch instances.

A worker daemon that creates and terminates virtual machine instances through hypervisor APIs. For example:

- XenAPI for XenServer/XCP
- libvirt for KVM or QEMU
- VMwareAPI for VMware

Processing is fairly complex. Basically, the daemon accepts actions from the queue and performs a series of system commands such as launching a KVM instance and updating its state in the database.

**XenAPI for XenServer/XCP**

Hypervisor provides the fundamental isolation between virtual machines. Xen is open source hypervisor system. Xen is a component of many different products and projects. The hypervisor itself is very similar across all these projects, but the way that it is managed can be different, which can cause confusion if you’re not clear which toolstack you are using. Make sure you know what toolstack you want before you get started.

XenAPI is the API provided by XAPI. This name is also used by the python library that is a client for XAPI.

An Open Source virtualization software which includes the Xen hypervisor and XAPI for the management.

**Libvirt for KVM or QEMU**

Hypervisor provides the fundamental isolation between virtual machines. KVM is open source hypervisor system. KVM turns the Linux kernel into a hypervisor, and comes standard with many Linux distributions. OpenStack is also a Linux distribution, so the marriage of OpenStack with KVM makes sense. When using the KVM hypervisor with libvirt on OpenStack Compute nodes, live migration of instances from one Compute server to another requires that the libvirt daemon is configured for remote network connectivity. The libvirt daemon configuration recommended in the
OpenStack Configuration Reference manual configures libvirt to listen for incoming TCP connections on all network interfaces without requiring any authentication or using any encryption. This insecure configuration allows for anyone with network access to the libvirt daemon TCP port on OpenStack Compute nodes to control the hypervisor through the libvirt API.

**VMware API for VMware**

Hypervisor provides the fundamental isolation between virtual machines. VMware vSphere is an open source hypervisor system. VMware vSphere Hypervisor is a free bare-metal hypervisor that virtualizes servers so you can consolidate your applications on less hardware. OpenStack Compute supports the VMware vSphere product family and enables access to advanced features such as vMotion, High Availability, and Dynamic Resource Scheduling (DRS).

The VMware vCenter driver enables the nova-compute service to communicate with a VMware vCenter server that manages one or more ESX host clusters. The driver aggregates the ESX hosts in each cluster to present one large hypervisor entity for each cluster to the Compute scheduler. Because individual ESX hosts are not exposed to the scheduler, Compute schedules to the granularity of clusters and vCenter uses DRS to select the actual ESX host within the cluster. When a virtual machine makes its way into a vCenter cluster, it can use all vSphere features.

**Virtualization challenge in OpenStack open Source technology**

1. Open source application version challenge
2. Messaging service challenge
3. KVM virtualization challenge
4. Scalable Database challenge
5. Network challenge
6. Storage challenge

**Cloud performance load analysis**

When user logged in OpenStack dash board user can monitor total systems load such as how many VMs Running, how much VCPU’s, How much memory used how many IPs are activated etc.
Conclusion

In the current IAAS cloud technology model the network is build concentric to the Controller Node of the platform and the network is developed mostly by depending on VM migration or horizontal scaling techniques. However, addressing technique is managed using a set of APIs which guarantees the construction of the network along with elastic provisioning of the components required in nascent stage. The resources needed are allocated based on the instruction sent to compute node from the Controller Node. The IAAS user has to prepare the list of applications and resource to be used with varying requirement and based on this profile intended resources are allocated along with policies for the virtual machines where it hosts the application. In the OpenStack Cloud Platform all the connectivity is managed concentric to the Controller Node as we know. In this article the OpenStack architecture that has been introduced has ensured a redundancy mechanism for the Controller Node to make the platform more reliable and fast and robust. It has been observed that all applications are running properly with the system developed. However, we admit that there is still room for more investigation in the system developed but overall we can say that the approach has implemented successfully.

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Deciding Pertinent Citations in Published Empirical Articles

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Abstract

This article is an attempt to precede with the validation that pertinence of citations in scientific articles is a core problem in citation analytics.

In this study, an empirical investigation of pertinence of citations made in Indian Journal of Chemistry A is presented. In this particular study, citations made in the introduction sections in issues published from 1999 to 2007 were analyzed. An empirical scientific article was randomly selected every issue published, and the pertinence of selected article was determined.

The result showed that less than 20% of the citations were pertinent to the study. Overall, over 80% of citations made in the introduction sections may not be applicable in the computation of effective impact of publications.

Keywords: Content analysis; Content pertinence; Performance evaluation; Impact factor; Citation analysis

Introduction

Objective evaluation of research performance has gained widespread importance as necessary tools that allows one to gain insight into institutional productivity, and benchmark their activities against peers worldwide (Thomson Reuters, 2016). While various methodologies have been used to evaluate research performance, however, the prominent methodologies are bibliometric assessments which involve some citation analytics (Adedayo, 2015a). Although the use and acceptance of citation analytics in research benchmarking is widespread (Hubbard and McVeigh, 2011; Garfield, 1972; Thomson Reuters, 2014), however, many critiques of citation analytics have been published (Thomson Reuters, 2014; Saha et al., 2003; Adler et al., 2008; Adedayo, 2015b, Adedayo, 2016a; 2016b; DoRA, 2013; RCUK, 2013).

Also, many of its limitations have been identified and it’s usage with caution has been advised (Saha et al., 2003; DoRA, 2013; RCUK, 2013). Adedayo (2014a; 2014b; 2015c) discussed important issues that identified means through which citation analytics can be adulterated. Recently, Lariviere et al., (2016) with their straightforward protocol, revealed the full extent of the skew of distributions and variation in citations received by published papers that is characteristic of all scientific journals. Their study found out that about 75% of articles in journals have citations less than the average indicated by Journal Impact Factor (JIF) of the journal where they were published. The simple implication of this result is that, if reward system or credit distribution is based on JIF, then about 75% of rewards and recognition would be attributed to undeserving persons. Obviously, there is the need to refine the JIF methodologies. To refine the methodologies of citation analytics, various approaches proposed include careful cull and curate of appropriate citations to count in evaluation computations. Also, many published studies have advocated discouraging honourific reward attribution (Persson and Glanzel, 2014; Adedayo, 2015b; 2015c). Cawkell, (1977) and Adedayo, (2015c) have proposed that the citation analytics would work better, only
if every citing author meticulously cited only the earlier works pertinent to theme of the new manuscript. Therefore, pertinence of the cited reference to the new study being reported becomes crucial as an important consideration during performance evaluation.

In this particular paper, an empirical study to investigate pertinence of citations made in the introduction sections of articles published in Indian Journal of Chemistry A is presented. The idea presented in the report is very fresh, and original! It forms one of the first attempts to use empirical methods to determine pertinence of citations in scientific publications. Herein, the rationale for the study is identified.

Methodology

Citation pattern in articles published in Indian Journal of Chemistry A, was studied. Citation pattern in issues published in the journal from 1999 to 2007 was studied. An article is randomly selected from each issue published by the journal, and a systematic cull of citation in the articles was made (Adedayo, 2015a; Adedayo, 2015b; Adedayo, 2016a; 2016b). Citations in the articles were classified as citations with Real and Imaginary Pertinence (Adedayo, 2015a; Adedayo, 2016a; 2016b). Citations made in Introduction sections were considered as Citations with Imaginary Pertinence while those made in the Methodology/Results/Discussion of Result/Conclusions are considered to have Real Pertinence.

The total number of authors cited in the Introduction sections were counted and recorded as $N_c$. Also, a counting of common citations made both in the Imaginary and the Real sections was made, and recorded as $n_c$. Pertinence ($p$) of the Imaginary section (Introduction section) of each article was determined by finding the ratio $n_c : N_c$ expressed as a percentage i.e.

$$p = 100 \left( \frac{n_c}{N_c} \right)$$

(1)

The average Pertinence for each journal and the entire publishers were determined.

Results and discussion

Tables 1 to 9 present the results for the study. Table 1 provides information on pertinence of Introduction section in articles published in Indian Journal of Chemistry A, Volume 38A. From the Table, the highest pertinence observed is 50%, which is for the article published in March, 1999 in volume 38A, number 11, pages 244-.248. The lowest pertinences were 0%. Articles: Volume 38 A, Number 5, pages 453-457; Volume 38 A, Number 8, pages 792-796; Volume 38 A, Number 10, pages 973-976, all had 0% pertinences. The average pertinence for articles published in the journal for the year 1999 is 15%.

Table 1. Representative citation distribution in articles published in the journal issue in 1999

<table>
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<th>S/N</th>
<th>Journal Issue</th>
<th>Publication Date</th>
<th>Article Pages</th>
<th>$N_c$</th>
<th>$n_c$</th>
<th>Pertinence (%)</th>
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<tr>
<td>2.</td>
<td>Vol. 38 A (02)</td>
<td>February, 1999</td>
<td>130-135</td>
<td>4</td>
<td>1</td>
<td>25</td>
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<tr>
<td>3.</td>
<td>Vol. 38 A (03)</td>
<td>March, 1999</td>
<td>244-.248</td>
<td>6</td>
<td>3</td>
<td>50</td>
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<tr>
<td>4.</td>
<td>Vol. 38 A (04)</td>
<td>April, 1999</td>
<td>303-306</td>
<td>20</td>
<td>1</td>
<td>5</td>
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</tbody>
</table>
Table 2 provides information on pertinence for Volume 39A. From the Table, the highest pertinence observed is 100%, which is for the article published in November, 2000 in volume 39 A, number 11, pages 1174-1176. The lowest pertinences were 0%. The average pertinence for articles published in the journal for the year 2000 is 21%.

Table 2. Representative citation distribution in articles published in the journal issue in 2000

<table>
<thead>
<tr>
<th>S/N</th>
<th>Journal Issue</th>
<th>Publication Date</th>
<th>Article Pages</th>
<th>$N_c$</th>
<th>$n_c$</th>
<th>Pertinence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>Vol. 39 A(05)</td>
<td>May, 2000</td>
<td>501-506</td>
<td>15</td>
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<tr>
<td>6.</td>
<td>Vol. 39 A(06)</td>
<td>June, 2000</td>
<td>603-610</td>
<td>35</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>Vol. 39 A(08)</td>
<td>August, 2000</td>
<td>851-855</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9.</td>
<td>Vol. 39 A(09)</td>
<td>September, 2000</td>
<td>974-979</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Average for the year 21

Table 3 provides information on pertinence for Volume 40A. From the Table, the highest pertinence observed is 83%, which is for the article published in August, 2001 in volume 40 A, number 08, pages 896-900. The lowest pertinences were 0%. The average pertinence for articles published in the journal for the year 2001 is 34%.
Table 3. Representative citation distribution in articles published in the journal issue in 2001

<table>
<thead>
<tr>
<th>S/N</th>
<th>Journal Issue</th>
<th>Publication Date</th>
<th>Article Pages</th>
<th>$N_c$</th>
<th>$n_c$</th>
<th>Pertinence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Vol. 40 A (01)</td>
<td>January, 2001</td>
<td>1-3</td>
<td>7</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>2.</td>
<td>Vol. 40 A (02)</td>
<td>February, 2001</td>
<td>222-224</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>Vol. 40 A (05)</td>
<td>May, 2001</td>
<td>437-441</td>
<td>6</td>
<td>1</td>
<td>17</td>
</tr>
</tbody>
</table>

Average for the year 34

Table 4 shows information on pertinence for Volume 41A. From the Table, the highest pertinence observed is 100%, which is for the article published in November, 2002 in volume 41 A, number 11, pages 2251-2255. The lowest pertinences were 0%. The average pertinence for articles published in the journal for the year 2002 is 27%.

In Table 5, we see the information about pertinence for Volume 42 A. From the Table, the highest pertinence observed is 50%, which is for the article published in November, 2003 in volume 42 A, number 11, pages 2677-2679. The lowest pertinences were 0%. The average pertinence for articles published in the journal for the year 2003 is 8%.

For Table 6, we see have pertinence for Volume 43 A. From the Table, the highest pertinence observed is 86%, which is for the article published in January, 2004 in volume 43 A, number 01, pages 28-34. The lowest pertinences were 0%. The average pertinence for articles published in the journal for the year 2004 is 16%.

Table 4. Representative citation distribution in articles published in the journal issue in 2002

<table>
<thead>
<tr>
<th>S/N</th>
<th>Journal Issue</th>
<th>Publication Date</th>
<th>Article Pages</th>
<th>$N_c$</th>
<th>$n_c$</th>
<th>Pertinence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Vol. 41 A (01)</td>
<td>January, 2002</td>
<td>54-64</td>
<td>-</td>
<td>-</td>
<td>- (NERA)</td>
</tr>
<tr>
<td>2.</td>
<td>Vol. 41 A (02)</td>
<td>February, 2002</td>
<td>304-307</td>
<td>13</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>4.</td>
<td>Vol. 41 A (04)</td>
<td>April, 2002</td>
<td>771-773</td>
<td>6</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>5.</td>
<td>Vol. 41 A (05)</td>
<td>May, 2002</td>
<td>955-959</td>
<td>11</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>S/N</td>
<td>Journal Issue</td>
<td>Publication Date</td>
<td>Article Pages</td>
<td>$N_c$</td>
<td>$n_c$</td>
<td>Pertinence (%)</td>
</tr>
<tr>
<td>-----</td>
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<td>------------------</td>
<td>---------------</td>
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</tr>
<tr>
<td>1.</td>
<td>Vol. 42 A (01)</td>
<td>January, 2003</td>
<td>79-83</td>
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<td>0</td>
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<tr>
<td>2.</td>
<td>Vol. 42 A (02)</td>
<td>February, 2003</td>
<td>250-254</td>
<td>23</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>Vol. 42 A (03)</td>
<td>March, 2003</td>
<td>564-567</td>
<td>23</td>
<td>0</td>
<td>0</td>
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<tr>
<td>4.</td>
<td>Vol. 42 A (04)</td>
<td>April, 2003</td>
<td>719-726</td>
<td>12</td>
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<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>Vol. 42 A (05)</td>
<td>May, 2003</td>
<td>1086-1088</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>Vol. 42 A (08)</td>
<td>August, 2003</td>
<td>1865-1867</td>
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<td>9.</td>
<td>Vol. 42 A (09)</td>
<td>September, 2003</td>
<td>2205-2209</td>
<td>5</td>
<td>0</td>
<td>0</td>
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<tr>
<td>10.</td>
<td>Vol. 42 A (10)</td>
<td>October, 2003</td>
<td>2531-2535</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12.</td>
<td>Vol. 42 A (12)</td>
<td>December, 2003</td>
<td>2954-2958</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Average for the year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

Table 5. Representative citation distribution in articles published in the journal issue in 2003

<table>
<thead>
<tr>
<th>S/N</th>
<th>Journal Issue</th>
<th>Publication Date</th>
<th>Article Pages</th>
<th>$N_c$</th>
<th>$n_c$</th>
<th>Pertinence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Vol. 43 A (01)</td>
<td>January, 2004</td>
<td>28-34</td>
<td>8</td>
<td>7</td>
<td>86</td>
</tr>
<tr>
<td>2.</td>
<td>Vol. 43 A (02)</td>
<td>February, 2004</td>
<td>333-336</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>Vol. 43 A (04)</td>
<td>April, 2004</td>
<td>752-755</td>
<td>9</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>5.</td>
<td>Vol. 43 A (05)</td>
<td>May, 2004</td>
<td>1066-1075</td>
<td>33</td>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 6. Representative citation distribution in articles published in the journal issue in 2004
In Table 7, the information about pertinence for Volume 44 A is presented. From the Table, the highest pertinence observed is 30%, which is for the article published in May, 2005 in volume 44 A, number 05, pages 1016-1018. The lowest pertinences were 0%. The average pertinence for articles published in the journal for the year 2005 is 11%.

**Table 7.** Representative citation distribution in articles published in the journal issue in 2005

<table>
<thead>
<tr>
<th>S/N</th>
<th>Journal Issue</th>
<th>Publication Date</th>
<th>Article Pages</th>
<th>(N)</th>
<th>(n)</th>
<th>Pertinence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vol. 44 A (01)</td>
<td>January, 2005</td>
<td>80-84</td>
<td>8</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>Vol. 44 A (02)</td>
<td>February, 2005</td>
<td>261-264</td>
<td>27</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Vol. 44 A (03)</td>
<td>March, 2005</td>
<td>521-525</td>
<td>23</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Vol. 44 A (04)</td>
<td>April, 2005</td>
<td>687-692</td>
<td>15</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>Vol. 44 A (05)</td>
<td>May, 2005</td>
<td>1016-1018</td>
<td>10</td>
<td>3</td>
<td>30</td>
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<tr>
<td>6</td>
<td>Vol. 44 A (06)</td>
<td>June, 2005</td>
<td>1151-1158</td>
<td>15</td>
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<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Vol. 44 A (07)</td>
<td>July, 2005</td>
<td>1378-1382</td>
<td>13</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>Vol. 44 A (08)</td>
<td>August, 2005</td>
<td>1594-1596</td>
<td>5</td>
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<td>0</td>
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<tr>
<td>9</td>
<td>Vol. 44 A (09)</td>
<td>September, 2005</td>
<td>1756-1765</td>
<td>18</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>10</td>
<td>Vol. 44 A (10)</td>
<td>October, 2005</td>
<td>2010-2014</td>
<td>12</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>11</td>
<td>Vol. 44 A (11)</td>
<td>November, 2005</td>
<td>2240-2246</td>
<td>12</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>12</td>
<td>Vol. 44 A (12)</td>
<td>December, 2005</td>
<td>2445-2449</td>
<td>21</td>
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<tr>
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<td>Average for the year</td>
<td></td>
<td></td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Table 8, the information about pertinence for Volume 45 A is presented. From the Table, the highest pertinence observed is 29%, which is for the article published in November, 2006 in volume 45 A, number 11, pages 2418-2420. The lowest pertinences were 0%. The average pertinence for articles published in the journal for the year 2006 is 5%.
Table 8. Representative citation distribution in articles published in the journal issue in 2006

<table>
<thead>
<tr>
<th>S/N</th>
<th>Journal Issue</th>
<th>Publication Date</th>
<th>Article Pages</th>
<th>$N_c$</th>
<th>$n_c$</th>
<th>Pertinence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Vol. 45 A (01)</td>
<td>January, 2006</td>
<td>45-50</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>Vol. 45 A (02)</td>
<td>February, 2006</td>
<td>409-411</td>
<td>6</td>
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<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>Vol. 45 A (03)</td>
<td>March, 2006</td>
<td>581-586</td>
<td>18</td>
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<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>Vol. 45 A (04)</td>
<td>April, 2006</td>
<td>858-863</td>
<td>13</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>5.</td>
<td>Vol. 45 A (05)</td>
<td>May, 2006</td>
<td>1139-1143</td>
<td>14</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>6.</td>
<td>Vol. 45 A (06)</td>
<td>June, 2006</td>
<td>1400-1404</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>Vol. 45 A (07)</td>
<td>July, 2006</td>
<td>1631-1637</td>
<td>16</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>Vol. 45 A (08)</td>
<td>August, 2006</td>
<td>1813-1819</td>
<td>10</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>9.</td>
<td>Vol. 45 A (09)</td>
<td>September, 2006</td>
<td>2045-2047</td>
<td>8</td>
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<tr>
<td>10.</td>
<td>Vol. 45 A (10)</td>
<td>October, 2006</td>
<td>2406-2411</td>
<td>15</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12.</td>
<td>Vol. 45 A (12)</td>
<td>December, 2006</td>
<td>2628-2631</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Average for the year: 5

Table 9. Representative citation distribution in articles published in the journal issue in 2007

<table>
<thead>
<tr>
<th>S/N</th>
<th>Journal Issue</th>
<th>Publication Date</th>
<th>Article Pages</th>
<th>$N_c$</th>
<th>$n_c$</th>
<th>Pertinence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Vol. 46 A (01)</td>
<td>January, 2007</td>
<td>54-59</td>
<td>8</td>
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</tr>
<tr>
<td>2.</td>
<td>Vol. 46 A (02)</td>
<td>February, 2007</td>
<td>276-279</td>
<td>22</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>4.</td>
<td>Vol. 46 A (04)</td>
<td>April, 2007</td>
<td>589-594</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>Vol. 46 A (05)</td>
<td>May, 2007</td>
<td>742-747</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>Vol. 46 A (06)</td>
<td>June, 2007</td>
<td>933-936</td>
<td>9</td>
<td>7</td>
<td>75</td>
</tr>
<tr>
<td>7.</td>
<td>Vol. 46 A (07)</td>
<td>July, 2007</td>
<td>1069-1074</td>
<td>5</td>
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<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>Vol. 46 A (08)</td>
<td>August, 2007</td>
<td>1283-1288</td>
<td>11</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

Average for the year: 23
In Table 9, the information about pertinence for Volume 46 A is presented. From the Table, the highest pertinence observed is 100%, which is for the article published in March, 2007 in volume 46 A, number 03, pages 416-421. The lowest pertinences were 0%. The average pertinence for articles published in the journal for the year 2006 is 23%.

Figure 1 presents the overview the variation of pertinence within the articles analyzed. From this figure, it can be seen that about 95% of the article have pertinences ≤ 50%. Figure 2 gives the information on the frequency distribution of $N_c$ within the articles analyzed. Here, it is shown that the most frequent $N_c$ lies within the range 3-25. Within this range, $N_c$ have at least a frequency of 4. Figure 3 presents the frequency distribution of $n_c$ within the articles analyzed, while Figure 4 shows the frequency distribution of pertinence within the articles analyzed. These figures show the same trend. Frequencies were highest for zero $n_c$ and pertinence. These decreased down the line. From here, it shows that the probability of finding article with higher pertinence decreases as both $n_c$ and pertinence increased.

![Graph](image)

*Figure 1. Overview of the Variation of Pertinence within the Articles Analyzed*
Figure 2. Frequency Distribution of Nc within the Articles Analyzed

Figure 3. Frequency Distribution of nc within the Articles Analyzed
Figure 4. Frequency Distribution of Pertinence within the Articles Analyzed

Overall the average pertinence for the study is found by calculating the mean for the average pertinences for all the journals issues analyzed i.e.

$$p_m = \frac{P_{Vol.35,A} + P_{Vol.39,A} + P_{Vol.40,A} + P_{Vol.41,A} + P_{Vol.42,A} + P_{Vol.43,A} + P_{Vol.44,A} + P_{Vol.45,A} + P_{Vol.46,A}}{9}$$

Where $p_m$ is the mean of the average pertinences for the entire journal issues analyzed.

$$p_m = \frac{15 + 21 + 34 + 27 + 16 + 11 + 5 + 23}{9} = 18\%$$

With this, it is clear that, on the average, only 18% of citations in the introduction sections of the articles studied are pertinent to the reported research. This result is supported by the works of Lariviere et al., (2016) and Adedayo, (2015b). In his study, Adedayo, (2015b) extended the work of Saha et al., (2003), drawing similarities between citations and votes. When citations are considered as votes, Adedayo, (2015b) predicted that about 80% of citations made in the introduction sections may not be applicable in the computation of effective impact of publications. The result of the study also agrees with the assertion of Cawkell, (1977), that pertinence of cited literature reference in a scientific article is very important in impact evaluation considerations.

**Conclusion**

This investigation has shown that significant proportion of citations made in the introduction sections of scientific articles only have imagined pertinence to the study reported. Overall the average pertinence
for the study is less than 20%. Going by this fact, therefore, citations in scientific articles can be validly classified into two i.e. Citations in Imaginary sections and citations in the Real sections. Also, pertinence; a new parameter useful in the evaluation of scientific publications has been introduced.

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