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Entertainment Franchising Readiness through an Entrepreneurial Ecosystem: A Case of the Local Film Industry

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Abstract

This study focused on the local movie makers' readiness to use the strategy in creating more youth employment opportunities across the country. The key informants were film producers, directors, actors, publishers, distributors, vendors and script under Uganda's Movie Federation. A triangulation of unstructured interviews, participant observations and document review constituted this mainly qualitative study.

The study findings revealed that most movie makers especially the producers and distributors are willing but unable (less ready) to create more meaningful youth jobs through the entertainment franchising strategy. The movie makers' inability was found to be mainly caused by the currently weak co-existence and co-evolution of the Federation members with other key players. Those partners include the respective government agencies, media houses, educational institutions and the development partners. Some movie pirates were willing to be converted into authorized movie distributors (franchisees) in Uganda.

To build on the complexity theory for guiding the entertainment franchising readiness practice, there is need for public-private partnerships (PPPs) as a dependent variable that predicts the industry's entrepreneurial ecosystem. So, a study on the entrepreneurial ecosystem for movie franchising as a youth-employment strategy in exemplar countries is needed.

Key Words
Entertainment franchising, readiness, entrepreneurial ecosystem, complexity and movie industry

Introduction

Creative and innovative industries are interactively speeding up the socio-economic transformation around the world (Davis & Naqvi, 2012; Tribe, 2011). As one of such media-based industries, the entertainment industry is contributing to the entrepreneurial ecosystem behind the observed socio-economic transformation in a number of countries (Suresh & Ramraj, 2012; Kacou, 2011). For instance, Nigerian movies are being used in promoting the country's culture, tourism, entrepreneurial products, economic progress, business and investment opportunities, government support and national pride on television channels across the world (Orya, 2014; Moudio, 2013; Vatier, 2013; Davis & Naqvi, 2012). Nigeria's movie industry has also been recently recognized as the country's 2nd biggest source of economic growth and youth employment because of its promotional contribution to the socio-economic transformation (Orya, 2014; Moubio, 2013). As the country's movie industry delivers such success, the African movies segment in most of Uganda's free-to-air TV programming is increasingly being dominated by Nigerian movies (Musoke, 2014; Moudio, 2013; Yose, 2013).

Nigerian movies, music style, English accent (Pigin), fashion, restaurants, banks, insurance brands, stand-up comedy, culture and internationalization are currently benchmarked by Uganda's socio-economic transformers who 'potentially' include the local movie industry (Musoke, 2014; Orya, 2014; Moudio, 2013; Muleme, 2013). However, more than 80% of the Nigerian movies which are sold in Uganda and around the world are mainly in form of pirated DVD copies which lowers the local movie industry's profitability and government tax revenue collections (Musoke, 2014; Chen, Watson, Cornachione & Azevedo, 2013; Moubio, 2013; Kacou, 2011). So, it is now the time for the local movie industry's scholars, policy makers and movie makers among other players to increasingly benchmark the Nigerian success story alongside other role model industries like USA's Hollywood and India's Bollywood (Nigeriafilms.com, 2014; Chen *et al.,* 2013; Muleme, 2013; Locke & Golden-Biddle, 1997). Those exemplar industries contribute more than 75% of the world's highest money-making movies which are produced, duplicated, distributed and sold as entertainment (movie) franchises.

For instance, entertainment franchising has enabled an internationally benchmarked movies like Harry Porter, James Bond and Spiderman to make more than US$ 7 billion from contractually marketing its respective series, seasons, spin-offs, cross-overs, translations and adaptations in form of movie franchises (Mutumba & Kibirango, 2016; Moudio, 2013; www.wikipedia.com). When compared with the less than US$ 1 billion generated by all Nigeria's top- grossing 100 movies sold within a period of at least 5 years, a money-making and readiness challenge is revealed. However, there is lack of a locally contextualized study that explains the local movie makers' entertainment franchising readiness to deliver more sustainable employment, wealth creation and socio-economic transformation across a country like Uganda (Chen *et al.,* 2013; Davis & Naqvi, 2012; Kacou, 2011; Locke & Golden-Biddle, 1997). The currently available knowledge is still too linear to guide the local movie industry towards contributing better in achieving such national goals in today's evolving market place (Moudio, 2013; Knight & Cross, 2012; Kacou, 2011; Ghoshal, 2005; Locke & Golden-Biddle, 1997). So, a non-linear, contextualized, complexity-driven model is needed to enable the industry to also use today's internet-enabled media channels like youtube, facebook, twitter and the piracy-related technologies within a diversity of industry players. Such complexity thinking is pointing towards the transforming of today's unauthorized sellers (pirates) into authorized movie distributors and adapters hence entertainment franchise holders (franchisees) for both the local and foreign movies across the country

(Muleme, 2013; Moudio, 2013; Vatier, 2013; Goldstein, Hazy & Lichtenstein, 2010). This study is therefore aimed at contributing to the complexity-understanding of the needed entertainment franchising readiness in the local movie industry.

Some scholars have attempted to reveal the complexity understanding of today's evolving movie quality, distribution and retail changes, partnerships and ecosystem for transforming a local movie industry into one with higher business readiness (McDonald, 2013; Tribe, 2011; Goldstein *et al.,* 2010; Doherty, 2007). For instance, a recent study by McDonald (2013) shows how a global leader in online movie distribution, Netflix has managed to use the internet to competitively sell more movies in ways that the traditional video stores can no longer achieve due to today's piracy and other related complexities around the world (McDonald, 2013; Moudio, 2013). So, the pirates in Nigeria and Uganda who are currently making more than 5 times the money compared to what is earned by the local movie makers are also not safe against such complexity models whose world-class approach (Musoke, 2014; McDonald, 2013; Moudio, 2013; Goldstein *et al.,* 2010). Soon, the pirates' currently 'successful' video shops might be closed due to the same internet which also favors the online franchised-movie distribution especially where the local movie industry's copyright enforcement is interactively empowered (Musoke, 2014; McDonald, 2013; Copyright and Neighbouring Rights Act 2006; Goldstein *et al.,* 2010). Meanwhile, the Government of Uganda through the Uganda Communications Commission (UCC), other related government bodies and the Uganda Federation of the Movie Industry (UFMI) are seeking for ways of improving the local industry's competitiveness. They are doing so through a diversity of initiatives like the annual UFF-Uganda Film Festival and the 70% local content requirement for Uganda's free-to-air televesion channels (Sekyewa, 2014; Chen *et al.,* 2013; Vatier, 2013; Yose, 2013; Tribe, 2011).

The country's other related initiatives also includes the Copyright Police, proposed Film Fund and the annual Film Forum among others which also impact on the country's respective readiness and tourism competitiveness (Sekyewa, 2014; Orya, 2014; UCC, 2014; Tribe, 2011; Kotler, Makens & Bowen, 2007). An integration of such approaches presents a complexity of opportunities for the local tourism strategists to also partner with the local movie industry alongside the mobile telecom companies, media, leading musicians, sports personalities among other entertainment-related providers. Such collective partnerships have the potential to deliver the desired inward internationalization and socio-economic transformation especially through the entertainment franchising strategy (Orya, 2014; Chen *et al.,* 2013; Moudio, 2013; Vatier, 2013; Tribe, 2011; Hausmann & Hidalgo, 2009). In addition, the policy makers behind the country's other wealth creation initiatives are seeking to tap into such a diversity of partnerships for the local movie industry's desired competitiveness (Orya, 2014; Chen *et al.,* 2013; Tribe, 2011; Hausmann & Hidalgo, 2009). A synthesized coherence or triangulation of such a diversity of cross-cutting initiatives creates the needed entrepreneurial ecosystem-driven opportunities for more authorized marketing of the locally-produced movies as entertainment franchises (Musoke, 2014; Tribe, 2011; Goldstein *et al.,* 2010; Locke & Golden-Biddle, 1997).

The local movie makers can then sustainably create more wealth, employment opportunities and contribute to Uganda's faster socio-economic transformation when they are enabled to be interactively-ready to market and sell their movie products through the entertainment franchising strategy (Musoke, 2014; Smith, 2014; Chen *et al.,* 2013; Vatier, 2013; Tribe, 2011). The complexity theory's guidance then becomes important because of its interactive-empowerment approach through a diversity of public and private partnerships

(PPPs), which seems to be the 'missing link' for the local movie industry's entertainment franchising readiness (Smith, 2014; Knight & Cross, 2012; Kacou, 2011; Tribe, 2011; Goldstein *et al.,* 2010; Hausmann & Hidalgo, 2009). Therefore, it was found to be contextually appropriate to base the complexity approach on in-depth views and triangulated evidence from those in the movie/film making practice in order to empirically answer the following research questions (Musoke, 2014; Vatier, 2013; Knight & Cross, 2012; Saunders, Lewis & Thornhill, 2012; Neuman, 2007).

1. In which ways are Uganda's local movie makers interactively-empowered for their entertainment franchising readiness?
2. Then, why is the complexity approach needed across the local movie industry?
3. How will the needed complexity improve the entertainment franchising readiness?

In order to answer the above exploratory research questions, an interpretivistic philosophy guided the methodology and next parts of this study. It was because the study mainly focused on the knowledge re-construction towards the complexity theory as the guide for empowering the local movie industry's entertainment franchising readiness (Chen *et al.,* 2013; Knight & Cross, 2012; Saunders *et al.,* 2012; Neuman, 2007; McKelvey, 1998). Ontologically, the respective readiness (willingness and ability) reality was seen in terms of subjective and unstructured views in the local movie industry's context (Knight & Cross, 2012; Saunders *et al.,* 2012). Epistemologically, the researcher assumed the inductive (qualitative) approach as reflected in the following methodology (Knight & Cross, 2012; Saunders *et al.,* 2012; Lewin, 1946).

Study Methodology

This study was approached using the qualitative (exploratory/theory building), cross-sectional research methodology with some bits of participatory action research (Saunders *et al.,* 2012; Neuman, 2007; Lewin, 1946). The aim was to understand the entertainment franchising readiness phenomenon by learning from the local movie makers as part of the transition/problem-solving process while also considering the needed interactive-readiness for transforming the industry (Toffel, 2016; Musoke, 2014; Knight & Cross, 2012; Kacou, 2011; Neuman, 2007; Lewin, 1946). This study was conducted with the 8 key informants who also included the country's movie pirates and regulators as some of the partners in this knowledge-building and interactive-solution finding process as presented below (Chen *et al.,* 2013; Knight & Cross, 2012; Lewin, 1946).

- ✓ Informant 1, a coordinator of the Uganda Film Festival (UFF) 2013 & 2014 which is a Uganda Communication Commission (UCC) initiative aimed at inspiring and empowering more Ugandans through film. This informant was chosen because he is well grounded on the history, evolution, progress and diversity of goals behind the Annual UFFs (Owaraga, 2013; Doherty, 2007; Yin, 1994).
- ✓ Informant 2, a local movie producer who is a founder member of the Uganda Federation of Movie Industry (UFMI) which was started in around 2007. He is the current patron of UFMI who also owns one of those movie production and distribution companies. His company is sometimes 'accused' of starting the DVD 'price wars' that lead to the local industry's piracy struggles (UFMI minutes between 2012 and 2014; Kotler *et al.,* 2007).
- ✓ Informant 3, another leading local movie producer who is yet to register with UFMI. He was chosen because he is beginning to appreciate the needed entertainment franchising readiness-related initiatives as reported in local media (Musoke, 2014).

- ✓ Informant 4, one of Uganda's leading Video Jockers (VJs) and local language (Luganda) translators who is also a publisher of pirated movies across the country. This key informant was chosen because he has been seen to be against any copyright implementation efforts in Kampala hence entertainment franchising progress. He has been a VJ who pirates and translates most of the world's top movies for more than 15 years (Seruga, 2014).
- ✓ Informant 5, a leading retailer and vendor of pirated movies who is changing her mindset towards becoming an authorized distributor of the local movies hence showing some signs of the local industry's entertainment franchising readiness (Musoke, 2014). She was chosen because of her over 10 years in the local movie industry with now a shop in Kampala's central business district which she is dedicating to the selling of copyrighted/authorized movies (UFMI Minutes of June 2012-August 2014).
- ✓ Informant 6, a leading UFMI-registered script writer and movie director based in Kampala but with clients in other parts of Uganda as also in Burundi and Rwanda (UFMI Minutes of June 2012-August 2014).
- ✓ Informant 7, a representative of UFMI's Actors Guild who has always expressed his dream of acting in a world-class but locally produced movie franchise that can be benchmarked with at least 50% of the James Bond quality in the next 5-10 years. He has been to Hollywood and Nollywood (UFMI Minutes of June 2012- August 2014).
- ✓ Informant 8, one of the former Top 5 distributors of local movies who nearly ran out of business in the recent years. He is now a leading distributor of foreign pirated movies and a leading financer of the UFMI's operations who is also 'well connected' with the key officers in Uganda's regulatory bodies (UFMI Minutes of June 2012-August 2014).

The data collection was through a triangulation of unstructured interviews that lasted an average of 3 hours per informant, participant observations for content analysis and the document review (Knight & Cross, 2012; Saunders *et al.,* 2012; Doherty, 2007; Neuman, 2007). The unstructured interviews enabled the trained interviewers to adjust to the local language demands and the mood of the respective informants since they were encouraged to also ask some questions to us as we interviewed them during the data collection (Saunders *et al.,* 2012). Such participatory action research and data triangulation strengthened the validity and reliability of the collected and discussed findings below (Knight & Cross, 2012; Doherty, 2007; Yin, 1994).

Data Analysis

The told stories from the unstructured interviews were transcribed from the field notes into post-interview scripts which were then triangulated with the findings from the other data sources (Knight & Cross, 2012; Neuman, 2007). This progressive triangulation enabled the researcher to empirically get a more in-depth understanding of this study's entertainment franchising readiness phenomenon across the 3 data sources (Neuman, 2007). The triangulated data were then interpreted to construct out the contextual meanings that formed this study's emerging themes hence concepts in the presented matrices (Saunders *et al.,* 2012; Neuman, 2007; Ghoshal, 2005; Lewin, 1946). In so doing, this study's qualitative data was manually analyzed using the thematic and content analysis in line with the above research questions (Knight & Cross, 2012; Neuman, 2007). The questions were reflected in the specific issues raised in the interview guide, observation and document review checklists. As a result of this mainly qualitative methodology, the following findings were revealed and are discussed below.

Findings and Discussion

According to the findings from an interview with Informant 1, the government of Uganda is beginning to interactively-empower its local movie makers but not yet specifically for the needed entertainment franchising readiness as reflected in the matrix presented in Table I below.

Table I: Empowerment of Uganda's Local Movie Makers for the Readiness

Kind of Empowerment	Year	Revealed Purpose
Uganda Film Festival	2013	To empower Ugandans through local Film.
Film Fund	Proposed	To increase access to affordable film financing from the government.
70% Local TV Content Required	2013	To motivate the local movie producers to make more movies for the local TV stations.
Film Forum by Role Models	2012	To have Africa's top movie makers inspire and train the local movie industry.
Copyright Enforcement	2013	To empower Uganda's creative industry through Copyrights and Neighbouring Rights Act of 2006 and its Regulations of 2010.

Source: Compiled from the Findings

As presented in Table I above and specifically brought out from an interview with the film festival's coordinator (Informant 1), it was specifically revealed that the overall focus of the above empowerment package is to increase the number and quality of Ugandan produced movies on the country's local TV stations. He said that, '*The goal of this year's film festival (UFF 2014) is to inspire and empower more local makers to collectively produce better quality movies that will create more jobs especially for our unemployed youths'*. When asked about how the government (UCC)-facilitated Film Fund and the 70% Local Content which is mandatory for all TV programming in Uganda will empower the local movie makers, his response was that, *'these 2 initiatives will enable our local producers to access the needed financing for making better quality movies that can compete with the leading foreign movies at the different market levels'*. Informant 1's response means that UCC is legally and financially empowering the local movie makers through both initiatives. From what was observed in the few authorized retailers and vendors' sales outlets around Kampala, the UCC-delivered empowerment is not yet interactive enough to enable the local producers' ability to make movies with the world-class quality whose success can be replicated through the franchising strategy. For instance, the banks and other financial institutions are not yet convinced by the UCC's optimism towards local movie industry's win-win transformation although the industry recognizes the importance of movie makers who are perceived to be financially-successful. This is illustrated by the pictures in the respective promotional documents (the posters and banners) which were used for the UFF 2014. It was revealed that most (around 90%) of the photos used in the adverts were those of Uganda's more established actors. These included the photo of Abbey Mukiibi who has acted in the best-selling 'Last King of Scotland' and 'Strength of a Woman'. This means that the series of annual film festivals utilizes message carriers (local movie makers especially the actors) who are crowd pullers from Uganda's more successful movies hence increasing their respective esteem across the industry. Overtime, their more successful movies can be replicated and sold in other markets when

the industry's level entertainment franchising readiness is interactively-improved. Such a strategic direction points towards the consideration of the local producers' views as part of the interactive-solution finding (Chen *et al.,* 2013; Lewin, 1946). Meanwhile, as a participant in both the UFF 2013 and the UFF 2014, i observed that while some of the UFMI-registered movie makers have been against and trying to stop the film festivals, most of the federation's non-members continue to seek for more opportunities to participate in the annual festivals. In addition, it was also observed that although most of the UFMI members continue to be positive about the engagement of leading Nigerian, South African and Kenyan movie makers besides the content buyers from the likes of DSTV and Zuku TV, some of the members are yet to appreciate UCC's 'complexity' approach to local industry transformation. The local industry's conflicts present UCC as the institutional-generative leader (Goldstein *et al.,* 2010) who is trying to empower all the local industry's movie makers with an interactions resonance that also engages the conflicting parties through the annual film festivals. The emerging theme here is that the local industry's readiness-related initiatives are being implemented at the 'edge of chaos' where the conflicting local movie makers need to collectively build a country-wide ecosystem of symbiotic players. The in-built synergy strengthens the infant industry's entrepreneurial ecosystem in ways that interactively improves the needed franchising readiness. In so doing, Uganda's local industry becomes more ready for the franchising strategy by engaging a complexity of young and empowered movie makers, the transformed movie pirates, distributors and vendors among other key players in today's evolving movie industry (Tribe, 2012; Goldstein *et al.,* 2010; Hausmann & Hidalgo, 2009). This is because such interactively-empowered youths are usually time-rich and good at seeking for new trends, technologies and networks for creating more wealth through time-tested, world-class strategies like entertainment franchising through an ecosystem of networked-resources and new energy.

Among the local movie industry's key ecosystem players also include the older movie producers. So, the views of the 2nd key informant on the ways in which the local movie makers are interactively-empowered across the industry's market levels were sought in order to compare them with those of the 1st key informant. This local producer responded that '*Because of the poor copyright enforcement, today's total weekly sales of our unpirated Ugandan movies are as low as 180 DVD copies at 1,500 Uganda shillings per copy (270,000 Uganda shillings per week). You cannot compare that to 5-10 years ago when one (1) local movie distributor was selling more than 10,000 copies at 15,000 Uganda shillings per copy (150,000,000 Uganda shillings) in a week through his 40-60 staff members and/or 6 retailers'*. His outcry shows that indeed the pirates have negatively affected the industry's financial attractiveness for the local movie makers. This shows why the local movie makers need some country-wide enforcement of the copyright law in ways that take care of the local market complexities which are escalated by the internet-enabled piracy (Musoke, 2014; McDonald, 2013; Goldstein *et al.,* 2010). A content analysis of Uganda's Copyright & Neighboring Rights Act 2006 and the respective Regulations of 2010 revealed that there are more than 20 articles, sections and regulations that emphasize how the local movie industry stands to benefit from the respective enforcement. As presented in Table 2 below, the current copyright law framework is one the ways in which the local movie makers are interactively-empowered to some extent, though mainly still '*on paper*'.

Table 2: Showing a Review of Uganda's Copyrights Documents for the Local Movie Industry

Document	Part(s)	Sections/Regulations	Constructed Theme
The Copyrights and Neighboring Rights, 2006	Part VI	Sections 41-56	Administration of the Copyrights
Copyrights and Neighboring Rights Regulations, 2010	Part IV & V	Regulations 18-28	Copyrights Enforcement for movie-related products through UFMI

Source: Uganda Gazette 2006 and 2010

From the 2nd key informant's expressed positivity during the same interview with him, this local producer said that *'Authorized distributorships are what is we need through collectively and sustainably implementing the Copyright & Neighboring Rights Act 2006 and respective Regulations 2010. This will and can turn around all the movie piracy which is holding us back as an infant movie industry'.* Although the copyright law already exists with its unexploited wealth creation potential, the country's copyright enforcement efforts are yet to physically empower the local movie makers towards the industry's improved financial attractiveness and its entertainment franchising readiness (Musoke, 2014; Moubio, 2013; Tribe, 2011). According to an online article by Musoke (2014) and the observed hope which was also expressed during more than 5 of the frequent UFMI meetings that I attended, the currently limited copyright-empowerment is interactively being strengthened through a growing diversity of government partners. For instance, the UCC, UFMI, Uganda Registration Services Bureau (URSB) alongside other government bodies like the Uganda Police, Media Center and the Uganda Revenue Authority (URA) are beginning to work together towards the needed copyright enforcement and the creative industry's competitiveness. However, the private sector where most of the internet-enabled piracy is practiced and where the authorized/franchised movie franchising must be practiced is yet to be brought on board. It is now time for UFMI and its current partners to also bring the likes of the Private Sector Foundation of Uganda (PSFU), Uganda Investment Authority (UIA) and the Kampala City Traders Association (KACITA) among other private sector bodies. In line with scholars like Tribe (2011), Goldstein *et al.,* (2010) and Hausmann & Hidalgo (2009), it is the complexity approach's co-evolution and co-enforcement that is yet to be connected for the above public and private partners to interactively improve the industry's entertainment franchising readiness. It is also through the complexity approach that even the other local movie producers who are not yet registered under the federation (UFMI) and the current movie pirates will be easily brought on board. The country's ICT regulator (the National Information Technology Authority of Uganda, NITA-U) and the internet service providers are also needed on board. As an increasing complexity of symbiotic private and public partners strengthen the movie industry's entrepreneurial ecosystem, more local movie makers and pirates have no choice but to become ready for interactive business strategies like entertainment franchising. In order to further understand the needed interactive-empowerment, the next informant's views were sought.

The 3rd key informant, a veteran movie producer was also asked about the ways in which Uganda's local movie makers are interactively-empowered for their entertainment franchising readiness. His response was that, *'apart from the Copyright Police, Copyright Inspectors and the annual film festivals, I do not see any interactive legal, financial, media/informational and social empowerment from our government'*. In turn,

this informant asked the interviewer whether she was seeing any interactive- empowerment like that given to Uganda's other sectors like the case of agriculture and manufacturing. She only mentioned the occasional media reporting on UBC TV, Bukedde TV and some other government-media houses. She emphasized that the government-media support is usually seen when the movie makers demonstrate against the rampant movie piracy, without hinting on the Film Fund which is presented in ***Table 1*** above. The unmentioned financial empowerment among others is an indication of the limited informational empowerment in the local industry. According to the local newspaper reports, the same veteran movie producer had previously expressed some piracy-related fear for his latest movie. He expressed that he had already spent 17 million Uganda Shillings in putting together his new movie (Evil Money) but he was not sure whether he would recover his invested money because of the likely piracy from businesses like Papa's shop on Zai Plaza in Kampala's central business district. The limited information sharing across the industry is worsened by the low interactions resonance among the respective partners. The less information sharing 'traps' such movie makers and other players into a counter-productive blame game that scares him as a local movie maker. His fear was in line with the 'Survival Trap' which is elaborated by Kacou (2011) who calls for the complexity approach to such common frustrations in bottom-of-the pyramid (BoP) markets like Uganda's local movie industry. When complemented by other scholars like Chen *et al.,* (2013) and Tribe (2011), you realize that the 'survival trap' is making the frustrated movie makers and bonafide distributors of copyrighted DVDs in the local movie industry to blame the other players. Instead of such a blame game, the piracy-driven 'survival trap' can be escaped through an interaction of a diversity of public and private partners across the local movie market. It is a complexity of the above 'trapped' partners that can interactively create the needed ecosystem for the respective readiness. This will empower the local movie makers towards the industry's entertainment franchising readiness and increased contribution to Uganda's socio-economic transformation like in the case of Nigeria (Orya, 2014; Tribe, 2011; Kotler *et al.,* 2007). To do so, even the religious leaders/preachers, cultural leaders, local politicians, community-trend setters and media gurus are needed in order to improve the local movie makers' psychological and social empowerment. With such a growing complexity of partners from a diversity of key stakeholders, the local movie makers can and will easily take on the entertainment franchising strategy. Otherwise, the currently few and less interactive public-private partners' efforts might instead be weakened by Uganda's institutionalized culture of bribing those in authority, which the 'adamant' pirates continue to exploit in disguise of creating more jobs in the country. A further analysis based on the participant observation during a meeting held at Imperial Royale Hotel in Kampala, most leading movie pirates are using their piracy financial strength and accumulated wealth to 'buy' the support of the money-hungry officials of some local authorities like Uganda Police across the country.

For instance, a review of a popular local language (Luganda) TV Show revealed Informant 4 claiming that, '*Our so-called local movie makers and the federation (UFMI) cannot stop us from pirating the foreign movies because the Americans and Nigerians are not complaining about our business. See, we are creating more jobs for the unemployed youths out there. Besides, we are licensed by Kampala City Council Authority (KCCA) and pay more taxes to Uganda Revenue Authority (URA)'.* The show's moderator asked him whether he is willing to be converted into an authorized publisher of both local and foreign movies. His response was that*, 'if the local movies' quality is seriously improved and if they allow us to sell their DVDs at the same or lower prices as the foreign movies. With increased acceptance, we are willing to become their authorized sellers'.* This pirate's willingness to become a franchisee seller of the better quality local movies shows that a complexity approach is needed to strengthen such mindset changes towards the respective franchising

readiness in the industry. As more leaders of the local Video Jockeys (VJs), movie vendors and pirates become interactively-ready to be converted into franchisee publishers/distributors/sellers of the local and foreign movie titles in Uganda, the local movie makers' entertainment franchising readiness will be improved (Musoke, 2014; Moubio, 2013; Tribe, 2011). The respective readiness of the public sectors players like the Media Council and the other key private sector players like the local movie industry's entrepreneurs, business people and investors will also be interactively improve. In complement, ***Table 2*** above shows that such complexity-driven mindset changes are constitutionally supported for this creative, media-based industry to become more attractive for the country's faster socio-economic transformation through locally-made movies. So, the need for a deeper understanding of this evolving phenomenon called for the next views (Goldstein *et al.,* 2010; Yin, 1994).

Informant 5 was a leading retailer and vendor of pirated movies for the last 10 years. During the interview, she claimed that her preference for such movies was because it is a more lucrative business which attracts a diversity of 'entrepreneurs' into their financially-empowered product community along most of Uganda's busy streets. However, she also recognized that the same piracy which attracted such entrepreneurs into the business is now causing the 'hurting' price wars which are reducing the respective business profitability. This wake-up call is in complement with the 2nd informant. They both agreed that a foreign copyrighted movie DVD copy which used to be sold at 15,000 Ugandan shillings in 2005 is now sold at 700 Ugandan shillings which is increasingly becoming a lose-lose industry reality (Kacou, 2011). The triangulated agreement implies that there are some 'untapped' readiness opportunities through the 'win-win' complexity approach. Previously, on about 2 local TV programmes, she had arrogantly said that, *'We no longer sell their locally-made movies/Bina-Uganda because they are of poor quality compared to the popular foreign movies'*. Her TV response was similar to that of another previously interviewed movie pirate who emphasized the need for the respective producers to improve their local movie quality. The above movie pirates' demand comes at a time when some of Africa's leading digital TV giants like DSTV, Zuku TV and Azam TV are increasingly calling for good-quality local content for their pay TV programming. However, both dealers in pirated movies showed their recognition of the need to be interactively-ready for the win-win entertainment franchising strategy which is indirectly supported by Uganda's current copyright act and regulations in ***Table 2*** above. It was also observed that the 'unauthorized' street vendors are also taking away most of the consumer buyers. Meanwhile, an increasing number of business buyers (retailers) of the pirated movies are starting to download the respective movie on their own besides some of them getting more scared of UFMI's copyright enforcement progress as also reported by Musoke (2014). With time, the complexity approach with its destructive technology models like that of Netflix and the growing diversity (complexity) of public-private partnerships might force an increasing number of pirates to become franchisee (authorized) publishers and distributors of the local movies. The complexity approach in the local movie industry makes the script writers and other movie makers' views to also become increasingly important because of the needed improvement from the storytelling to the locally-produced movie quality (Chen *et al.,* 2013; Tribe, 2011; Goldstein *et al.,* 2010). It is against this value chain angle that the next key informant was also interviewed.

From an interview with Informant 6, a script writer and movie director, it was revealed that allowing the rampant movie piracy to go on 'unchecked' by the country's copyright and technology regulators among others is a lose-lose direction for all stakeholders. For instance, he said, *'It's good that UFMI is making some strategic inroads with UCC and other key government bodies. However, while the local movie pirates are becoming richer and arrogant, we losing our money to them and the producers are unable to pay us well'*. His

concern implied that the copyright enforcement by the Federation (UFMI) is not yet pragmatic enough to curb the rampant movie piracy in Uganda's local movie industry. If an increasing complexity of partnerships in the respective areas and at the various industry levels is not strategically ensured, more local movie makers of various categories will not only become frustrated but they might leave the industry for the pirates (Kacou, 2011; Goldstein *et al.,* 2010). However, a series of observations from the UFMI meetings which were held between June 2012 and August 2014 revealed that the Federation is unconsciously moving towards a more complexity approach in partnership with the Uganda Police and other local authorities. For instance, a keen look at more than 15 photos that have so far appeared in the print and electronic media further shows that an increasing number of movie makers, pirates, regulators and other potential public-private partners is frustrated by the inadequate regulatory enforcement. As earlier revealed by the scholarly works of Kacou (2011), Tribe (2011), Goldstein *et al.,* (2010) and Doherty (2007), the local industry frustrations can instead be changed into a win-win reality where the local movie makers and the other partners will collectively find a medium (an ecosystem) for the industry's entertainment (movie) franchising readiness. In order to understand how the local industry's interactive readiness will be improved through the complexity-driven ecosystem, a representative of the Actors Guild under UFMI was also interviewed and he revealed the next findings.

Informant 7, an established actor according to the Ugandan context was then interviewed about the ways in which the local movie makers are interactively-empowered, why and how the complexity approach is needed. He answered, *'Some embassies like the Royal Dutch Embassy used to sponsor some artists and actors to study film making in Netherlands in partnership with our government but I do not know why they stopped'*. This revealed a key way in which the actors used to be interactively-empowered in terms of capacity building hence efficacy support, although not directly for their industry's needed franchising readiness. It was also noted that the capacity building was yet to be delivered through the needed complexity approach for more sustainable readiness especially among the local movie makers, current pirates and the industry regulators. This is because the scholarships were only single-provided, donor-dictated and unsustainable considering the country's constitutional resistance against the gay rights which are a key issue to some development partners. A more complexity-driven, self-sustaining business approach to improving the movie production quality, distribution and wealth creation competitiveness is supported by scholars like Goldstein *et al.,* (2010) and McMillan (2008). These 2 scholars' case studies have illustrated how such a theoretically-strong and practical approach is also right for the local movie industry's entertainment franchising readiness. They show how the complexity approach brings the industry partners together into an ecosystem of networked resources and energy for sustainable readiness towards the world's emerging business models like online distribution. However, there is still need for further data from another key player in order to construct more valid knowledge for this study's readiness challenge (Saunders *et al.,* 2012; Neuman, 2007).

From this study's last interview with Informant 8, it was revealed that the local movie makers are less interactively-empowered by some local authorities compared to the pirates. He lamented that *'the pirates are supported by some network of top police officers in 'making' more profits and cash that they also use to 'pocket' other local authorities.* This was interpreted as a key source of counter-productive empowerment to the movie pirates in an infant local industry. Fortunately, during one of the Copyright Working Group (CWG) meetings, it was observed that an increasing number of the police officers who are trained by the government to handle Uganda's software/internet-enabled piracy are starting to express more willingness to partner in through a more interactive copyright enforcement approach. The interactive willingness and ability (readiness) of the Copyright Police further strengthens the need for the complexity-driven approach in improving the

respective readiness. This is because according to Kacou (2011), the local movie industry's interactive readiness among most of the movie producers, publishers, distributors, implementing authorities, development partners and the community leaders among others becomes stronger when it increasingly mediated through or moderated by an ecosystem with a diversity of symbiotic partners. From further evidence, a content analysis of the more than 15 meetings respectively attended and over 10 photos examined from the local media revealed more diverse partners who are getting on board. This emerging diversity includes some cabinet ministers, officials from the key embassies, investment advisors, intellectual property lawyers and key journalists among others. Such a growing complexity of interactive partners reveals how the local movie makers' entertainment franchising readiness can and/or will soon be improved through a diversity of public-private partners across the various industry levels and areas of operation. In so doing, as the Copyright Police enforces the copyrights, the tax collectors (URA) will maximize the industry's 'less-tapped' tax contribution while the government creates more meaningful employment opportunities especially in Uganda's mainly youthful entertainment industry. Meanwhile, the local movie makers will be earning more incomes because of the improved interactive-empowerment. More world-class local movies that also promote the country's tourism attractiveness will be made and sold as franchise brands across the respective markets, as long as the local movie makers' readiness continues to improve.

Conclusions and Contribution to Theory

The local movie makers are mainly legally empowered through the country's copyright law framework although it is not yet interactive enough to cause the needed entertainment franchising readiness across the local industry. This is because the enforcement of this key entertainment franchising-related law has not yet practically contributed to the interactive empowerment of the local movie makers' readiness. Its less-collaborative enforcement is favoring the pirates against the copyright owners of the respective movies, most of whom are facing the respective financial fears. With more collaborative enforcement, the industry's financial support in form of the Film Fund and the 70% Local Content required on Uganda's local TV can then contribute to the needed movie franchising readiness for more youth employment. In so doing, those 2 forms of industry support become a sustainable reality when a movie maker is dealing with a complexity of UCC, UFMI and other key players during his/her practice and during the annual Uganda Film Festivals (UFFs). The other emerging forms of interactive/collaborative empowerment include the capacity building support from the respective partners. However, the capacity building needs to be less donor-funded for strengthened sustainability even where the donors withdraw their tax payers' money. The study also revealed some esteem support which is coming from both the recognition during the UCC-organized UFFs and Africa's leading Digital TV content buyers like Zuku TV who are demanding for more quality, locally produced movies. Although the communications commission-UCC is starting to play its generative leadership role in partnership with other regulators and the local Federation (UFMI) through the festivals, favorable local TV content requirements and the still-inactive Film Fund, the complexity approach is not yet fully- practiced by the needed diversity of partners in the local industry's readiness challenge.

The complexity approach is needed because it enables the creation of a more internally and externally collaborative entrepreneurial ecosystem. Its multi-level symbiosis brings together a diversity of public and private partners whose co-evolving synergies sustainably empowers the local movie makers besides forcing the respective movie pirates to increasingly become ready for the entertainment franchising strategy. As a result of the positive deviance which is being caused by the emerging interactions, some leading pirates are

starting to accept that the complexity approach's win-win practices are the 'way forward' for Uganda's infant industry. However, the local producers are yet to interactively-improve the quality of their locally-made movies. This will strongly influence the local publishers, distributors, retailers, vendors and regulators to interactively-empower more local movie makers towards the industry's needed entertainment franchising readiness in the emerging markets. The local movie makers' readiness will be further strengthened by the country's trained and engaged Copyright Police officers who are showing more willingness to implement the respective law in partnership with UCC, UFMI, other industry regulators including the cabinet ministers through the complexity approach. Such a diversity of industry partnerships strengthens the justification for the complexity approach towards the movie makers' readiness. So, the complexity approach is needed to strengthen the readiness efforts among the above current and future partners for the country's sustainable gain from the entertainment (movie) franchising strategy.

It is through the complexity approach's co-existence and co-evolution adaptations that more movie makers and other industry players will easily become more ready to combine efforts in win-win ways that prepare them for world-class strategies like the entertainment (movie) franchising. The interactive approach provides the knowledge construction and national model development resources for the authorized replication strategy to drive the industry towards its key players' readiness at various levels and in the respective areas of empowerment. Some of the major themes that were interpreted as indicators of such an interactive approach include the public-private partnership (PPP) support as one of the independent variables, the entrepreneurial ecosystem and symbiosis as the mediating variables, and expected win-wins as components/constructs under the entertainment franchising readiness which is the dependent variable. The ways of sustainably improving the complexity practice for the needed readiness points towards some policy, research and managerial implications for the following stakeholders.

Managerial Implications

It is now the time for UCC and UFMI as the leading partners in improving the local industry's competitiveness to continue attracting a growing diversity of public-private partners beyond those attracted through the annual film festivals and the Federation meetings. They can do so by engaging the local media to secure some TV/Radio programmes where this study's constructed themes are interactively discussed with a growing diversity of listeners. In so doing, more of the local banks and other financial institutions will also get on board as their respective managers and staff members become engaged through a complexity of such media interactions. By the time the leaders of the local movie makers present their respective franchise proposals to such service providers, a critical mass of willing bankers will be available to welcome them.

The annual film festivals need to also have reforming pirates and Copyright Police officers recognized in order to inspire other non-movie makers to create a stronger ecosystem whose co-evolution empowers the local movie makers' entertainment franchising readiness. Since the current movie piracy-driven financial struggles are mainly enabled by the internet-enabled download software, the respective government regulators with UCC continuing its generative leadership role can initiate an Anti-piracy Software Development Contest where more Netflix-like are to be developed for the local movie industry. Such contests may be implemented through a structure and system that brings together the country's computer science and software-related university students with franchising values like mutual success commitment and complementary resources networking among others. Alternatively can create a Reformed Pirates Guild which it has to popularize

through the leading media platforms and use such willing franchisee-distributors to easily convince more of the many movie pirates out there to join the industry's emerging win-win distribution strategy.

In order to implement the above recommendations, some studies need to be conducted to provide more qualitative and quantitative evidence to empirically support/guide the respective readiness progress. However, this study has mainly been qualitative in nature. So, the constructed themes need to be tested through a quantitative study which tests the relationship between or the contribution of the movie industry ecosystem on the entertainment franchising readiness among the local movie makers. Although such surveys will mainly be cross-sectional, comparative and/or longitudinal studies may also be carried out in Uganda and the exemplar countries. The studies will call for the respective governments to provide the needed research finding for 3-7 years through the likes of UCC in partnership with the respective universities and/or research institutions. To some extent, UCC, UFMI and some local newspapers have made such research contributions which have enabled this exploratory study.

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Influence of Parenting Styles and Self-Concept on Students' Achievement in Mathematics: A Case Study of Kaplamai Divison, Trans Nzoia County, Kenya

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Abstract

Students in Kenya seating for the Kenya Certificate of Secondary Education Examinations (K.C.S.E) have been performing dismally in Mathematics. This trend has raised many questions that catapulted us into this research. This study was designed to respond to the current public outcry as to why mathematics had massive failure at K.C.S.E. We linked the influence of parenting styles and self concept to the massive failure in mathematics. The researchers have employed a casual comparative research design since they were interested in the cause and effect of the poor performance. Quantitative research methodology was adopted where a total of 214 students responded to the questionnaires that had been piloted and their reliability obtained. The data collected was analyzed using means, standard deviations, Pearson product moment correlation coefficient (PPMCC), t-test and one way analysis of variance (ANOVA). It was realized that authoritative and authoritarian parenting styles as well as self concept have significant influences on students' achievement in Mathematics. The researchers argue that all stakeholders in Mathematics education should strive to foster positive self concept of students and make attempts to eradicate stereotyped roles which promote gender disparity in Mathematics achievement.

Key words: K.C.S.E, Comparative research, Quantitative research, PPMCC and ANOVA.

1. Introduction

In recent years, Mathematics has been posting poor results as indicated in the Kenya National Examinations Report (K.N.E.C, 2015) despite being a compulsory subject both at the primary and secondary level of education and being a basic requirement to any of the prestigious courses at the university including Medicine and engineering. The mean score of the results has been exemplified in Table 1 and Figure 1. Mathematics as an expression of the human mind reflects the active will, the contemplative reason and the desire for aesthetic perfection. Its basic elements are logic and intuition, analysis and construction, generality and individuality (Richard and Herbert, 1996). The list of subjects that borrow from mathematics in the Kenyan 8-4-4 educational curriculum has grown to include Physics, Chemistry, Biology, Agriculture and Business Studies. Stakeholders in the education sector in Kenya have been concerned about the poor performance in science subjects and notably mathematics over the years. Students' performance in mathematics and science subjects in examinations administered by the Kenya National Examination Council has remained below expectation. This has been exemplified in the table 1 and figure 1.

Table 1: K.C.S.E mean scores of Mathematics from the year 2000-2014

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
16.61	18.72	13.23	18.25	16.24	17.62	12.24	16.26	18.73	9.40	8.83	9.89	10.01	10.01	8.98

As shown in Table 1, mathematics has posted poor results over the years and hence need to investigate the factors that lead to such a performance. Graphically, we can represent this as;

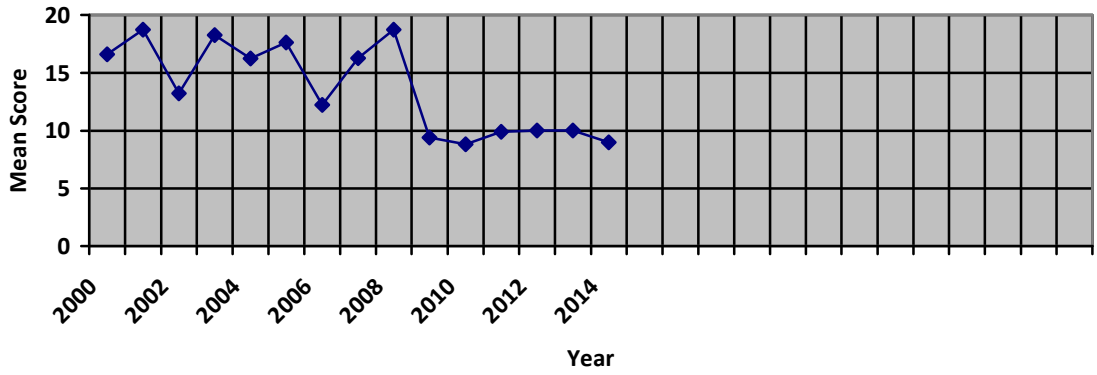

Figure 1: Graphical representation of Mathematics mean scores from 2000-2014.

This situation, (as shown in table 1 and figure 1), does not favour Kenya in its effort toward developing a scientific and technological culture. More often than not, teachers are blamed for the poor performance and even when the blame is directed to a student, explanation is offered only in terms of the students' cognitive and intellectual ability.

Various studies have identified areas of difficulty in the learning of mathematics at various levels (Cramer, Post and delMas, 2002; Kato, Kamii, Ozaki & Nagahiro, 2002; Harries & Suggate, 2006; Harries & Barmbey, 2007). Indeed Brown, Brown, and Bibby (2008) observed that in many countries, many students do not enjoy school mathematics and seek to avoid it later. Mathews and Pepper (2005) note powerful reasons for not continuing with mathematics. This includes lack of enjoyment and a belief that the subject is boring, for both high attaining as well as low attaining students. These studies consider performance in mathematics from the perspective of school factors therefore externalizing it. In this case the role of individual students in mathematics achievement is ignored. Little or no consideration is given to the fact that the student's perception of self in mathematics can affect ones achievement in Mathematics. Little attention too is paid to the fact that parenting could influence ones' performance in the subject. As at now, knowledge of how certain human factors relate to ones achievement in mathematics is not well known. A gap exists in understanding the possible relationship between certain human attributes such as self- concept, parenting and the individuals' evaluation of self -efficacy in the performance of mathematics at the secondary school level. This study makes an attempt to contribute towards filling the existing gap by establish the role of internal processes such as self- concepts (academic and mathematics self-concepts) on students' achievement in mathematics.

Most studies conclude that there is a relationship between self-concept and academic achievement. Maritim (1979) reported that self- concept was a strong predictor of academic achievement and those pupils who thought highly of their abilities significantly out achieved those who had low perception of their abilities. He further points out that on all achievement variables investigated, boys performed better than girls. Maqsud (1983) asserts that it is important for educators in Africa to bear in mind that self -concept is essential in facilitating quality education and teachers can play a great role in this area. Loxley's (1981), findings indicated that 68% of achievement in mathematics is explained by school factors. Schiefelbein and Simmons (1981) found out that out of 13 observations, the social status of parents was a significant predictor of achievement in ten of the observations. Mwangi's study (1983), found two variables to be significantly related to achievement in mathematics; the availability of teaching materials and availability of resources.

Maritim (1979), in Misigo (1998), asserts that pupils personality characteristics help to explain differential performance among children. Therefore, consideration of the pupil's performance cannot be separated from their personality. This study investigated personality of students as manifested in their self concept and its influence on achievement in mathematics. Commenting on child rearing Shiundu, (1990) observes that the challenges of child moulding is a parental responsibility and that failure of parents to inject the right dose of life expectations in a child results in future problems for the child for example, failure of the child to mix well in society. He further points out that though the parents feed, clothe and care for their children, they do little to strengthen their children's character. Lack of strong character according to him makes the child a push over for the forces outside the family. Shiundu focused on the role of the parent as a provider of basic needs for the child's education, survival, security, facilities and guidance. The most recent study done to investigate the reasons for dismal performance in mathematics is one done by Sifuna, Manyali, Sakwa and Mukasia (2016), where they linked poor mathematics performance to methodology applied by teachers. They argued that the approach applied in teaching of mathematics is purely teacher centered which leads to low retention. The researchers advocated for Simulation in which they believe strongly from their results that it may improve the performance in mathematics. There is, however, scanty information on the relationship between parenting and achievement in Mathematics.

The researchers of this paper were therefore of conviction that studying factors determining achievement in mathematics should begin from the learner who is an important player in the learning process, without whom learning is impossible. The learner cannot be exonerated from the blame game whose focus is poor achievement in mathematics. This study therefore attempted to focus mathematics achievement on the learner as opposed to external factors. The learner is not only affected by the environment but he/she positively or negatively affects the environment (Bandura, 1986). In the light of the learner being a central player in academic achievement, this study sought to understand how self- concept of the learners and parenting styles relate to achievement in mathematics among secondary school students. As earlier mentioned, this is a comparative research and researchers were much interested in the cause and the effect of the poor performance in mathematics.

2. Statement of the problem

Mathematics performance in the national examinations has puzzled many scholars and this study has linked the poor performance to the parenting styles and the self-concept in mathematics. Seemingly, there is no known study that has been done to investigate the role

played by parenting neither styles nor the self concept in mathematics. The researchers intended to fill this gap by studying the above variables in relation to mathematics performance. The following null hypotheses were tested at an alpha level of 0.05. $H_0$1: Self –concepts have no significant influence on students' achievement in mathematics. $H_0$2: Parenting styles have no significant influence on students' achievement in mathematics.

3. Objectives of the study

This study was basically based on the following two objectives;

a) To determine the influence of self-concepts on student's achievement in mathematics.
b) To investigate the influence of parenting styles on student's achievement in mathematics.

4. Methodology

A causal-comparative design was adopted. This is because the study was concerned with explaining and predicting the relationship between independent and dependent variables. It specifically investigated the influence of parenting styles and self concept on students' academic achievement in Mathematics. Such issues are best investigated through a causal comparative design; the design enables the researcher to investigate the influence of independent variables on the dependent variable without manipulating the independent variables. The causal comparative design entails examining naturalistically occurring treatments. For the purpose of this study the causal comparative design enabled the researchers to determine the influence of parenting styles and self concept on students' achievement in mathematics.

The method of data collection that was adopted was use of a questionnaire that was piloted and its reliability achieved. The statistical tools used were calculation of means and standard deviations to show how the respondents' scores varied. Pearson product – moment correlation coefficient (r) was used to determine the extent of association between two variables. The t-test for independent samples and one way Analysis of Variance (ANOVA) were used to determine how great the differences between two means were. Significance of r, t and ANOVA were tested at an alpha value of 0.05.

5. The Sample population

The target population consisted of 5,671 secondary school students in Kaplamai Division from 20 secondary schools. The sample was drawn from 11 schools, 3 same sex and 8 co-educational schools selected from the 20 schools. The sample consisted of 214 participants where the schools were selected using stratified sampling while the participants were selected randomly selected. A big sample was chosen for accuracy as stipulated by Sifuna *et al.* (2016).

6. Instrumentation

The study made use of students' KCSE examination results and questionnaires.

6.1 Examinations

Previous scores of students were used in this study, the examinations they sat were reliable. We verified reliability of the examination by using Kurder-Richardson 21 formula.

$$KR21 = \left[\frac{n}{n-1}\right] \times \left[1 - \frac{M \times (n-M)}{n \times Variance}\right]$$

Our calculated KR21 was found to be greater than 0.7 as stipulated by Frekel *et al.,* (2011)

6.2 Questionnaires

We equally prepared questionnaires of which we obtained the reliability by Cronbach's alpha as since it is superior to Kurder –Richardson 20 formula. This is because it can be used with continuous and non dichotomous data. Cronbach's alpha can again be used for testing with partial credit and for questionnaires using a Likert scale. We found out that,

Given variables $x_1, \ldots, x_k$ and that our $x_0 = \sum_j^k x_k$, then Cronbach's alpha is defined by

$\frac{k}{k-1}\left(\frac{\sum_{i \neq j}^{k} \operatorname{cov}(x_i, x_j)}{\operatorname{var}(x_0)}\right) = \frac{k}{k-1}\left(1 - \frac{\sum_{j=1}^{k} \operatorname{var}(x_j)}{\operatorname{var}(x_0)}\right)$ in this case, we let our $x_j = t_j + e_j$ where tj and ej are independent of each other. We also let $x_0 = \sum_{j=1}^{k} x_j$ and $t_0 = \sum_{j=1}^{k} t_j$ then one can easily calculate the reliability of $x_0 \geq \alpha$ where α is cronbach's alpha. We calculated our α and it was higher than 0.7 which is the standard set α value.

7. Results and discussion

This study obtained information from a total of 214 respondents and thus the following sections present the research results and subsequent discussions.

7.1 Demographic Information of Respondents

The demographic information of the respondents obtained provided parameters that supported the study. The sample was drawn from 11 schools, 3 same sex and 8 co-educational schools selected from 20 schools in Kaplamai Division. In each school, only Form 3 students participated in the study. The sample consisted of 214 participants consisting of boys and girls selected from 850 Form 3 students. As already mentioned, the schools were selected using stratified sampling while the participants were selected randomly. Each school provided 20 participants whose selection reflected the proportion of girl and boys in each class. Table 2 shows the population sample and school categories.

Table 2: Number and Percentage of Study Sample by Categories

School category	No. of schools Sampled	Sampled %	No. of schools in Division	No. of students sampled
Single sex (Girls)	2	100	2	34
Single Sex (Boys)	1	100	1	34
Mixed	8	47	17	146
Total	**11**	**55**	**20**	**214**

Each school provided participants who responded to the students' self concept questionnaire SSCQ and the parenting styles rating scale SPSR. In the selection of participants, consideration was given to the proportion of girls and boys in the population, there were more girls (112) than boys (102) in the population. Representations in the sample reflect the proportion of each gender in the population.

7.2 Students' Academic Self Concept and Achievement in Mathematics

The first objective of this study was to investigate the influence of self- concept on students' achievement in mathematics. Two types of self-concepts were investigated; academic self- concept and mathematics self-concept. To achieve this objective, self- concept of respondents was computed from responses to a 27 item questionnaire on self- concept. The respondents were then classified into those with positive and negative self concepts. The respondents' mathematics achievements were obtained from computing a mean mark for a year using recorded marks in the teachers' mark books. Means, Pearson correlation coefficient (r) and t-test were used to determine the significance of relationships between variables and to test the hypothesis.

Out of the 214 respondents who participated in the study, 42% had positive academic self-concept, 48.6% had a negative academic self-concept while 9% were neutral. The respondents with positive academic self-concept posited a mean mathematics score of 50.3 while those with negative academic self-concept had a mean of 35.8. Those with a neutral academic self-concept had a mean score of 39.5. Table 4.1 shows means and standard deviations of mathematics achievement versus academic self- concept of respondents.

Table 3: Means and Standard Deviations of Mathematics Achievement among Respondents

	Mathematics Achievement			
Academic self concept	**N**	**M**	**S.D**	**%**
Positive	90	50.3	6.7	42.1
Neutral	20	39.5	5.5	9.3
Negative	104	35.8	5.34	48.6
Total	**214**			**100**

The results in the table show that mathematics mean score of students with positive academic self-concepts is higher than that of students with negative academic self- concept.

7.3 Students' Mathematics Self Concept and Achievement in Mathematics

Data analysis showed that 38.3% of respondents had positive mathematics self- concept, with a mean mathematics mark of 33.24, Respondents with negative mathematics self-concept were 44.9% and 16.8% had neutral mathematics self- concept. Table 4.2 shows achievement in mathematics for respondents with positive and negative mathematics self concepts.

Table 4: Comparison of Mathematics Self-Concept with Achievement in Mathematics

	Mathematics Achievement			
Academic self concept	**N**	**M**	**S.D**	**%**
Positive	82	33.24	6.27	38.3
Neutral	36	22.3	5.3	16.8
Negative	96	21.56	5.17	44.9
Total	**214**			**100**

The results on the table shows that mathematics mean scores for students with positive mathematics self- concepts is higher than that of students with negative mathematics self-concepts. Figure 2 provides a summary of relationships between academic self- concept, mathematics self – concept and achievement in mathematics.

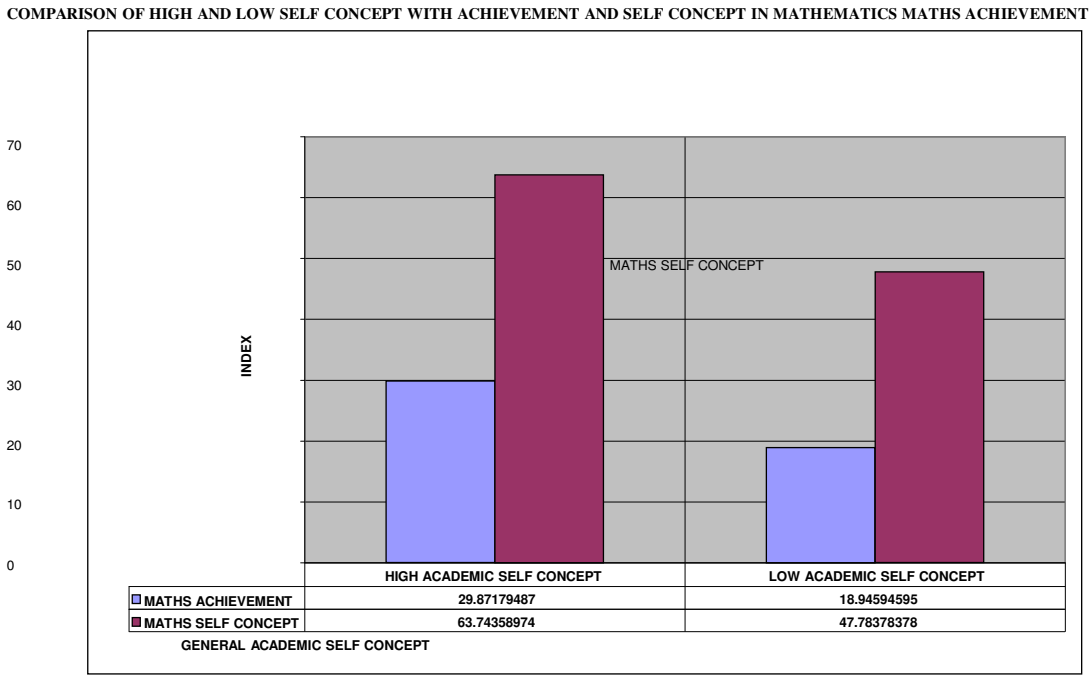

Figure 2: Relationship between Students' Mathematics Self-Concept and Mathematics Achievement

To find out whether there was significant differences in mathematics mean scores of students with positive self-concept and negative self-concept, the following hypothesis was tested at an alpha level of .05. HO_1: Self – concepts have no significant influence on students' achievement

in mathematics. The Pearson correlation coefficient (r) was computed to determine relationship between variables. While t-test was used to determine the difference in mathematics mean scores for students with negative and positive self- concepts. Academic self – concept verses achievement in mathematics yielded ($r = 0.64$, $t=11.54$, $df =192$ $p < 0.05$).

Mathematics self- concept versus achievements in mathematics, ($r = 0.73$, $t =14.80$, $df=192$ $p<.05$); Academic self concept versus mathematics self concept ($r = 0.85$, $t=22.36$, $df =192$ $p<.05$ .In terms of the coefficients of determination (r^2) the relationship between achievement in mathematics versus academic self- concept; mathematics self- concept, yielded $r^2 =0.4096$ and 0.533 respectively. The relationship between academic self- concept versus mathematics self-concept yielded $r^2 =0.723$. These results show that 41% and 53.3% of the student's achievement in mathematics is determined by the student's self-concept and mathematics self-concept respectively. Academic self- concept positively influences mathematics self- concept by 72.3%. Table 4.3 shows the results of data analysis for self-concepts and students achievements in mathematics

7.4 Parenting Styles and Students' Achievement in Mathematics

The second objective of this study was to investigate the influence of parenting styles on students' achievement in mathematics. To achieve this objective, parenting styles for respondents were analyzed from the responses in the questionnaire and their mean mathematics scores were computed. There were 214 participants in the study, 36.9% were under authoritative parents, 30.4% under authoritarian parents, 19.1% under permissive and 13.6% under neglectful parents. These results show that majority of the respondents' mostly experienced authoritative and authoritarian parenting styles. Few respondents experience permissive and neglectful parenting styles.

After analyzing the mean mathematics scores for respondents under various parenting styles, the following mean scores were obtained: authoritative = 24, authoritarian = 22, neglectful = 15 and Permissive = 20. From these findings, it was observed that authoritative and authoritarian parenting styles yielded higher mathematics mean scores: (24 and 22) respectively than those under permissive and neglectful parenting styles (20 and 15) respectively. This suggests that students under authoritative and authoritarian parenting styles are better achievers in mathematics compared to those under permissive and neglectful parenting styles.

To find out whether there was significant differences in mathematics mean scores for students under various parenting styles, the following hypothesis was tested.

HO_2: Parenting styles have no significant influence on students' achievement in mathematics. The t- test was used to determine the difference in mathematics means scores for students. The following t- values were obtained, authoritative parenting versus students' achievements in mathematics $t = 7.51$, $df =77$ at $p \leq 0.05$; authoritarian parenting versus students' achievements in mathematics $t = 5.23$, $df = 63$ at $p \leq 0.5$; neglectful parenting versus students' achievements in mathematics $t = 1.13$, $df = 27$ at $p \leq 0.5$; permissive parenting versus students' achievement in mathematics $t = 1.75$, $df = 39$ at $p \leq 0.5$. Table 4.4 shows parenting styles against students' achievements in mathematics.

Table 4: Comparison of Parenting Styles with Achievements in Mathematics.

Parenting styles	N	t=c.v	df	t=t.v
Authoritative	**79**	**7.51**	**77**	**2.00**
Authoritarian	**65**	**5.23**	**63**	**2.00**
Neglectful	**29**	**1.13**	**27**	**2.00**
Permissive	**41**	**1.75**	**39**	**2.02**

The results from the table show that parenting styles have significant influence on students' achievement in mathematics. From the obtained results, it was concluded that there are significant differences between mathematics mean scores for students under the four parenting styles. On the basis of these findings, authoritative and authoritarian parenting styles have significant influences on student's achievements in mathematics. Consequently the null hypothesis HO_2 was rejected.

For the purpose of determining the relationship between each parenting styles and respondent's achievement in mathematics the Pearson correlation coefficient (r) was computed. The following (r) indices were obtained for the four parenting styles: Authoritative (r = 0.65), authoritarian (r =0.55),neglectful (r = 0.21) and permissive (r= 0.301). In the four cases, the results indicated strong positive relationships between authoritative, authoritarian parenting styles and achievement in mathematics. However neglectful and permissive parenting reported a weak correlation with achievement in mathematics.

Authoritative parenting style yielded a strong positive correlation coefficient (r=0.65) with achievement in mathematics. The coefficient of determination (r^2) for the relationship between parenting styles versus student's achievement in mathematics yielded values as follows: authoritative =0.423, authoritarian = 0.3025, neglectful = 0.0454 and permissive =0.0906. This result shows that 42.3% and 30.3% of the student's achievement in mathematics is influenced by authoritative and authoritarian parenting styles respectively.
On the contrary, only 4.54% and 9.06% of the student's achievement in mathematics may be attributed to neglectful and permissive parenting styles respectively which were not significant.

8. Conclusion

The following conclusions were made based on the research findings.

1. Parenting styles influenced students' performance in mathematics. Respondents under authoritative and authoritarian parenting styles had higher positive correlations with achievement in mathematics. (r = 0.65 and 0.55) respectively. That the influence of neglectful and permissive parenting styles was not significant.
2. Students' self-concepts (academic and mathematics self-concepts) have significant influence their achievement in mathematics. Those with positive self-concepts performed better in mathematics than those with negative self-concepts.
3. Parenting styles significantly influenced students' self-concept; authoritative and authoritarian parenting styles had a strong positive influence on the respondents' self-concepts. The influence of neglectful and permissive parenting styles was negative.

9. Recommendations

This study makes the following recommendations based on the findings and conclusions;

- There is need for both parents and teachers to be good role models and to communicate positively in order to provide the children with positive feedback on their mathematics achievement and other social skills. This is essential for improving their self-concept and achievement in mathematics. Parents should employ mainly authoritative and authoritarian parenting styles in caring for their children because they have a positive influence on students' self-concept and mathematics achievement. On the contrary, permissive and neglectful parenting styles have a negative influence on students' achievement in mathematics and on students' self-concepts.
- Parents and teachers should either minimize or avoid giving negative feedback which generates and perpetuates negative self-concepts among students.
- Teachers should make a deliberate effort to care for students so that they meet their cognitive, emotional and psychological needs. This may translate into higher academic achievement or better achievement in mathematics.
- Parents should be cautious in their duty of parenting by avoiding permissive and neglectful parenting styles if they wish to see their children meet academic challenges. Instead, they should adopt authoritative and authoritarian parenting styles, which are associated with the development of instrumental competency in students.
- Individual students should reduce or avoid negative self evaluation which consequently undermines their achievement in mathematics. There is a positive relationship between all measures of self perception and academic achievement (Jones & Grieneeks, 1970). Students should emulate good role models within their environment and beyond and shun bad models.

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Antimicrobial Properties of Endodontic Biomaterial with Chlorhexidine

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Abstract

Introduction: *In recent years,a new endodontic cement (Calcium Enriched Mixture or CEM) has been introduced, with clinical applications similar to those of MTA. It has been shown that CEM has antibacterial activity better than that of MTA. On the other hand, use of chlorhexidine to promote the antibacterial activity of different dental materials is increasing. The aim of the present study was to evaluate the effect of adding CHX toCEM on its antibacterial activity.*

Materials and methods: *The antibacterial activities of the materials under study [(CEM cement+CEM solution+2%CHX) and (CEM cement+CEM solution)] against P.aeroginosa, E.faecalis, S. aureus and E. coli were evaluated using agar diffusion technique, followed by determination of the diameter of microbial zone of inhibition around the materials by 3 independent observers after 72 hours. Data were analyzed by Mann-Whitney U test. Statistical significance was defined at P<0.05.*

Results: *The mean diameters of zones of inhibition in the CEM+CEM solution and CEM+CEM solution+CHX groups against P.aeroginosa, E.faecalis, S.aureus and E. coli were (13.2 and 9), (21.10 and6), (20.2 and9) and (17 and9.75) millimeters, respectively, with larger diameters in the CEM+CEM solution+CHX group compared to CEM+CEM solution group with all the microorganisms (P<0.05).*

Conclusion: *Incorporationof CHX into CEM resulted in an increase in antimicrobial activity of CEM.*

Key words: CEM cement, chlorhexidine, antibacterial.

1. Introduction

Mechanical pulp exposure and exposures due to caries in teeth with immature apices, without the symptoms and signs of irreversible pulpitis, should be sealed in order to preserve pulp vitality and prevent pathologic changes in periradicular tissues(Reyhani et al., 2015b). In addition, communication pathways between the root canal and the periodontium, including perforations, should be sealed with restorative materials to prevent bacterial leakage(Reyhani et al., 2015a). Since these materials are at close contact with vital tissues they should be biocompatible and induce regeneration of the affected tissues and restore the conditions before their involvement. CEM cement is a new dental material with applications similar to those of MTA. The main ingredients of MTA are calcium oxide, sulfur tricalcium, phosphate oxide, silicon oxide, aluminum oxide, sodium oxide, manganese oxide and chlorine, which are mixed with a water-based liquid to yield bioactive calcium and phosphate(Asgary et al., 2008b). The results of a recent studyshowed that CEM cement releases calcium and phosphate ions. CEM cement has a pH value similar to that of MTA; however, it has higher fluidity compared to MTA with shorter working time and less film thickness(Shahi et al., 2015). A study by Asgary et al showed that CEM has antimicrobial activity against pathogens, similar to that of calcium hydroxide and better than that of MTA. Antifungal effects of MTA and CEM against *Candidaalbicans* have been compared and it has been shown that both materials completely destroy the fungus in 24 hours(Asgary and Kamrani, 2008, Ayhan et al., 1999, Hasan Zarrabi et al., 2009).

Chlorhexidine has been initially introduced as an irrigation solution due to its broad-spectrum antibacterial activity. Studies have shown that CHX is effective against bacterial species that are isolated from the infected root canals; these microorganisms include *S.aureus*,*E. faecalis*, *S. salivarius*, *E.coli* and *C. albicans*(Barrios et al., 2013, Gomes et al., 2003, Hernandez et al., 2005). Use of CHX to promote the antimicrobial properties of dental materials with the aim of improving prognosis is increasing. Studies have shown that adding 0.12%

CHX to MTA increases its antibacterial activity (Hernandez et al., 2005). A study by Bidar et al, using direct contact technique, showed that incorporation of CHX into CEM resulted in an increase in its antimicrobial activity; however, the effects of adding different concentrations of CHX to CEM were not significantly different from each other (Bidar et al., 2015).

The aim of the present study was to evaluate the antimicrobial activity of CEM on *P. aeroginosa*, *E.faecalis*, *S.aureus* and *E. coli* using agar diffusion technique.

2. Materials and Methods

The antimicrobial activities of the materials under study were evaluated against *P.aeroginosa*, *E. faecalis*, *S. aureus* and *E. coli* using the agar diffusion technique. Standard microbial strains were provided by the Department of Microbiology, Faculty of Medicine, Tabriz University of Medical Sciences. All the bacterial strains were grown in Mueller-Hinton Broth (MHB) for 24 hours at 37°C. Then a suspension was prepared from each bacterial strain at a concentration of 1.5×10^8 CFU/mL (turbidity equal to McFarland's 0.5 standard solution). Each suspension was used to culture bacterial species on MHA using a sterile swab. The materials under study were placed on the basal layer in each plate in a well. The plates were incubated at 37°C for 24 hours. A total of 8 plates were used for each bacterial strain, i.e. on the whole 34 plates were used, which were randomly divided into 4 groups and two plates were used as positive and negative controls, containing solutions with and without microorganisms, respectively. Evaluations were carried out in sterile MHA culture media measuring 4 mm in depth in plates measuring 2×10 cm. A sterile punch was used to produce two identical holes measuring 4 mm in diameter at least 3 mm apart from each other in the basal layer of each plate. Each hole was filled separately with the materials under study, which consisted of the following: a mixture of 1 g of CEM cement powder +0.36 mL of CEM cement solution, and a mixture of 1 g of CEM cement powder +0.18 mL of CEM cement solution + 0.18 mL of 2% CHX (Conseppsis, Ultradent Products, South Jordan, Utah, USA). Finally, the diameter of zone of inhibition around each test material was measured using a ruler accurate to 0.5 mm, after 72 hours.

3. Results

With all the microorganisms under study the mean diameters of zones of inhibition in the CEM+CHX group were significantly greater than those in the CEM group ($P<0.05$). Table 1 shows the mean diameters of zones of inhibition in the study groups.

Table 1. The mean diameters of zones of inhibition in the study groups

Bacterial species	Mean diameter of zones of inhibition	
	CEM+CHX	CEM
E. Faecalis	21.10	6
P. aeroginosa	13.20	9
S. aureus	20.20	9
E. coli	17	9.75

4. Discussion

In the present study, the antibacterial activity of CEM mixed with chlorhexidine was evaluated against *P. aeroginosa*, *E. faecalis*. *S.aureus* and *E.coli*. The results showed the positive effect of adding CHX to CEM on its antimicrobial activity.

Treatment of teeth with immature apices and repair of perforations are two important procedures in the field of endodontics and MTA is the most commonly used material to this end(Asgary et al., 2008a). CEM was introduced by Asgari et al in recent years. The main constituents of CEM are calcium oxide, sulfur tricalcium, calcium phosphate, calcium carbonate, calcium silicate, calcium hydroxide and calcium chloride. CEM has dental applications similar to those of MTA (Asgary et al., 2008b). Studies comparing these two materials have shown that they have comparable sealing ability; however, the antibacterial activity of CEM is higher than that of MTA (Hasan Zarrabi et al., 2009). Since microorganisms are the main factors involved in the failure of endodontictreatment, the antimicrobial activity of materials used in endodontic treatment has always been of great significance. The bacterial species included in the present study are real endodontic pathogens, which are related to cases resistant to treatment (Shakouie et al., 2014). Although aerobic bacteria or the related microorganisms do not have a great role in initiating primary infections, they are found with a high frequency in root canal treatment failure cases. These bacteria can enter the root canal system before treatment, during treatment and after treatment to cause secondary infection(Kayaoglu et al., 2005). In the present study, agar diffusion technique was used, which is the most commonly used method to evaluate antibacterial activity and has been used by many researchers in a large number of studies. The results of the present study showed that adding 2% CHX to CEM solution results in a significant increase in its antibacterial activity, consistent with the results of astudy carried out by Bidar et al, in which direct contact method and bacterial species other than those used in the present study were used (Bidar et al., 2015). The antibacterial

effect of CHX against all the microorganisms in the present study has already been shown. Studies have shown that CHX is effective against bacterial species found in infected root canals, including *S. aureus*, *E. faecalis*, *S. salivarius*, *E. coli* and *C. albicans*(Gomes et al., 2003, Holt et al., 2007, Stowe et al., 2004). Use of CHX is on the rise to increase the antibacterial activity of dental materials to improve prognosis.

CHX is a synthetic cationic bis-guanide, which consists of 2 similar circles of 4-chlorophenyl and two bi-guanide groups, whichare connected to each other with a central chain of hexa-methylene (Stowe et al., 2004). CHX is a lipophilic and hydrophobic positively-charged molecule, which reacts with bacterial cell membrane phospholipids and lipopolysaccharides and enters the cell through a number of active and passive transport mechanisms. Its action is attributed to the reaction of its positive charge with the negative charge of phosphate groups on the cell membrane (Gomes et al., 2003). Therefore, the osmotic balance of the cell is disrupted, increasing cellular permeability and allowing CHX to enter the bacterial cell. CHX is a base and is stable like a salt. The most commonly used oral form of CHX is its gluconate form, which is soluble in water and at physiologic pH releases positively charged CHX. At low concentration of 0.2%, low-molecular-weight components such as potassium and phosphorus exit the cell. On the other hand, at concentrations higher than 2%, CHX results in cell death. Of course it should be kept in mind that adding CHX to WMTA results in cell death and decreases its compressive strength (Holt et al., 2007). In addition, a mixture of MTA and CHX gel did not set for theleast 7 days. On the other hand, the solution and gel forms of CHX exert different effects on the setting time of MTA. Kogan et al mixed MTA powder with CHX gel in order to evaluate the compressive strength of this mixture; however, since the mixture did not set up to 7 days after mixing, it was not possible to measure its compressive strength (Kogan et al., 2006). Therefore, it is suggested that further studies be carried out on CEM to evaluate the effect of adding CHX on its physical properties, such as compressive strength and sealing ability.

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EFFECTS OF FIRE ON GRAZING RESOURCES IN THE SAVANNAH GRASSLANDS ECOSYSTEM IN NAIROBI NATIONAL PARK, KENYA

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ABSTRACT

A study of the effects of burning on grazing resources was conducted from July, the savannah grasslands ecosystem of Nairobi National Park. The aims and scope of this study were to examine how controlled experimental burning affected the grazing resources in the park.However,the specific objectives were to : determine how presence and intensity of fire affected the standing crop in the park.,find out how the fire control measures had influenced grazing recourses in this Park and formulate a controlled burning program for this park based on the findings of the study.Results from all the study sites on standing crop reflected a very high proportion of dead grass in unburnt plots even during the middle of the rainy seasons.The plant nutrient analysis showed that new growth of grasses in the burned plots had a higher nitrogen content and were thus likely to be favoured by herbivores. This is because the palatability and digestibility of the living grass declined with age. Hence it was possible that burning reduced the amount of unpalatable, less nutritious materials. The speed of the backfires varied inversely with the wind velocity. The speed of fire was lowest where the opposing wind velocity was highest this resulted in hot burn and higher consumption of the grazing recourses. The largest amounts of ash were formed where the vegetation standing crop was highest before burning in the experimental plots.The results obtained indicate that a rotational burning scheme can be recommended. Such a programme would initially be experimental and its effects carefully monitored. The frequency and the time of prescribed burning would depend on the amount of accumulated grass, which in turn is dependent on precipitation and grazing pressure in this Park.

Key words: Grazing resources, Standing crop, burnt, unburnt, herbivores, experimental plots, fire.

1. O Introduction

1.1 Background of the study

An important feature of Nairobi National Park is that during the wet season the wildebeest and zebras migrate to south of the park into the former Kitengela Conservation Unit and the adjoining wet season dispersal areas. It had been observed that in these areas the grass is short and remains so during the wet season. It was assumed that this occurred due frequent burning of the grasslands by the pastoral communities living to the southern areas of the park. The presence of short grass during the wet season in this area was also probably contributed by the grazing pressure caused by livestock owned by Maasai people in the south of the Park. The new grass that sprouted in the Kitengela area soon after the rains may hold the wildebeest and zebra populations and only drought forces them back into the Park during the dry season (Foster and Coe, 1968; Foster and Kearney,1967). At the time of this study the standing crop of grasses had increased, with a high proportion of dead materials. This was because of the absence of a burning or mowing policy and no intensive drought had been experienced in the Park since 1976. Therefore, the herbivore population within the Park boundaries was very low during the wet seasons in 1977 and 1978 because most of the large herbivores had migrated to the Kitengela area to the South.

Studies elsewhere have shown that animals are attracted to new flush of grass in burnt areas (Pratt, 1967; Van Rensburg, 1971) supposedly due to a combination of factors. Such factors include improved palatability and higher nutrient content of the grass that appear after the rains. Foster and Coe (1968) ,suggested that the migration of the Park herbivores to Kitengela Conservation Unit was due to the fact that grasses there are short and have higher nutritional quality than the fibrous, less nutritious grasses that dominate the Park during the wet season. It was also suggested that improved visibility for predator avoidance attracted the animals in the areas where grass was kept short by burning or grazing pressure. Hence grasses in the South and East of the Park being kept shorter provided better visibility and thus created a greater chance for herbivores to detect and escape from predators (Rudnai ,1975) .

In addition to this , there are also permanent water holes and dams in the park which include Narogomon, Ormanye, Hyena and Karen Primary School dam which were constructed in 1964. Gosling (1975) suggested that the presence of permanent watering places contributed to the concentration of game in this Park especially during the dry season when water resources outside the Park were less reliable .

This problem raised several questions such as could a burning programme in the Park improve grazing resources by improving nutritional quality of grasses and/or provide better visibility for the main herbivores in the Park? Nairobi National Park is a significant tourist attraction and therefore earns a substantial amount of revenue for the country. Thus, could burning provide short grass areas within the Park in which game could concentrate and be more easily watched by tourists? Would burning improve grazing resources such that the animal communities can be contained within the Park boundaries throughout the year or at least for a larger proportion of the year and, therefore,the Park remain a tourist attraction throughout the year? A wildlife management policy that would attempt to keep animals within the Park would most likely also reduce the animals' danger to poaching when they leave the Park boundaries during the dry seasons.

Thus the main objective of this study was to formulate a burning programme based on scientific findings, since no such programme existed for this Park from it time of establishment in 1946. For example after one and a half years (1977-1979) of exceptionally high rainfall the standing crop of dead material was such that

this created a dangerous situation with regard to accidental fires during the dry seasons as was observed in August and September, 1978 during this study. Once such grassfires in the mid dry season had caught good hold especially with the large amount of fuel and a following the wind ; it could be difficult to stop them. It was realized by that no realistic burning policy could be formulated without being based on scientific investigation. The foregoing account therefore was an effort to throw light on the need and purpose of this study.

1.2 The study area

The area of Nairobi National Park is approximately 115 square kilometres and is situated 7km to the south of the city of Nairobi in the northern wetter areas of the Athi - Kapiti plains(Morgan ,1967). The Park extends 48 km in length with an average width of 6.5 km. The southern and south-eastern boundary of the Park is formed by the Athi River tributary namely, the Mbagathi. The northeastern and northwestern boundaries were fenced in 1963 to prevent the animals from moving into the nearby Mombasa-Nairobi railway and highway , Jomo Kenyatta International Airport and the city industrial area.

The Park topographically presents a gently undulating aspect. The highest elevations are attained in the wooded North-west (1,790m a.s.l.). The land declines towards the Embakasi plains in the eastern and central part of the Park which are 1,648m a,s,l. The land further declines to the Athi River in a number of gorges that open into the basin in the southeastern part of the Park (1,508m a.s.l). The Park is traversed from the north east by a number of perennial rivers of which the Mokoyeti, Ormanye and Sosian are the main ones. It is also drained by numerous seasonal rivers.

The Park is situated in the four seasons area of Kenya (Thompson and Samson, 1967) with the highest rainfall occurring between March and May. The data for 1977 and 1978 were obtained from the Kenya Meteorological Department as recorded from the four weather stations. Those were Warden's Camp situated near the Warden's house in the Park and Cheetah gate. The other stations were located outside the Park but close to the boundaries at Wilson Airport adjacent to the Park's northwestern boundary and Embakasi Station near the former Embakasi Airport. The total annual rainfall during this period 1977 and 1978 varied from 1116.8 mm around Warden's camp in the North to 580.3 mm at the Cheetah gate station in the South East of the Park. In general there are two rainy seasons that influence the Park climate . One occurs in March to May (the long rainy season) and the other October to early December (short rainy season).

At the time of the declaration of a National Park in 1946, the grassland fires most likely still annually swept the Athi-Kapiti plains (Warden Pers. Comm. 1978). No fire breaks that existed to prevent fires started from outside the Park from crossing through the boundaries from the nearby railway line , Mombasa highway and city suburbs .No official policy on grassland burning existed since the time of establishment of the park (Warden, Personal . Comm., 1978). However, in the late nineteen sixties a policy of controlled burning was followed by the warden and his staff. Burning and mowing were also carried out to provide short grass areas on which the game could concentrate and be more easily watched by tourists (Gosling, 1975). Gosling (1975), also reported that hay from the park was sold for financial profit during the period 1963-1968. Burning was also carried out during the dry seasons to control ticks (Warden, Pers Comm. 1978). This practice was stopped and fire breaks were cleared to prevent fires spreading from outside into the Park in 1969.

Although Pratt (1967) and Foster and Kearney (1967) pointed out the advantages of burning in the Park, a no

burning policy was maintained from the early 1970's ,but accidental fires still almost annually occurred in the park. It was feared that a controlled burning policy could reduce grazing resources available to the animals should drought occur as it happened in 1960-1961 and 1973-1974 (Warden, pers. comm.). Because of this *no burn policy* **,**certain grasslands in the Park completely remained protected from fires for four to six year**s.**In August and September 1978 wildfires occurred in the Park and covered a large portion of the grasslands in the plains and the Athi-basin (24.76% of the Park was burnt). The game counting blocks IIIA, IV, VA and VB had their grass completely burnt (fig 1). These fires had originated from outside the Park from nearby adjacent Mombasa-Nairobi highway or railway.The areas covered by these fires are shown on the Fig.1. The effects of the fire were classified after Contrad and Poulton quoted by Daubenmire (1968).

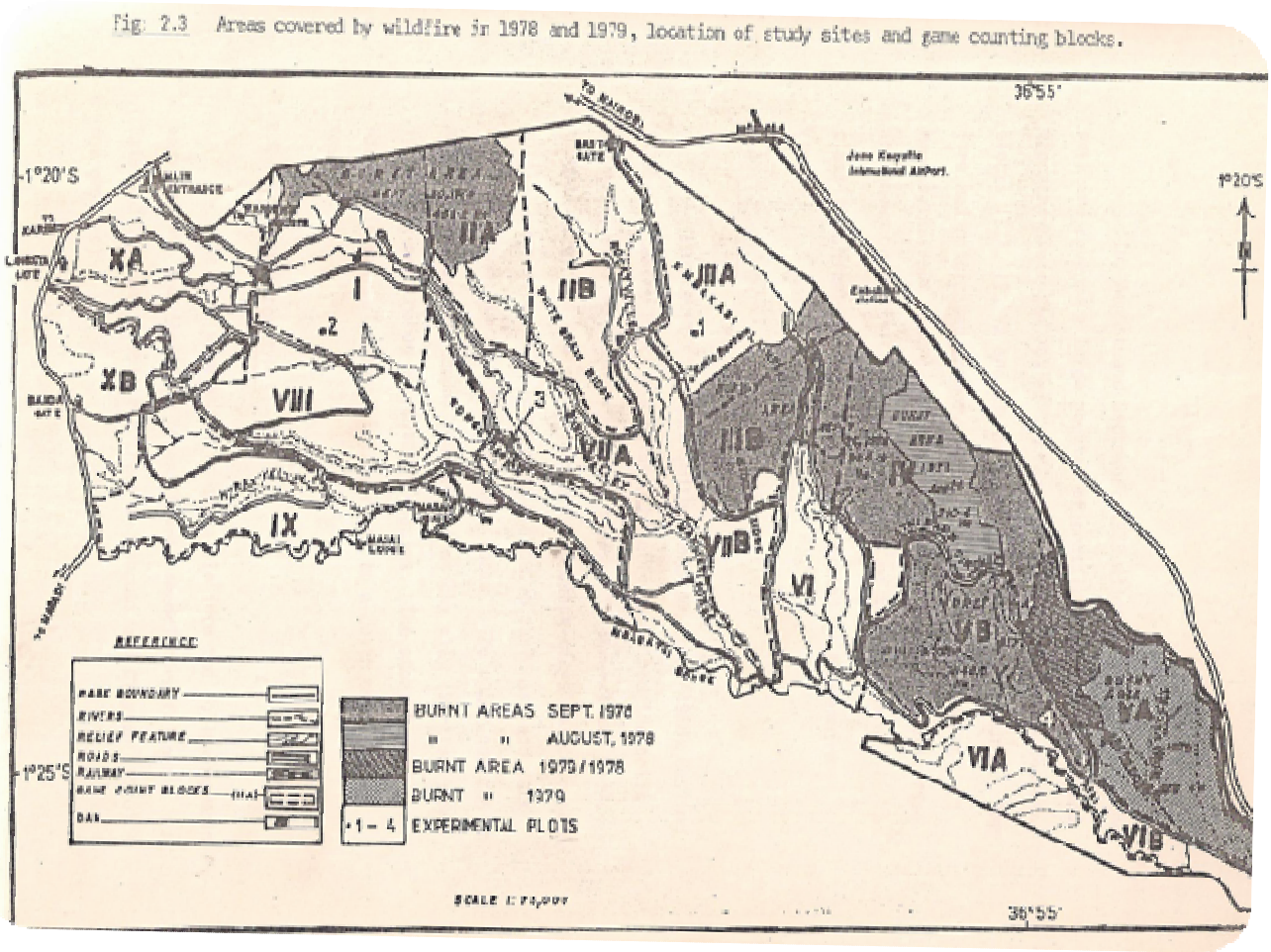

Fig 1: *Park areas covered by wildfires 1978 and 1979,location of study sites game counting blocks are indicated in capital Roman numbers.*

The Park vegetation is divisible into the following main physiognomic and floristic types according to Dale and Greenway (1961) and Goldsmith and Harrison (1967) for trees , shrubs and grasses. These were :**The forest or woodland -** this is in the elevated northwestern region of the Park. It is a part of the once extensive Langata Forest. The dominant species are *Croton megalocarpus***,** *Brachylaena hutchinsii, Calodendron ca-*

pense, *Teclea spp.a*nd *Dryospyros abyssinica*. **Acacia - Themeda grassland:** this covers the plains and forms 40% of the Park vegetation lying on the deep black cotton soils. *Acacia drepanolobium* is locally dense and up to 2.5 m high. The dominant grasses in order of density were *Themeda triandra*, *P. maximun, P. mezianum*, *A. Gayanus, Setarla sphacelata* and *Ischemum afrum*. *Aspilia mosambicensis* bushes are also frequent (Heriz -Smith ,1962). **The Open grassland** :with scattered trees and bushes: this mainly occur in the Athi River basin. It is an open almost treeless plain of gentle slopes carrying a grey-black calcareous clay soil. The dominant grass species in order of density are *Themeda triandra ,Pennisetum mezianum* and *Pennisetum stramineum.*

The monthly ground total animal counts during the period of the study indicated that there were about seventeen large mammalian species in the Park . These included, Burchells zebras, the white bearded wildebeest. Thompson's and Grant's gazelles, buffaloes, warthogs, black rhinos, and hartebeest. Also included in the counts were large birds inhabiting the Park, namely :Ostrich, secretary birds, crested crane and kori bustard. For obvious reasons truly nocturnal animals were not included in the game counts. These include jumping hare, civet, wild-cat and gen.

1.3 Review of the Literature

Although **r**esearch on effects of fire in grasslands had been carried out elsewhere in the world there was lack of information on this subject in East Africa. Much of the research in East Africa was based on either chance observations of wildfires or planned studies conducted under very unpredictable conditions. In Kenya particularly, there was scanty published work on the effects of fire on grazing resources in the savannah grassland ecosystems that existed in this country. Edward (1942) working near Nairobi was perhaps the first to conduct a study on burning and grazing in East Africa. He observed that fire could favour certain desirable grasses and that conversely, grazing often suppressed the certain desirable grasses and also reduced number of ticks, mites and tsetse flies in open burnt sites (Hill, 1971).

Pratt (1967) studying the response of grazers to burnt grasslands in Nairobi National Park and nearby Machakos area noted that zebras, gazelles and Kongoni were attracted to burnt areas.He also observed that there was less dry matter production in burnt areas due to uncontrolled grazing during the critical recovery period rather than due to the direct effect of the fire. Foster and Coe (1968) suggested that the usual seasonal Southern migration of wildebeest in Nairobi National Park could be held back if the quality of grazing resources was improved by controlled burning or mowing.

Bell (1970) in his study of the use of the herb layer by grazing ungulates in Serengeti noted that Thompson's gazelles do occur in the absence of other herbivore species, mainly where the herb layer was kept short by burning or any other human activities, for example grazing by domestic stock. This is because Thompson's gazelles preferred the most nutritious diet of all the ungulates he studied, and such a diet was mainly available in burnt areas.

Several other ecologists have-emphasized the importance of fire as an ecological factor and as a useful management tool in grasslands (Strugnell and Pigott ,1978; Norton -Griffiths ,1979; Byram quoted by Daubenmire ,1968; Glover, 1968; Debano and Contrad, 1978; Afolayan and Fafunsho, 1978; Kilgore, 1978 ; Afolayan and Ajayi, 1980 **;** Moore,1960; Van Rensburg ,1971; Kessel ,1976; Vogl ,1974); Lock and Milburn,1971). Thus, fire is an important ecological factor in maintaining grasslands in their form (Skovlin ,1971 ; Cooper ,1961).Fires may lead to establishment of trees and shrubs and permits vegetation succession

leading to some type of wooded plant community (Edward and Bogdan, 1951; Talbot, 1963; Dimbleby, 1977 and Afolayan, 1978; Peberdy ,1969).

Very little is known and can be said about occurrence of fires in the Athi-Kapiti plains before the advent of written records. It is probable that the pastoral inhabitants of this area occasionally fired the savannah grasslands (Edwards and Bogdan, 1951). For example, the Maasai and Kikuyu peoples may have established themselves in the Athi-Kapiti plains around the sixteenth century (Morgan, 1967). These native tribes probably burnt the vegetation and used fire to improve grazing for their livestock and to facilitate hunting (Owen, 1966; Ojany and Ogendo, 1973). The plains being dominated by savanna grassland were possibly annually burnt by fires started by the hunters .

Accidental and deliberate burning of vegetation also may have occurred frequently in the plains during the dry seasons (Stewart and Zaphiro, 1963; Owen, 1966). This was carried out by Maasai people mainly to provide short green growth for their cattle and sheep, when the palatability and feeding value of unburnt range was low (Glover, 1968; Ojany and Ogendo, 1973).

3.0 Research Methodology

3.1 Selection of Experimental and Control Plots

It was necessary that plots be established upon which controlled experimental burning would be carried out adjacent to unburnt control plots. The plots were established in areas of relatively uniform soils and vegetation. Data were collected in order to establish the similarity of each set of paired plots before the experimental burning.It was postulated that fire might differently affect the grazing resources in the major vegetation types. Hence the plots were located in the two main vegetation types of A**cacia -Themed**a grassland and **open grassland with scattered tree**s. There were no plots established in the forest or woodland vegetation type as it was considered to be of less important in this study since it contained negligible numbers of large herbivores.

These sets of paired plots (each 50x50M) were located in **Acacia - Themeda** grassland (Figure 1). Site 1 was established on an almost level flat plain about 2 km from the East gate by road, near the Radio Beacon. The area was domonated by grasses species such as *Themeda triandra,Setaria sphacelata, Pennisetum mezianum* and *Andropogon gayanus*) with scattered *Acacia drepanolobium* bushes. Site 2 had a pair of plots situated about 3 km by road from Langata gate. It was on the southern side of the Mokoyeti Channel and to the south of Narogomon Dam; The vegetation was similar to that of site 1, except that there were more grass species than those on site 1 . Additional species were *Digitaria nodosa*, *Panicum maximum*, *Aristida adoensis* and *Eragrostls heteromera*. Site 3 was located near sign post 18 on Songora Ridge. The vegetation of this site has been described by Stanley-Price (1974) as bushed grassland and differed in terms of edaphic factors from sites 1 and 2 although included in the plains Acacia - Themeda grassland. The final study site (site 4) was located in the Athi River basin (Fig. 1).

The four sets of paired plots which were situated in the main grasslands of this Park were treated as follows: One plot in each set was to be burnt and the other was left unburnt to provide a control experiment . The plots were coded for ease of subsequent reference. All plots that were to be burnt were coded with the letter "B" thus IB, 2B, 3B or 4B. The digit indicated the location (Site) of the plot while the letter "B" denoted the burnt (treatment)"member" of the burnt set. The other plots which were the control that is unburnt were referred as

"U" plots thus 1U, 2U, 3U or 4U.The sites of study also corresponded with the major game counting blocks (Figure 1). Locations of the plots in each study site or block was done through a simple random selection . This was done after identification of the major soil/vegetation types to be studied . On arrival at such sites a compass direction was chosen. This was done by writing the eight compass direction on eight cards and a single direction was randomly drawn from the hat. Then an assistant who knew least about the vegetation was asked to walk for a hundred meters in the chosen direction, the course of this direction being maintained by use of a prismatic compass. The hundredth meter point was used to mark off one corner of the first plot, the rest being fitted by use of 90° bearing of the compass. The second plot was located adjacently separated by 10 m fire break and parallel to the first one. Each plot was enclosed by a 10 m wide graded fire break.

3.2 Determination of Standing Crop and Chemical Composition of Grass

A determination of the status of standing crop was carried out in each set of plots before experimentation. The number of samples was maintained at ten per plot. The point quadrats a non-destructive method of vegetation analysis by Goldsmith and Harrison (1967) was applied . The quadrats were distributed throughout the study plots by simple random walk technique (Goldsmith and Harrison, 1967 ; Chapman ,1976,). This method involved walking on compass bearing (randomly chosen) for a random number of paces. Random numbers (1-10) from Fisher and Yates (1963) were used for determining the number of paces to be made before sampling and changing direction.

Standing crop ,that is , the weight of all the grass material at any given moment per unit space, (Petrusewicz; and MacFadyen, 1970) of the vegetation was measured by harvesting before the grass in the plots was burnt, two months after burning when significant amount of dead grass was noticed in the burnt plots and at one month intervals thereafter. Monthly harvests were started on 21August ,1978 and continued until May 1979. On each sampling time ten samples (ten quadrats 0.25m) were selected as above from each plot (burnt and unburnt) at each study site. All living and dead material was randomly collected from each quadrat by hand clipping as close as possible to the soil surface. The harvested material was taken to the laboratory in sealed polythene bags and stored at 5°C prior to sorting. The vegetation from each quadrat was separated into living green and dead categories. That is, dead grass included dried leaves and stems, while living grass consisted of green leaves (containing chlorophyll) and living stems. Living and dead grass were not sorted into species because the dried leaves and stems had lost many of the identifying features. After sorting, the material was oven dried at 80°C to constant weight.

The general physical appearance of grass in experimental sites was observed during the study period. This investigation was a subjective one, since it involved assessment and categorization of the physical condition of grass during the growing season, at each sampling time and during the monthly game counts. This was done by visual estimation of the height and the physical condition of the grass. Descriptive terms were used such as "long dried" seemingly dry grass approximately 70 cm tall, short dried relatively dry grass but less, than 10cm tall, burnt black grass recently burnt with only charred tussocks left and lush green sprouting green grass. It was hoped that such information would offer an explanation as to why certain animal species were found in particular game count blocks at different periods of the year.

The nutrient status of the grass before and after burning was analyzed. The grass material samples were collected from both plots in all the study sites during the following periods:Before the experimental burning, this was during mid October, late in the "long dry season", Two months after burning that is in December 1978 - during the middle of the "short rainy season", **and** six months after burning, during May 1979, a. time corres-

ponding to the middle of the long rainy season .The dried samples of dead and living stems and leaves were cut into small pieces measuring approximately 2-3 cm in length. This was followed by mixing of the ten samples of each category obtained from the field at any one time. Triplicated samples were drawn from the mixture and used as representative samples for nutrient analysis, for each category of plot before sending them to the Kenya Agricultural Research Institute Laboratories, Nairobi for nutrient and chemical analysis.. The methods indicated in table 1 were used for analyzing the macro-nutrients concentrations in each sample.

Table 1: Methods used in the Analysis of macronutrients contained in the samples

NUTRIENT	NUMBER 'OF 'SAMPLES	ANALYTIC METHOD USED
Nitrogen	3	Microkjeldal
Phosphorus	3	Colourimetric
Potassium	3	Atomic absorption
Magnesium	3	Atomic absorption
Calcium	3	Atomic absorption

3.3 **Burning Procedure**

Daubenmire (1968) classified fire into two main types: headfires, those spreading with the wind, and backfires, those spreading against the wind. Headfires cause less damage than backfires because the maximum temperature along the vertical fire profile is well elevated above the ground where seeds and perennating buds are located. Other factors being equal, backfires are more damaging because maximum temperatures are nearer the ground than in head-fires (Daubenmire, 1968). In addition, the backfire is characteristically slower and hotter than head-fires, if wind and fuel conditions remain the same (Daubenmire 1968). However, backfire is easier to control than head-fire. Contrad and Poulton quoted by Daubenmire (1968) classified burning intensity with respect to the effect of fire on grasses. This classification was used in the study to determine the fire intensity.

The rate of fire spread varies approximately with the square of wind velocity (Daubenmire, 1968), the speed of the wind and its direction were measured using a hand held anemometer. This was held 15 cm above the ground surface. The direction and speed of the wind were noted for every five minutes for thirty minutes before the grass was set on fire in each plot . The average speed and direction of the wind were used to represent speed and direction of the wind during the burning period. The direction the wind blew was also compared with a hand-held light nylon piece of cloth (20 x 20 cm). This was held by one corner at 1.5 m above the ground surface and the direction indicated by the "tail" was checked against that of a prismatic compass.

The measurements of the wind direction was to make it possible for the categorization of fire, whether backfire or head-fire. The knowledge of the wind speed enabled the researcher to predict the speed of the head-fire or backfire (Daubenmire, 1968). Thus acknowledgement of these two factors was important for any fire management precaution that was to be taken.

3.4 Determination of Moisture content in the grass

The amount of moisture in grass material was measured before the controlled burning experiment. Ten grass samples were collected using simple random method from each plot before burning. Each sample was placed in a polytene bag which was immediately sealed and weighed using a spring balance, to determine their field weight. These samples were later placed in paper bags, transferred to the laboratory and dried to constant weights in the oven at 105°C. The water content in both soil and grass samples was calculated by subtracting the oven dry weight from field (wet) weight. The average differences for ten samples (soil and grass) was expressed as a percentage of the average dry weight of the grass.

4.0 Results and Data analysis

4.1 Moisture Content of the Grass before Burning

The intensity of all backfires was class 1 according to Daubenmire (1968). The speed of these fires varied inversely with the velocity of the wind. The grass moisture in this experiment did not affect the fire intensity or speed of the fire-line progression. Fire intensity was high even where the grass moisture content was relatively high (36.17%) as in plot 3B. All the grass fuel was consumed in all the study plots.

4.2 Standing Crop and Nutrient Content of Grass in Control and Experimental Plots

The results of the harvest measurements are summarized in tables 2 to 5 and standard errors are given for each measurable amount in all the four study sites .There was no significant difference t - test, $p > 0.05$ in total standing crop dry weight in each set of control and experimental plots before the experiment in August, 1978. However, the total standing crop differed greatly at least $p < 0.05$ and often $P < 0.001$ in the two sets of plots in all the study sites during the months that followed the experimental burning. At all times of the study the quantity of dead grass exceeded the amount of living in unburnt plots . There was also more living grass than dead in the burnt plots during the early part of growing season. This picture changed towards the middle of the growing season (March and April) and the amount of dead grass began to exceed that of living grass.

Measurements of nutrients Nitrogen,Phosphorus and Potassium (NPK) contained in live grass in each plot before and after burning are illustrated in table 6 and 7 and percent crude protein in living and dead grass in burnt and unburnt plots is shown in Table 8 . In general there was an increase in grass nutrient during November 1978 in all the plots. However, except in very few cases e.g. phosphorus and nitrogen in plot 2,the nutrient level was higher in burnt than in unburnt plots in December i.e. two months after the experiment

The quantity of live grass was similar in burnt and unburnt (tending to be slightly more in unburnt), but the proportion of total standing crop that is live was greater in burnt than in unburnt. The quantity of nutrients in terms of live grass (kg ha^{-1}) was greater in burnt than unburnt that is grass in burnt plots had a higher concentration of nutrients. However, a certain amount of caution is needed in interpreting the data on changes in plant standing crop and nutrient content of grasses. This is because although the four study sites were representative of the Park grasslands, they were dominated by somewhat different combinations of grass species. The study sites were also separated by distances ranging from 8 km to 15 km (Fig. 2.3). Thus, they received slightly different amounts of rainfall . It is also noted that the quantities of dry matter harvested during the study period for each treatment at four study sites were different. The variations in weight of the total grass standing crop (live and dead) in different plots were significant. These differences in weight of grass do not relate to the rainfall gradient across the Park. Ideally, there should be more than one set of study plots in each type of

grassland. Measurements should also continue over several years with different burning regimes.

5.0 DISCUSSION

Data from all of the study sites on standing grass crop reflect a very high proportion of dead grass present in unburnt plots even in the middle of the rainy season, the dead grass: green grass ratio was 4.7:1. Van Rensburg (1971) also reported that complete protection from fire resulted in accumulation of dead herbage which hindered the growth of the new grass in a pasture. Edwards and Bogdan (1951) also found that palatability and nutritive value of grass depends upon the distribution of hard tissues in leaves. They also noted that digestibility decreases with the age of the grass because of increase in fibre content. Heady (1960) reported that in the dry season when the crude protein in many grasses is low animals have problems digesting such materials. Many species of herbivores showed decided preference for young grasses which have higher crude protein content than the old fibrous grass (Strungnell and Pigott, 1978). Similarly, Afolayan (1978) observed in Kainji National Park, Nigeria, that grazing dropped as the crude protein decreased with the age of the grass.

In this study it was found that crude protein of dead grass in burnt and unburnt plots was low compared with that present in living grass. It was assumed therefore, that the palatability and digestibility of the living grass would decline as it grew old. Thus athese results show the importance of burning in reducing the amount of unpalatable, less nutritious materials. It was also noted that in burnt areas green grass appeared earlier (when the rains came) than in unburnt areas. This is because the new growth was hidden by the old material in unburnt areas. It seems probable that the grazers had difficulty in selection of live grass within an accumulation of dead grass. This would explain why the herbivores were attracted to burnt areas where the dead grass: live grass ratio was low.

The accumulated dead materials may also increase the likelihood of wildfire during the dry season since they contain large amounts of dry grass representing fuel rather than food reserves for herbivores (Heady, 1960). It can, therefore, be argued that people who object to burning may be opposing the burning of useless dry herbage in this Park especially during exceptionally wet seasons. The removal of dead grass by burning stimulated more vigorous growth which seemed to attract the grazers. In this study, it was observed that the percentage cover for *Themeda triandra* did not increase after burning. However, it is unrealistic to expect significant floristic changes within the few months of this study. Lock and Milburn (1971) found that removal of plant cover by fire resulted in an increase in *Themeda triandra*. They noted that the increase in this species resulted from seedlings rather than from the sprouting of the old tufts.

Earlier observations in this Park confirmed the observations made here, that burning produced grass that attracts herds of wildebeest and zebras (Foster and Coe , 1968; Pratt ,1967; Park records ,1968). It is also reported that burning in 1968 had the desired effect of keeping quite a large number of migrating herbivores in the Park during the rainy season when they would normally have moved to Kitengela Conservation Unit as soon as the rains start and remain out until the grass and water supplies dry out in the Conservation Unit. Although burning was found to be important no purposeful burning was done after 1969. Instead, mowing was carried out in 1968 to attract the game (Park records, 1968). In such mowed areas the palatability and nutritional value was assumed to be improved. The Assistant Warden (Park records, 1968) also recommended a plan-of rotational burning such that the same area was burnt once in three years.

It should, however, be mentioned that the plains game were not being attracted to burnt areas only by im-

proved palatability of the grass but also probably, by improved visibility. Short grass areas resulting from burning or grazing may provide a better chance of detection and escape from predators than tall grasses of burnt sites (Vogl, 1974). This possibility cannot be ruled out, since there was a higher concentration of plains game in unburnt short grass areas during the dry season. In such areas the nutritional quality and accessibility of grasses would have been suspected to be poorer than in the tall grassland areas during the same period. When the rains came, the unburnt short and long grass areas had a lower game occupancy than burnt areas.

Thus, it is most likely that it is the enhanced palatability of grasses rather than predator avoidance that attracts the grazers to burnt areas. The browsers also did not show any decided preference for short grassland areas. Therefore , their movement from one block to another was most likely determined by food availability rather than predator avoidance. The detailed investigation of the above possibilities could not be carried out due to the time limit of this study.

Repeated burning, however could be detrimental to grasses and hence, grazing resources. A comparison of nitrogen in the ash with that present In the standing crop before burning indicates a slight reduction in the total nitrogen. It is likely, therefore, that some nitrogen present in the unburnt material is lost through volatilisation when the material is converted into ash (Daubenmire ,1968; DeBano and Contrad ,1978). Although, there are few investigators who report loss of nitrogen from grass material after burning many have found nitrogen condition definitely improved in the soil as a consequence of grassfire. For example in the savannah grasslands of Nigeria, nitrogen was lowest in plots protected from, burning (Moore, I960). Thus, although there a was loss of nitrogen after burning through volatilization the input through rainfall and fixation from the atmosphere is sufficient to balance the small loss resulting from burning (Hunter et al., quoted by Daubenmire, 1968).

6.0 MANAGEMENT AND MONITORING RECOMMENDATIONS

The Park is already divided into blocks of land (game counting blocks) which are separated by motorable roads. These blocks can be burnt on a rotational system under a well planned controlled burning programme. The roads should provide fire-breaks to prevent the fire from spreading to blocks which were not intended for burning at any one given time. Therefore, these roads should be cleared of any vegetation before each burning procedure.

It is suggested that blocks IIA, IIB, IIIA and IIIB may form one set of burning blocks. VA, VB and VIA a second set and VIIA, VIIB a third set. The fourth set would consist of blocks 1, VIII and IV. One game counting block in each of the first three sets should be burnt at any one time. For example the following blocks could be burnt at the same time at each burning period .Blocks II (A and B), and VA and VIIB , blocks IIIB, VB and VIIA and blocks IIIA, VIA and VI

Block IV would be left aside as an unburnt block and thus completely protected from fire. Blocks I, VIII and IX form important dry season food reserves because they contain marshes and permanent dams and hence the plains game concentrate here during the driest periods of the year.

Each of these blocks would only be burnt at the end of dry season unless heavily grazed and trampled during the dry season. This would allow palatable standing crop to re-accumulate during the rainy seasons.

The frequency and the time of burning would depend on the amount of accumulated dead grass which in turn is dependent on precipitation and grazing intensity. Thus burning may not be necessary during the dry years when the plains game concentrate in the Park. Therefore the burning programme should be flexible depending on an accumulation of dead grass. However, the main purpose of burning in this Park (and an objective of this

study) is to improve the grazing resources and hence attempt to reduce the movement of herbivores to the outside of the Park at the beginning and middle of the rainy seasons. Late burning will not only have the desired-effect by improving grazing conditions but would also allow the grasses to recover during the rainy period that would follow this burning programme.

7.0 CONCLUSIONS

This burning programme would provide a burning and grazing mosaic over the whole Park that would create a variety of grazing resources at the beginning and middle of the rainy season. It would also ensure there is available flush of green grass during the growing season. It should, however, be mentioned that any such burning programme should be coupled with long term experimental projects on the impact of burning, mowing and grazing on grasses. Hence, the reason for the block IV being left aside as a control.

Occasional rotational burning in the game counting blocks under strict control is likely to provide the amount of grass and browse necessary for animal life and good visibility for game viewing (Afolayan and Ajayi, 1980). This practice together with the permanent dams and watering places would probably reduce the seasonal migration of large herbivores to the Kitengela Conservation Unit, where they are more likely to be poached as reported in 1968, 1969 and 1971 (Park quarterly reports).

At the time of study the Park Warden had found the need for improving the grazing resources and reducing grass fuel in the Park by burning during the wet periods in the year. However, this programme was not based on any research data. The results of this study were expected to help the Park authorities in designing and implementation of the Park's much needed use of fire as a management tool in its policy framework .

It should be pointed out that conservation areas like Nairobi National Park should ideally remain completely "natural" and unchanged. However, the Park is in an unnatural state already. The area is partly fenced, has man-made dams and roads and is surrounded by humans activities and nature can no longer be allowed to take its own course. For example the migration routes of the herbivores have been changed due to human occupation in the Athi - Kapiti plains and the former Kitengela conservation unit.The survival of this natural resource is currently totally threatened by humans habitation around all its boundaries.

Historical facts as well as the results of research, past and present, suggest that fire be regarded as an integral management option of the ecological and social complex of this Park.

The tendencies which have appeared in the short time in which this research was conducted unquestionably suggested that burning in this Park is necessary in order to remove accumulated fuel, aid better utilization of Park savannah grasslands ecosystem , help distribution of animals during the plant growing seasons and remove unpalatable grass growth. Use of fire could also improve visibility during game viewing and hence the Park be made more attractive to local and foreign tourists. The results also suggest that withdrawal of the fire factor initially may lead to a deterioration of the grazing resources in this ecosystem . This would also eventually result in a dominance of the woody species and exclusion of grasses and grazers in the course ecological plant succession.

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after the experiment

Table 2 Mean grass standing crop (.kg /ha) August, 1978 and then December 1978 to may, 1978

			1978		1979				
PLOT	TREAT-		AU-	DECEM-	JANU-	FEBRU-	MARCH	APRIL	MAY
1		B	7132.4	000 000	385.6	920. 0	1440.0	2745.6	2768.0
	Dead	U	6170.0	5800.0	6001.0	6520.0	6636.8	10060.8	6897.6
	live grass	B	393.8	1408.0	1582.4	1513.4	1883.2	1944.0	2206.4
		U	237.2 + 67-°	857.6 + 137.3	1076.8 4 + 217.2	1299.2 + 445.2	1281.6 + 170.1	1649.6 434.9	894.4 + 220-

Table 3 Mean grass' standing crop (kg ha^{-1}) August, 1978 and then December 1978 to May, 1979

			1978		1979				
PLOTS	TREAT-MENT		AU-GUST	DECEM-BER	JANU-ARY	FEBRU-ARY	MARCH	APRIL	MAY
2	DEAD Grass	B	6841.2 ± *985.3	000 000	507.2 ± 155.6	870.4 ± 220.8	1182.4 ± 236.3	1349.6 + 223.0	2659.2 ± 285.9
		U	6080.8 ± 808.0	6627.2 ± 1614.2	6776.8 ± 828.8	7051.2 ± 1248.6	5331.2 ± 1042.3	5752.0 ± 1769.79	7044.8 ± 510-3
	Live grass	B	333.8 ± 152.0	1120.0 ± 50.7	894.4 ± 332.9	1396.8 ± 256.9	1363.2 ± 314.9	1536.8 ± 275-1	2702.4 ± 329.4
		U	410.4 ± 56.1	1179.2 ± 86.9	1113.6 ± 170.1	1654.4 ± 166.5	1190.4 ± 441.5	1140.0 ± 271.4	976.0 ± 159-2

Table 4 Mean grass' standing crop (kg ha^{-1}) August, 1978 and then December 1978 to May, 1979

			1978		**1979**				
PLOTS	TREAT-MENT		AUGUST	DECEM-BER	JANU-ARY	FEBRU-ARY	MARCH	APRIL	MAY
3	DEAD	B	6455.6 ± 904.8*	000 000	302.4 ± 144.8	840.0 ± 256.9	1439,6 ± 546.5	2735.0 ± 74.1	2492.8 ± 224-4
		U	6526.4 ± 1027. C	6625.6 ± 1237.8	5812.8 ± 1085.8	5043.2 ± 1331.3	594G.G ± 246.1	G491.2 ± 1476.6	8904.0 ± 629.7
	LIVE	B	1220.0 ± 455.1	3545.2 ± 343.8	1098.8 ± 300-4	1712.0 ± 636.0	2270.4 ± 810-7	2396.8 ± 408.9	2292.8 ± 144-8
		U	471.6 ± 164.7	1320.0 ± 452.4	1126.4 ± 300-4	1907.2 ± 810 .7	1284. G ± 257-3	3134.0 ± 781.3	283G.G ± 213.5

Table 5 Mean grass standing crop (k/ha)August, 1978 and then December 1978 to May 1979

			1978		1979				
PLOTS	TREAT-MENT		AU-GUST	DECEM-BER	JANU-ARY	FEBRU-ARY	MARCH	APRIL	MAY
4	DEAD	B	6462.0 ± 755.5	000 ± 000	440.0 + 332.9	G92.8 ± 228.0	318.4 ± 217-2	2241.6 ± 195-4	2137.6 ± 665.9
		U	5804. ± 483.1	6516.8 ± 586.3	5980.8 + 1357.2	6774.4 ± 1990.5	6668.3 ± 955-5	3227.2 ± 2736.1	11460.8 ± 673.1
	LIVE	B	38.4 ± 32.6	1408.0 ± 394.5	1035.2 + 416.2	1563.2 ± 293.2	2172.8 ± 571.8	2836.8 ± 390.9	2881.6 ± 452-4
		U	0000 0000	966.4 ± 209.9	1136.00 ± 133-9	2731.2 ± 1147.3	2688. ± 264.2	3240 ± 651.5	3302.4 ± 325.7

NB: CONFIDENCE LIMITS WERE CALCULATED AT 95$ PROBABILITY LEVEL (P = 0.05). TEN SAMPLES WERE TAKEN IN EACH CASE DF = 9. $\underline{t\ s\ (n\text{-}1)\ \ddot{X}^{S.d}\ x\ S.E.}$

Table 6 Change in plant nutrients (in kg ha^{-1}) in living green grass before burning and two months after burning.

		N			P				K	
SITE	PLOT	BE-FORE BURN-ING	AFTER BURN-ING	DIFF.	BE-FORE BURNING	AF-TER BURNING	DIFF.	BE-FORE BURNING	AF-TER BURNING	DIFF.
1	B	2.17 (0.68)*	23.94 (1.70)	+ 21.77	0.31 (0.08)	2.11 (0.15)	+ 1.8	5.58 (1.40)	18.30 (1.30)	+ 12.72
	U	1.61 (0.68)	13.21 (1.54)	+ 11.6	0.19 (0.08)	1.03 (0.12)	+ 0.84	3.32 (1.40)	11.23 (1.31)	+ 7.91

2	B	2.42 (0-72)	14.90 (1.33)	+ 12.48	0.25 (0.07 5)	1.23 (0.11)	+ 0.98	3.59 (1.06)	7.84 (0.70)	+ 4-25
	U	2.91 (0.72)	18.14 (1.54)	+ 15,23	0.30 (0.07)	1.53 (0.13)	+ 1.23	4.35 (1.06)	16.74 (1.42)	+ 12.35
3	B	10.68 (0.88)	29.05 (1.88)	+ 18.37	2.95 (.242)	4.94 (0.32)	+ 1.99	15.93 (1.31)	31.32 (2.04)	+ 15.34
	U	4.13 (0.83)	15.97 (1.21)	+11.8 4	1.14 (0.24)	3.3 (0.25)	+ 2.16	6.18 (1-31)	18.8 (1.43)	+ 12.7

Table 7 Change in plant nutrients (in kg ha^{-1}) in living green grass before burning and two months after burning.

		N			P			K		
SITE	PLOT	BE-FORE BURN-ING	AFTER BURN-ING	DIFF.	BE-FORE BURN-ING	AFTER BURN-ING	DIFF,	_. BEFORE BURN-ING	AFTER BURN-ING	DIFF.
1	B	2.15 (0.58)*	6.90 (0.49)	+ 4.75	0.52 (0.13)	1.83 (0.13)	+ 1.31	0.49 (0.124)	1.55 (0.11)	+ 1.06
	U	1.28 (0.04)	4.46 (0.52)	+ 3.18	0.31 (0.13)	0.94 (0.11)	+ 0.63	0.29 (0.125)	0.69 (0.08)	+ 0.4
2 -	B	1.43 (0.423)	8.18 (0.73)	+6.75	0.32 (0.094)	1.90 (0.17)	+ 1.58	0.39 (0.12)	1.57 (0.14)	+ 1.18
	U	1.74 (0.423)	5.90 (0.50)	+4.16	0.39 (0.094)	1.18 (0.10)	+ 0.79	0.47 (0.94)	1.42 (0.12)	+ 0.95
3	B	4.73 (0.388)	8.50 (0.55)	+3.77	1.65 (0.94)	3.09 (0.20)	+ 1.44	(1.15 (0.94)	2.47 (0.16)	+ 1.32
	U	1.83 (0.39)	7.26 (0.55)	+5.43	0.64 (0.14)	2.24 (0.17)	+ 1.6	0.44 (0.09)	1.45 (0.1)	+ 1.01

Table 8 : Percentage Crude protein content (%N x 6.25) in living and dead grass in burnt and bunt plots (before and two months after burning).

Month	Percent Crude Protein Content												
	In live grass (Samples)						In dead grass (Sample)						
	Plot		Plot		Plot		Plot		Plot		Plot		
	1B	1U	2B	2U	3B	3U	1B	1U	2B	2U	3B	3U	In Grazed sprouts after wild-fires
Au-gust/September 1978	4.25	4.25	4.47	4.47	5.46	5.46	2.19	2.19	2.84	2.84	3.22	3.22	11.8
December, 1978	10.63	9.63	8.31	9.63	11.75	9.56	0	4.19	0	4.31	0	6.0	13.38

CLOUD COMPUTING

A Simple Mapreduce for Commodity Computers in a Cluster

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Abstract

A cloud is the Internet with associated standard protocols that provide a set of Web services to users. Cloud computing utility has been a dream for computer scientists and industries for such a long time. Cloud computing also means any application has a potential to scale, it could be giant that includes many computing clusters with thousands of computers [1].

One of the application of cloud computing is processing a very large amount of data, probably hundreds, thousands gigabytes, terabyte or even petabyte of data and Mapreduce has been playing a vital role in this type of data processing and gaining popularity.

Keywords

Cloud computing, Mapreduce, Hadoop, Data processing, Application, Utility

I. INTRODUCTION

Cloud computing has been around for more than ten years as Scott McNally former chief executive officer (CEO) of Sun Microsystems stated “We are living in a post PCs era…” as a keynote speaker at a “Teaching and Learning” consortium in Anaheim, California in 2000. IBM defines cloud computing as a service over the Internet and is the delivery of on-demand computing resources, everything from applications to data centers, over the Internet and on a pay-for-use basis [2].

Mapreduce was introduced by Google as a programming model for processing large data sets on clusters of commodity computers. Google first developed the framework for serving Google’s Web page indexing then the new framework replaced the older, earlier one. Software developers can use library routines to write parallel programs without concerning the infra-cluster communication, task monitoring or failure handling

processes [3]. This research paper introduces a simple Mapreduce framework that can be implemented in a single commodity computer in a cluster.

II. MAPREDUCE

Mapreduceis a programming model that can run on a large cluster of commodity computers to process large data sets. It is highly scalable and implemented in various programming languages such as Java, C++, and C#.

A Mapreduce program composed of a procedure called Map() method (function in C++, C#) that sort and filters chunk of data into "key-value" pairs, and another procedure called Reduce() method that performs a summary operation on the lists of key-value pairs that was produced from the previous step (map() method). The "Mapreduce System" (infrastructure of the framework) controls distributed servers, running various tasks in parallel, managing communications, data transferring among various parts of the system. It also handles the replication of data sets and fault tolerances [4].

III. HOW MAPREDUCE WORKS

A Mapreduce job splits the input data set into separated chunks which go into the map tasks (map() methods) in parallel. The framework sorts the outputs of the map tasks then inputs to the reduce tasks (reduce() methods). The outputs from the reduce tasks are final and stored in the file system. The framework is also responsible for scheduling all the tasks, monitoring and re-execute the fail tasks.

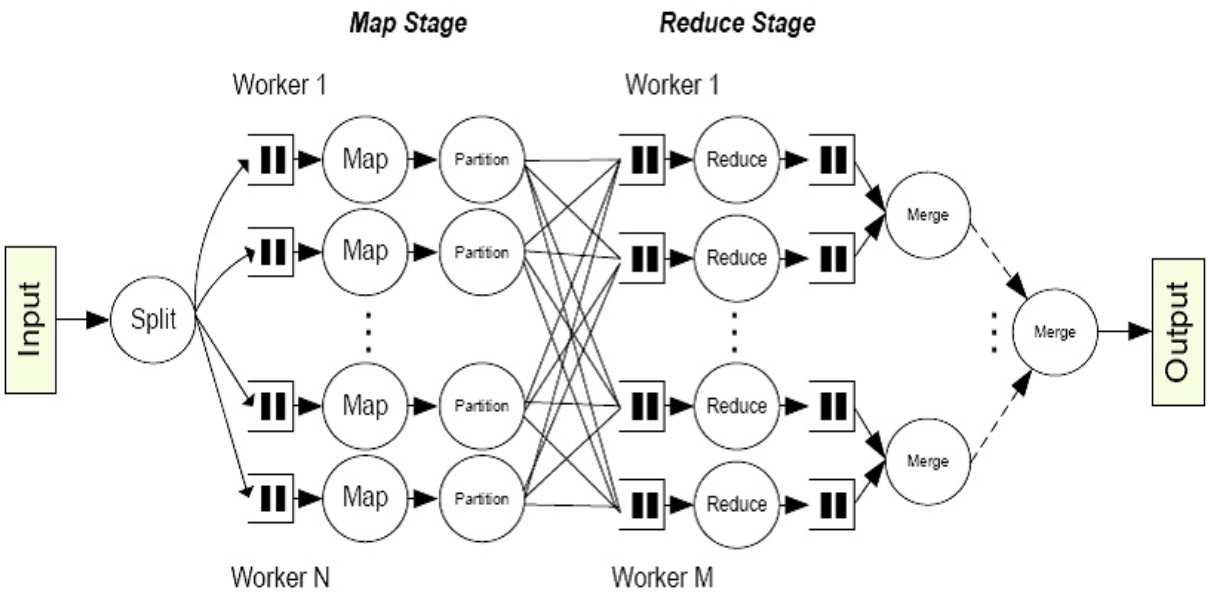

Figure 1: Mapreduce framework

III. 1. MAPPER

The mapper via map() method maps input key-value pairs into a set of intermediate key-value pairs. The map() method actually performs the task that transform input records into intermediate records.

```
   //A sample map() method to count number of words
public void map(Object key, Text value, Context context)
throwsIOException, InterruptedException{
StringTokenizeritr = new StringTokenizer(value.toString());
while (itr.hasMoreTokens()){
word.set(itr.nextToken());
context.write(word, one);
}
}
```

- Running through asample tiny dataset, the map output may look like the sample following, they are intermediate key-value pairs.

```
(dobbs, 20)
(dobbs, 22)
(doctor, 545525)
(doctor, 668666)
```

III. 2. REDUCER

The reducer via reduce () method reduces a set of intermediate values which share the same key to a smaller set of values. This smaller set of values are final values and the reducer task is completed so as the Mapreduce job.

```
   //A sample reduce() method
public void reduce(Text key, Iterable<IntWritable> values,
 Context context) throws IOException,
InterruptedException{
int sum = 0;
for (IntWritableval : values){
sum += val.get();
}
result.set(sum);
context.write(key, result);
}
```

- The input to the reducer step looks like this:

```
(dobbs, [20, 22])
(doctor, [545525, 668666])
```

- The output of the reducer will be:

```
(dobbs, 42)
(doctor, 1214191)
```

In this typical framework, before intermediate key-value data sets can be sent to the reducer, they must be sorted and shuffled via HTTP by the framework [5].

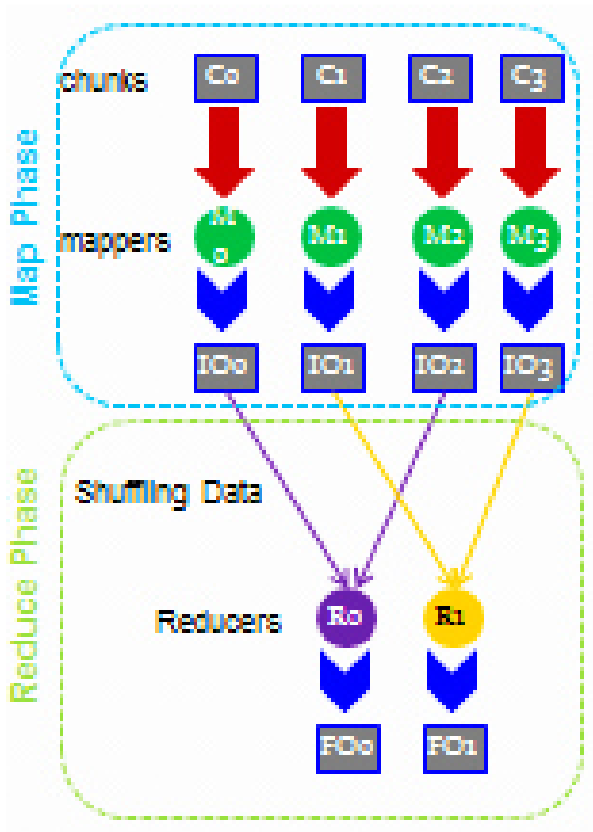

Figure 2: Hadoop Mareduce framework

In figure 2 above, we can see the Mapreduce framework does the splitting job of a huge data set and distributes data chunks to clusters which become input into the Mappers. After the mappers generate intermediate output, the framework again will perform the shuffling and sorting tasks before sending data into the Reducers.

IV. PROBLEM

Mapreduce has been increasing its popularity with the evolution of the Internet, distributed, parallel, grid and cloud computing. However in educational context, it proved to be a burden in downloading software, resources and setting up, configuring the Mapreduce framework. Even more, writing the application program will require the use of many classes (import) from the Apache Hadoop extensive library and the users must be familiar to these classes as in the example of a program segment following.

```
package org.apache.hadoop.examples;

import java.io.IOException;
import java.util.ArrayList;
import java.util.Iterator;
import java.util.List;
import java.util.StringTokenizer;

import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.conf.Configured;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.FileInputFormat;
import org.apache.hadoop.mapred.FileOutputFormat;
import org.apache.hadoop.mapred.JobClient;
import org.apache.hadoop.mapred.JobConf;
import org.apache.hadoop.mapred.MapReduceBase;
import org.apache.hadoop.mapred.Mapper;
import org.apache.hadoop.mapred.OutputCollector;
import org.apache.hadoop.mapred.Reducer;
import org.apache.hadoop.mapred.Reporter;
import org.apache.hadoop.util.Tool;
import org.apache.hadoop.util.ToolRunner;

public static class MapClass extends MapReduceBase
    implements Mapper<LongWritable, Text, Text, IntWritable> {

    private final static IntWritable one = new IntWritable(1);
    private Text word = new Text();

    public void map(LongWritable key, Text value,
                    OutputCollector<Text, IntWritable> output,
                    Reporter reporter) throws IOException {
      String line = value.toString();
      StringTokenizer itr = new StringTokenizer(line);
      while (itr.hasMoreTokens()) {
        word.set(itr.nextToken());
        output.collect(word, one);
       }
    }
 }
```

```
public static class Reduce extends MapReduceBase
    implements Reducer<Text, IntWritable, Text, IntWritable> {

    public void reduce(Text key, Iterator<IntWritable> values,
                       OutputCollector<Text, IntWritable> output,
                       Reporter reporter) throws IOException {
      int sum = 0;
      while (values.hasNext()) {
        sum += values.next().get();
      }
      output.collect(key, new IntWritable(sum));
    }
  }
```

[6]

V. A SIMPLE MAPREDUCE

This simple Mapreduce will concentrate on the core computing of a commodity computer, assuming other (over heading) tasks are done by the (outer layers) framework such as splitting a large data set into smaller chunks of data that distributed to cluster of commodity computers then splitting the chunks of data again into reasonable sizes for each single commodity computer to process. In a parallel computing environment, we can imaginethe overall picture of this simple Mapreduce framework with the overhead tasks as the two outer loops. The first handles the splitting of huge data set into chunks and control the clusters, the second will split chunk of data into reasonable sizes and control commodity computers in a cluster. A pseudocode for a simple Mapreduce framework is shown in figure 3 following.

```
//First Outer Loop
fori = 1 to n clusters in the framework
{ do splitting of data and manage clusters }

//Second Outer Loop
forj = 1 to m commodity computers in the cluster
{ do splitting chunk of data and manage commodity computers }

      //Core Mapper and Reducer for a Simple Mapreduce
      //Map method to read and generate data to intermediate
      //key-value pairs.
      map()                    //map() method
      { read data input
```

```
        process data
        output intermediate key-value pairs
         }
         //Reduce method to combine data with the same key and
         //output final key-value pairs (final result)
        reduce()                //reduce() method
        { receive list of intermediate key-value pairs
        process, combine key-value pairs with the same keys then
        outputfinal key-value pairs
         }
     } //End of second outer loop
  } //End of first outer loop
```

Figure 3: A Simple Mapreduce framework

V.1. THE SIMPLE MAPPER

In this simple Mapreduce framework, the Mapper via map() method will read input data then generates a list (an array or a linked list of nodes) of intermediate key-value pairs which will go into the Reducer. A node in this framework is the unit for storing a key-value pair, and can be defines as an inner class in Java or a structure in C++ and C#.

```
//Define inner class (node) to store a key-value pair
public class KeyValueNode{    //define inner class
private String key;           //declare key is a string
privateint value;       //declare value is an integer
}
```

Algorithm for map() method:

1. Read input data file one line at a time
2. Break down the line into key (a word or a lexeme)
3. Insert key and assign value (1) into a node in an array of nodes
4. Repeat from step 2 until no more key
5. Repeat from step 1 until the end-of-file (eof)

When the Mapper accomplishes its task, it will produce an array of key-value pair nodes, in which many nodes might have the same key-value as shown in figure 4.

Key1, 1	Key2, 1	Key3, 1	Key4, 1	Key1, 1	Key5, 1	Key3, 1	...

Figure 4: An array of intermediate key-value pairs, some keys are repeated

V. 2. THE SIMPLE REDUCER

The Reducer via reduce() method receives an array of intermediate key-value pairs generated from the Mapper step as input. The reduce() method processes the array then produces the final key-value pairs as output. It actually combines those nodes that have the same key. The reduce () method uses a "Search-Combine-Reduce" algorithm similar to a "sorting and swapping" algorithm.

Algorithm for reduce() method

Assume the array contains n elements (nodes)

1. Set i = 0. Do n times for n elements of the array
2. Set index equals to i (i is the outer loop control variable)
3. j = index + 1. Do n-1 times for the remaining elements (comparing)
4. Compare key[index] and key[j]
5. If (a match):
   - Increment value of the leading key-value node
   - Rearrange the list to remove the duplicated key
6. Repeat from step 3 until the end of the list
7. Repeat from step 1 until no more element in the array

When the Reducer completes its task, the final output from a Mapreduce program would be similar to figure 5. Note that this list is shorter due to the removal of duplicate key (and increment the value in the leading node).

Key1, 2	Key2, 1	Key3, 2	Key4, 1	Key5, 1	...

Figure 5: Final output from Reducer

VI. A SIMPLE MAPREDUCE PROGRAM IN JAVA

Test input string: “Hello Word Hello Byte Hello Hadoop Goodbey Hadoop “

```
//scanString() method to break input string into key (word)
public static void scanString(String s){
if(s != null)
for(int i=0; i<s.length(); i++)  //All characters in a string
if(s.charAt(i) != (' '))      //If character is not a space
      temp += s.charAt(i);      //Grouping characters
      else{
      mapper(temp);          //Otherwise, invoke mapper method
      temp = "";             //Reset temporary string back to empty
}
}
//mapper() method to generate intermediate key-value pairs
public static void mapper(String s){
if(s != null){
      kvList[index].setKey(s);    //Set key and value into a node
      kvList[index].setValue();
}
index++;                      //Increment the index of the array
}
//reducer() method to combine nodes of the same key
public static void reducer(Mapreduce[] list){
int count = 0;                      //For counting number of matches
intinx;                           //For inner loop control
for(int i=0; i<index; i++){   //Outer loop for all elements
      inx = i;                      //inx is set tofirst element
      for(int j=inx+1; j<index; j++)//Inner loop for finding matches
if((list[j].getKey()).equals((list[inx].getKey()))){
            list[inx].incrementValue(); //Increment value of this Key
            reArrangeList(j, list);     //Rearrange the list
      }
      }
}
```

After running this program, we obtain the final output:

```
Input a string: Hello Word Hello Byte Hello HadoopGoodbeyHadoop

OUTPUT FROM MAPPER:
-------------------
[Hello, 1] [Word, 1] [Hello, 1] [Byte, 1] [Hello, 1] [Hadoop, 1] [Goodbey, 1] [Hadoop,
1]

FINAL OUTPUT FROM REDUCER:
--------------------------
[Hello, 3] [Word, 1] [Byte, 1] [Hadoop, 2] [Goodbey, 1]
```

VI. CONCLUSION

Mapreduce has been used in a wide range of applications that includes: pattern matching, distributed sorting, Web page searching, machine learning, etc… As originally developed by Google, Mapreduce was used to generate Google's index of the World Wide Web pages.

This research paper introduces a simple Mapreduce framework for processing a small data set by breaking down text input into words, generates an array of key-value pairs then outputs the final list (an array) of reduced key-value pairs. The final list indicates the number of matches for each key (word).

The research paper can be used as a basis for further works or teaching material for computer science courses such as Parallel computing, Cloud computing, or other courses in Data processing, Management Information Systems.

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Design an Instrument for the Educational Evaluation of Faculty Members of Dentistry Faculty

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1. Abstract:

Aim: *Evaluating the educational performance of faculty members in higher education is a basic element in planning to improve education. The aim of this study is to design an instrument for the educational evaluation of faculty members of dentistry faculty.*

Materials and Methods*: Having reviewed the literature and held panel discussions, first a preliminary list of 33 important evaluation questions was prepared and the content and face validity were used to check the validity and Cronbach's alpha coefficients and Pearson correlation coefficient were used to assess the reliability of the test. The votes of members of the group that were assigned to essential options were quantified through the Content Validity Ratio (CVR). The acceptance or rejection of the questions was based on the CVR and that if the CVR is equal to or greater than 0.75, the question would be accepted unconditionally. Data analysis was done using the software 17 SPSS.*

Results*: Eight questions were deleted or revised, finally the mean CVI of the present study obtained 74% and its CVR equivalent to 84%. It indicates the high validity of the questionnaire. Reliability of the designed instrument was confirmed by internal reliability and assessors' validity methods.*

Conclusion: *To assess and evaluate the performance of faculty members a reliable instrument must be used. The questionnaire designed in this study is a useful instrument to achieve this goal.*

Keywords: Design and Evaluation, Validity and Reliability, Educational Performance, Dentistry

2. Introduction

Higher education system is as a dynamic, complex and targeted system which has two qualitative and quantitative dimensions. The growth of such system requires the parallel development of both dimensions and that the assessment of which needs detailed process of evaluation (1). Evaluation is the most essential part of any program and one of the most difficult and important aspects of human resource management, that some call it as a vulnerable spot of management. Because only through which we can find and remove the shortcomings of a program.Not only an effective evaluation plays an important role in screening students, but also it increases students' motivation and helps the teacher to assess his activities and there by the students' learning and ultimately achievement of educational goals can be measured (2-3).In addition to students' evaluation done by professors, the evaluation of teaching process should also be emphasized in educational institutions, because training competent and expert manpower depends on this process to a large degree (4-5).Customer satisfaction is a key to success and that in medical education, customers include students studying in there, therefore, their satisfaction with this system and their involve mentin various fields of evaluating the quality and quantity of education that faculty members are one of them, may improve the educational system.

Investigating the comments of people involved in education such as students, will raise the credit of educational performance of professors and will help authorities in achieving the evaluation objectives that are to improve education quality(6). Students as recipients of educational services are the best source to identify the clinical training problems, because they have an immediate and direct presence in this process (7-8).

Students can be consulted on the quality of clinical education and have their experiences used to identify and determine the gap between what is happening in the clinical setting and what is expected by the stakeholders (9). Since there is no right instrument with adequate reliability and validity to evaluate the performance of faculty members of the dentistry faculty in students' perspective, thus this study is designed with the aim of designing such instrument.

3. Materials and Methods

In this descriptive – analytical study, after designing the questionnaire, content and face validity were used to evaluate validity and Cronbach's alpha coefficient and Pearson correlation were used to evaluate reliability. Having reviewed the relevant literature a preliminary list of evaluation criteria of faculty members was prepared. Because of the long list of criteria and their large number it was necessary to shorten the list which was later determined in an appropriate level(atotalof33 items) by forming a panel of experts and Delphi methods. After doing the necessary reviews by a statistician, their content validity was evaluated by 12 experienced teachers and experts and was again referred to the related statistician to analyze the responses given. To determine content validity index and introducing the final questionnaire, the Content Validity Index which is shown briefly as CVI is the mean of CVR remaining items in the model, test, or validated instrument. CVI represents the comprehensiveness of the judgments related to the validity or applicability of the model, test or the ultimate instrument. The higher the ultimate content validity, the closer the CVI value towards 0.99. The reverse is also true. The proposed methods of Chadwick et al and Laws he were used in order to determine the content validity (10-11).The internal reliability assessment and reliability of assessors' method were used to evaluate the reliability of the instrument.

Data analysis was done using software 17 SPSS. The votes of members of the group that were assigned to essential options were quantified through the Content Validity Ratio (CVR). The acceptance or rejection of the questions was based on the CVR and that if the CVR is equal to or greater than 0.75, the question would be accepted unconditionally. In this study P value was less than 0.5 which is considered statistically significant.

4. Results

After collecting the questionnaires of the assigned group member and inserting the data into the Excel software, the mean CVI of the present study obtained 74% and its CVR equivalent to 84%, 8 questions out of 33 ones in the questionnaire were deleted and/or revised in terms of writing method. If these parameters are modified, then CVI and CVR will certainly increase dramatically.

5. Discussion

One of the most important factors on conduction of an appropriate evaluation is an efficient instrument that can measure the desired targets. Among issues related to clinical training, both theoretical content and clinical principles should be taught efficiently (12-13). In this process (clinical training) students gradually gain experiences with the presence of the patient and prepare their mind using logical thinking and experiences to solve the problems of the patients. At this stage of education, lessons learned are put into practice, the skills are taught (14-15).

Clinical discussion at Medical Education Center accounts for the largest share or the most important part, and the real meaning of clinical teaching i.e. laying the groundwork to close and align the basic scientific information of the student, doing skills, along with the diagnosis, treatment of the patients and gaining a variety of professional skills (16).

Clinical environments have variable and unpredictable features which have inevitably affected the education of students and highlight the important role of the clinical teacher, so that some commentators consider clinical education as more important than theory teaching (17-18). And since the goal of clinical education is to create necessary opportunities so that students be able to close theoretical information to scientific fact(19), thus improving the quality of such issue can educate competent and qualified students in the clinical field. Clinical environment is an ideal environment for teaching and learning (20-21) and the complex process of learning in clinical environments depends largely on the learner's experience in clinic(22). On the one hand, if the educational objectives are proportionate to students' needs and according to the views of instructors and adaptation of qualitative strategies along with educational evaluation with an emphasis on the understanding of student self-efficacy, then it can lead to qualitative improvement of the educational process and in accordance with the evaluation requirements in educational planning, where Bazargan refers to in a study. Educators can by identifying an effective learning environment consider the viewpoints of clinical student and teacher and there by enrich clinical experience (23). In fact, in the process of education, teaching and learning are interdependent. Although the teaching is teacher's activity, the result is the learning that focuses on learner. Therefore, the efficacy must be investigated in both views i.e. student and teacher, so that a better education is achieved by bringing ideas together(24). Although there are many educational materials regarding efficient teaching in the classroom, it seems there is a limited number of these studies focus on the efficiency of clinical teaching. In evaluating teacher performance different aspects should be considered including teacher's behavior with students and colleagues, mastery on theoretical teaching, practical teaching ability and methods of student assessment. In this study, by employing the past studies and expert opinions, we have tried to identify various aspects of performance evaluation of faculty members of dentistry faculty, based on which the questionnaire items as evaluation instruments are designed. In designing a validated questionnaire, it is very important to investigate validity and reliability.

Various methods are used to determine the validity of the instrument, these methods include face validity, content validity, concurrent validity, predictive validity and construct validity. These methods, each are used with specific objectives. Face validity is used to assess physical appearance of the instrument, content validity to content correspondence of the instrument, concurrent validity when a standard questionnaire is available, predictive validity to predict a future phenomenon, and construct validity for structural adjustment of the instrument with the previous theories (24).

Usually in developing a questionnaire, initially for surface correspondence and determining the content scope of the questionnaires the content and face validity are used. Since the purpose of this study, is designing a specific questionnaire for professors' evaluation in viewpoint of the students, thus content and face validity were used.

Chadwick et al. suggest that the content validity method is used when a means of exchanging information which contains relatively clear and inferential messages is introduced and explained in an applied way. Laws

he also believes that judgment requires a high insight and level of abstraction and when inference scope of a message is extensive, researchers should quantitatively use face validity. Laws he developed a model to determine validity, so that questionnaires become available to panel group which helps panel members so that accurate judgment of the panel members based on necessary instrument components (model or questionnaire) is provided and they were asked to comment on each option in the judgment scale that was set. The responses of members were codified in different aspects of simple, necessity, being clear and relevant and importance. Lin believes that the number of experts needed to judge the content is completely optional instrument but at least 5 people and at most 10 people must comment in this regard.

Given that the mean CVI of the present study is 74% and its equivalent CVRis84%and due to the removal or revision, some questions indicated the acceptability of the obtained indicators from the instrument validity and all were a prove of usability of the question nairetoassess and evaluate the Faculty members of Dentistry faculty. Another measure that was used in study to increase the validity we can name employment of instrumentation experts in medicine and dentistry. In this study one of the most reliable methods of content validity namely calculating the CVR and CVI was used. In a recent study in order to determine the reliability of the designed instrument, the internal reliability and repeatability of the instrument was done in campus and by students. A second measurement of reliability and removing any possible limitations would be useful in further studies.

6. Conclusion

To measure and evaluate the performance of faculty members we must use a reliable instrument that accurately and reliably reflects the knowledge of performance of faculty members and that according to the results of this study, the obtained questionnaire is an effective instrument to achieve this goal.

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Evaluation of the Relationship Between BMI and DMFT/dmft in Children with Down Syndrome

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Abstract:

Introduction: *Despite the decrease in the prevalence of dental decay in recent years in developed countries, decay iscurrently one of the diseases that involve our community's children, including children with Down syndrome. The aim of this study was to evaluate the relationship between Body Mass Index and DMFT/dmft in children with Down syndrome who referred to Dental hospital in Tabriz.*

Material And Methods: *This cross-sectional study included 22 children with Down syndrome who were admitted to Dental hospital in Tabriz in 2015 (No: tbzmed.rec.1394.224). DMFT/dmft data was collected by direct observation using a torch light and participants' height and weight were measured using a digital scale and wallmeter and were recorded in the designed checklists. Patients'BMI was then calculated. After data entry to SPSS 18, descriptive statistics were used in the first stage and Pearson orSpearman correlation coefficient test was then used to assess the association of BMI with mean DMFT/dmft according to conditions and regression model to examine the role of gender and correlation between variables.In this study, P-values less than 0.05 was considered statistically significant.*

Results: *In this study, 7 patients (31.8%) were male and 15 (68.2%) were female. Mean total DMFT was 9.8±8.1 and the mean dmft score was 5±1.2. There was no significant relationship between BMI and dmft (P-value=0.073), while there was a positive correlation between BMI and DMFT (correlation coefficient>0 and P-value=0.016). There was also no difference between BMI and DMFT/dmft with gender. (P-value>0.05).*

Conclusion: *The results of this study showed that BMI increases with increasing DMFT in patients with Down syndrome.The reason of increased decay can be considered high-carbohydrate diet, low physical activity, lack of attention to oral hygiene due to not regularly brushing tooth after each meal, not using dental floss and mouthwash containing fluoride.*

Keywords: BMI, Down syndrome, DMFT/dmft

Introduction:

Tooth decay is the most common nutritional microbial (dietobacterial) and multifactorial disease in people with a several-thousand-years'history and is said to berooted in human life's history. According to the WHO reports, oral diseases such as decay is still one of the main problems in the field of health (1,2). Decay is an infectious transmissible disease. It is, in fact, a preventable disease and can be stopped at early stages and people are prone to it during the whole life span. Prevention and treatment of this problem depends on the understanding and assessing the amount of dental decay and its relationship with the dietary habits, the health, and dental care (2,3). Low and high weight and decay are multifactorial problems that affect children'sphysical and mental health. Diet and lifestyle are considered as decisive factors that can be assessed in studying the

relationship between obesity and tooth decay (4). The relationship between childhood developmental status and dental decay is complex and influenced by many factors such as age, sex, race, and other social factors (5).Diet and lifestyle changes caused weight gain and emergence of advanced tooth decay since the mid-1990s, due to increased welfare and access to high-calorie foods and drinks rich in carbohydrates; finding a positive relationship between these two variables is the basis of the formation of many of the studies in multiple countries (6).

The World Health Organization uses different indicators to determine the status of oral health in countries and compare them with each other, the most important of whichis DMFT (Decayed-missing-filled teeth) or mean of decayed, filled, and pulled-out teeth (6,7).

The results of the researches showed decay as an infectious multifactorial disease, strongly influenced by various factors such as individual'seducation, family income,and poor oral hygiene (2).

Body Mass Index (BMI) is widely used as a measure to alternativelyevaluate the body's physical condition and is considered a common indicator of patients' nutritional status.Many studies have assessed the effect of BMI on the incidence of cavities, but not able controversy exists regarding this association. (8,9).

Since sexual and mental impotence prevents achieving an ideal level of health, mouth diseasesare a major problem for people with disabilities (10,11). Downsyndrome includes a relatively large group of people with disabilities.

Oral findings in this syndrome include mouth breathing, open bite, missing tooth, conical teeth, small teeth, grooved lips and tongue, delayed growth, and high decay rate with an incidence of nearly 1 in every 700 live births. This is an underdeveloped syndrome and causes prognathic occlusal relationship (11).
Al-Maweri and colleagues conducted a study on children with Down syndrome and reported high prevalence of decay and dental care (12). Vellappally's research has also shown high levels of malocclusion and dental decay in children with Down syndrome (13).

Alm and colleagues reported the relationship between BMI and dental decay in a study in 2008 (14), while Sheller and colleagues showed no significant relationship between childhood decayand BMI in a study in 2009 (15).

Also Vania and colleagues showed that obese and overweight children have less dental decay than normal and below-normal children (16), while other studies have shown that obese children are more sensitive to dental decay because of a carbohydrate-rich diet (17).

Since studies regarding BMI and DMFT are limited with different and contradictory results and such a research has also not yet been carried out in children with Down syndrome and since children with Down syndrome have physical and mental problems and cannotperform their personal tasks such as oral hygiene particularly due to mental retardation, thus, the rate of dental

decay and periodontal problems of these patients is high. Also, as far as routine dental procedures is difficult in these patients due to their low cooperation, their dental care is provided in hospital conditions and under anesthesia, which requires great time and costs and anesthesia for these patients is accompanied by various problem, due to heart disease and etc., thereby reducing risk factors and use of preventive methods is essential in these patients. This study aimed to evaluatethe association of BMI with DMFT in children with Down syndrome to be able to take a step forward in reducing their dental decay, hospitalization for dental treatment, and health care costs by identification and screening patients with abnormal BMI.

Methods

This cross-sectional study collected data using a designed checklist. The target population included all children with Down syndrome (children diagnosed with Down syndrome who have been referred to dental hospital to receive appropriate treatment). After filling out the consent form by parents, children's height was measured by a wall meter without shoes and with the heels paired and weighted by digital scale (Seca made in Germany) without shoes and with light clothes by the educated examiners and were recorded in checklists.For a greater precision, the scale wasadjusted at the beginning of each working day. Then, BMI of each individual was calculated by dividing weight in Kg to height in m^2. To evaluate DMFT/dmft, all participants were examined by the mirror and dentists' catheter by flashlight and the required information of DMFT and dmft were recorded in the checklists.

Inclusion criteria:

1. Children with Down syndrome who were referred to Dental hospital in Tabriz
2. Tendency of parents

Exclusion criteria:

1. Lack of child'scooperation
2. Any systemic, genetic,or congenital diseases that influence dmft, DMFT, such as: amelogenesisimperfecta, dentinogenesisimperfecta, ectodermal dysplasia, Lefeverpapilon

After entering data into SPSS 18 software, descriptive statistics were used to describe data. To evaluate the association of BMI with mean DMFT/dmft,Pearson or Spearman correlation coefficient test was used to examine the role of gender and correlation between variables.In this study, P-values less than 0.05 was considered statistically significant.

Results

22 patients with the inclusion criteria were recruited into the study. Among the participants, 7 patients (31.8%) were male and 15 (68.2%) were female. The mean total DMFT was 9.8±8.1 and the mean dmft score was 5±1.2.

In the studied cases, the meanstudiedvariableswere not different between male and female patients.

To verify the statistically significant differences between the studied variables according to gender, two independent sample t-test was used. Significance level was considered 0.05. The results showed that the mean of the variables had no significant difference based on patients'gender; in other words, there was no statistically significant relationship between studied variables and patients'gender. (P-value>0.05)

1. There was no significant relationship between BMI and dmft. (P-value>0.05)
2. There was a positive correlation between DMFT and BMI; in other words DMFT increased with increasing BMI. (Correlation coefficient> 0 and P-value<0.05) (table 1).

P- value	correlation coefficient	The studied variable pair
0/073	-0/389	BMI,dmft
0 /016	0/505	BMI,DMFT

Table 1: Results of Pearson correlation test

Discussion:

This cross-sectional study was conducted on children with Down syndrome who were admitted to Dental hospital in Tabriz in 2015. The results showed no statistically significant relationship between BMI and dmft, while DMFT had a positive correlation with BMI;in other words DMFT increasedwith increasing BMI. There was also no difference between BMI and DMFT/dmft regarding gender.

In 2007 Oredugba compared 43 patients with Down syndrome with 43 healthy controls in terms of dmft and DMFT. Their results showed that patients with Down syndrome had higher rates of tooth decay that is in line with the results of the current study (18).

Vaziri evaluated DMFT and CPITN indices in patients with Down syndrome in 2007, including18 females and 19 males with this syndrome. According to his study, children with Down syndrome hadhigher DMFT because of periodontal problems that is similar to the present study (19).

Al-Maweri et al. (2014)conducted a study on 96 children with Down syndrome aged between 6-15, evaluated by questionnaire and clinical assessment and showed that 93% of patients had dental decay, fillings, and pull-outs due to decay and needed dental care. The results of their study is similar to the results of our study (13).

Giuseppina Laganà et al showed in a study in 2012 that dmft and DMFT is higher in females, whereas in our study no statistically significant difference was observed between dmft/DMFT and gender (20).

Vellappally and colleagues reported high rate of DAI malocclusion (Dental Aesthetic Index) and dental decay (DMFT) in children with Down syndrome in an investigation in 2014 and concluded highDMFT in patients with Down syndrome that is in line with the results of the present study (14).

Cheng KH conducted a study in China in 2007 on 65 patients with Down syndrome. The results showed that patients with Down syndrome had less dental fillings (2.4 versus 2.7) and fewer decayed teeth (1.1 to 1.7) compared to healthy controls (21). But in the current study, dmft was5±1.2 and the mean dmft score was 9.8±8.1. Their mean age was about 17-42 years. It seems that the contradictory results of the studies is because of different age ranges.

A study by Chakravathy K. and Thippeswamy H in 2013 on association of DMFT with BMI on 456 students from 13 to 15 years concluded that the prevalence of dental decayis higher among students with higher BMIs. The higher DMFT in this study wasmentioned to be because of higher frequency of high-carbohydratediet. From this standpoint, the results of the study is similar to the present study (22).

In 2004, Lee and colleagues compared dental decay in 28children with Down syndrome with 41 healthy children using the dmfsDMFSindex. Their participants' mean age was 11.4 with a range of 8-17 years andthe authors concluded that the Down syndrome group had lower decay compared to the control group, which was reported to be because of low range of the patients, higher age of the controls, and unequal number of the two groups (23).

Mojarad and colleagues assessed the correlation between BMI and decay (DMFT) in a study in 2011 in Hamadan on middle school students. In this study, DMFT was calculated 6.28%in male and 6.85% in female students. The results of this study showed no significant difference between high BMI and DMFT that is different from the results of current study (24).

Conclusions

Tooth decay is a multifactorialdisease. Various factors play a role in it, including bacteria, sugary materials, time of exposure to carbohydrates, the amount of salivary immunoglobulin, and etc.

The results of the current study showed that DMFT increases with increasing BMIin patients with Down syndrome.The reason of increased decay can be considered high-carbohydrate diet, low physical activity, lack of attention to oral hygiene due to not regularly brushing tooth after each meal, not using dental floss and mouthwash containing fluoride.

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Pakistan-China Relations: Thinking through an Indian lens

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Abstract

The rise of China and her development paradigm has drawn the attention of the world community and academics. The role and importance of Pakistan in this geometry of relations with Dragon in the South Asian region can not be denied. The objective of this article is to critically analyse the symmetry of Pakistan-China relations through an Indian lens. This study employed the qualitative method in which secondary sources of data are taken. This data is analysed thematically in this paper. It concludes that factors like: uneven development in Pakistan, slow pace of trade and investment by China in Pakistan, deepening Sino-Indian military ties could cast aspersions on Pakistan's political disputes with India in the long run. Therefore, this study suggests that the Chinese neutrality, win-win relations and complementary economic ties can further cement Pak-China friendship.

Key terms: Development, Geometry of relations, Symmetry, Dragon, Win-Win situation, Complementary

1.1 Introduction

"To win one hundred victories in one hundred battles is not the acme of skill. To subdue the enemy without fighting is the acme of skill".

[1](Sun Tsu, The Art of War) *CIRR*, XXI(73) 2015 p.89

The spectacular economic rise and pragmatic policies of China have, invariably, boosted its image, credibility and confidence among the powerful comity of nations in the world. Its own model of development has magnetized and magnified interaction among many countries, like South to South, South East, South West etc. After passing of the period of self induced isolation and ideological tendencies in its foreign relations, China has radically transformed, as a key role player, in the present global system. Given the economic transformation in China, it has given its idea about the form of governance based on the very foundations of the "Chinese Socialism Market".[2] (China Daily, November 8, 2012). China, in order to seek sustainable economic growth, needs more partners. In contrast to "Washington Consensensus", [3] (CID, Harvard, 2003), China has developed its own concept with the name of "Beijing Consensus", which entails: innovation,

diversification and self determination. The Chinese foreign policy has been adjusted in such a way that could entice, embrace and attract developing as well as developed countries (Joshua Cooper Ramo. March, 2004)[4].

The role of China is gradually increasing at the world stage. Within three decades, it has rapidly changed from an agrarian state with the world's second largest economy. The Chinese state behaviour is visible from its foreign policy that it propounded in 1950's. The main features of its foreign policy are: it seeks for mutual respect territorial integrity, non-aggression, non-interference, equality and mutual benefit and peaceful coexistence. (Xhao Kejin. Sept. 9. 2013)[5]. Given these developments and changing political, social and economic dynamics of China, Pakistan recognized China in 1950's. For many decades, the cardinal principle in Pakistan's foreign policy has been its relations with China in the region. Pakistan, however, recognized the Peoples Republic of China (PRC) in 1950. Their diplomatic ties began in 1951 (Farukh, *et al*,. 2013)[6].

Not only this, but also, Pakistan remained a staunch ally of China even at the times of Chinese isolation period that ranges from: 1960 to 1970. Most of the experts in Pakistan; about Pakistan and China relations believe that the strengthening ties between Pakistan and China were due to: India-China war on the border of 1962 US-India defence ties; Sino-Russian rift in relations, Chinese Conflict with Japan over Island issue; Indian builds up of Blue Navy in the Indian Ocean, Indian ties with South East Asian countries and Indian encirclement through the US, and Japan. Given this changing security scenario in the region, China engaged with Pakistan diplomatically, militarily, and economically.

Contrary to the analysts in Pakistan on China, after the Cold War period, the relationship between Pakistan and China changed dramatically over the years. This was due to Chinese changing economic outlook in the region and the world at large. Apparently, Pakistan and China relationship characterized as: "higher than the Himalaya, deeper than the ocean, and sweeter than honey". There happens to be a mindset among Pakistani politicians that Pakistan was in dire need of one or the other 'protector'. This hype was common in the earlier period of Pakistan. It is said that no country could be independent economically. But it should not be taken as subjugation and subservience. One may not deny the fact that economic interests underline the contours of geopolitical relations.

Notwithstanding, it has been observed that China has less economic but more political complementary relationship with Pakistan. Contrary to Pakistan, the Chinese relations with India is more competitive in economic terms. This uneven partnership, cooperation and friendship are also visible in economic investment of China either in India or Pakistan. It is said that Chinese trade with Pakistan is 10$ billion dollars. Similarly, China has about 60$ billion dollars trade and investment in India. It is safe to say that Chinese relations with Pakistan are geopolitical rather than economic.

Pakistan's renowned economist, Kaiser Bengali[7], in his article on Dawn News, with a title: "National Road to Development", dated: 13th August, 2012, said: Constant hand holding either by China or USA should not be considered by Pakistan". In fact, Pak-USA relations have been portrayed as 'roller coaster', dysfunctional marriage and existential threat. This concise and critical analysis portray that Pakistan should

not remain parasite. Tariq Fatemi- ambassador of Pakistan and noted writer was quoted by Stephen P. Cohen in his latest book on *The Future of Pakistan*, said ''Pakistan should be confident of its own abilities and remain optimistic about its future given its size, location and the qualities of its people"[8]. It has to explore and develop, improve inward so that it would remain no more dependent on foreign powers.

However, the Pak-China relations, are summarized by critics as under: Chinese neutrality over Kashmir; increasing Sino-India economic and military ties; issue of extremism and terrorism in Chinese province-Xinjiang; the Chinese more export into Pakistan rather than imports from Pakistan. Yet, to the utter failure of an understanding of the time-tested friendship between China and Pakistan, it cannot be denied that the former has lived up to the expectations of the people in Pakistan.

According to Bethany Allen (quotes from the Pew Research Center, in July, 2014, reported) that 78% respondents view China positively in Pakistan· (Bethany Allen-Ebrahimian, April.22, 2015)[9] . Keeping in view the broad spectrum of views, this study is aimed at critically analysing Pakistan's relations with Dragon. This study also sheds light on relations from an Indian perspective. In order to achieve this objective, the qualitative method in which secondary sources of data are taken. This data is analysed thematically in this paper.

1.2 Material and Methods

This study is concerned with Pakistan and China relations. The relations between two countries are critically analysed in this paper. Therefore, the epistemology of this study is qualitative method. Moreover, besides the qualitative research method, the researcher analysed data thematically in order to understand perspectives on China and Pakistan relations. In addition to this, the research employed the data from secondary source for instance: Books, research articles, journals, and Newspapers. This study analysed the relations critically so that relations between the two countries be realistically explored and understood. In this way, countries can revisit their relations and trade and investment ties from different perspectives. The research anticipates that this study will, not only help researchers or professional of political science and international relations students, but also it would be of enormous advantage for policy makers on the both sides.

Thematic Analysis

1.3 Pakistan- A part of 'Asia Pivot' strategy

Pakistan is considered as a "Pivot of Asia" (Ghulam, Waheed, Ch. (1947-1966, p 54)[10]**.** It holds great geopolitical importance in the region. It is situated at the cross-roads of South, Central and East Asia. The geopolitical standing of Pakistan has always attracted the attention of the major powers towards her. Keeping in view this importance, Pakistan's geopolitical importance cannot be ignored in such a grand equation. The Pak-China friendship is unique and precious from different accounts. First, China is neighbour to Pakistan, second, it has always withstood with Pakistan in the trying times. Its unhindered support and investment in multiple fields, for instance: economic, defence, political and social, is praiseworthy. "They have signed not only Border agreement (1963) but also FTA agreement" (Bir, Singh, Udhay, 2006. P 38)[11]. Therefore, it is safe to say that the friendship between Pakistan and China is remarkable, unparalleled, exemplary and dynamic. The former National Security Adviser of America, Henry Kissinger's meeting was arranged by

Pakistani channels in 1971. Since 1980's, China has been supporting Pakistan: diplomatically, technologically, economically and militarily. There are three factors which are attributed to have culminated into strengthening Pak-China relations. Those factors are mentioned as under: India-China war in 1962, Indo-USSR relations, India-US ties etc.

It is important to note that within a short span of time, the turning point in relations was due to the Chinses construction of Karakoram Highway (K.K.H), Gawadarport, establishment of Chashma Nuclear Reactors and construction of various dams in Pakistan, reflects commitment, sincerity and cordiality of Pak-China friendship. China has withstood with Pakistan in testing times. There have been wars between Pakistan and India in: 1965, 1971. Obviously, it was China not the US which helped Pakistan in difficult times. The frequent exchange of visits of both states to each other has given "the big stimulus to strengthen ties between Pakistan and China. It also helped both states to come closer to each other. This closeness reflects a strong and deep understanding" (Rasul Bux Rais, 1977. P 32)[12].

Economically speaking, Pak-China bilateral trade has been increasing rapidly. For example: the trade has increased from 1 billion dollars to 15 billion dollars in 2015. The Chinese Prime Minister Wen Jiabao visited Pakistan. He concluded economic deals with Pakistan and that is worth of 35 billion dollars in total. Masood Khan- the former foreign minister of Pakistan: "Approximately 120 Chinese companies are working in Pakistan. China has invested in Pakistan's infrastructure, energy, agriculture, banking, railways, space, commercial and health projects Heavy engineering, IT, Mining, and defence industry." "China is a time tested friend of Pakistan in the region and building projects worth $20 billion in the country. Moreover, the work is underway on different projects that are to the tune of 14-billion dollars" (Raja Aqeel and A. Rasheed, 2011)[13]. The rising China is focusing on the various projects and sectors in Pakistan.

Similarly, the Prime Minister of China-Wen Jiabao, while addressing the parliament of Pakistan in 11th December 2010, had said that "the steadfastness of the pine tree is shown in the frigid winter; the strength of the horse is tested in a long journey". Pakistan and China no doubt enjoy the friendly and cordial relations. Throughout the decades of their "all weather and time tested friendship", they almost have lived up to their expectations. The Chinese help, encouragement and support: security, economic, technological, human, infrastructure development, etc. have all along been worthy of praise (Wen Jiabao, December, 19, 2010)[14].

1.4 The Gawadar Deep Sea Port-A Game Changer in the region

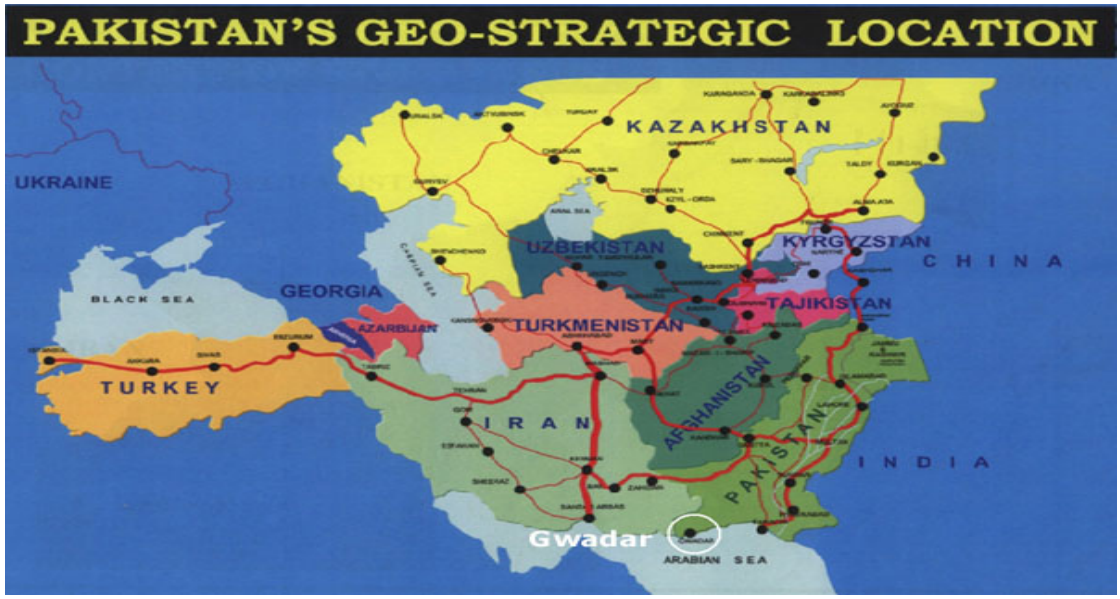
The Gawadar deep sea port is situated in Pakistan's Baluchistan. It is being considered as the 3rd deepest sea port in the world. The strategic and economic importance of the port has attracted the attention of the great powers of the region. Moreover, it holds a centre stage in fishing and industrialization purpose for the indigenous people of Baluchistan. No doubt, it is capable to carry out and handle international shipping vessels, and entails big potential to transfer oil from one place to another. It links itself with the strategic choke point of the Gulf of Oman, Straits of Hormuz, Central Asian countries (Uzbekistan, Tajikistan, Kyrgyzstan, Azerbaijan, and Turkmenistan), Afghanistan and Middle East (*The News*, Dec.07. 2015)[15].

There are three major stakeholders of this deep sea port: P.S.A (Port of Singapore Authority), N.L.C (National Logistic Cell), and A.K.D (Group of Karachi). Pakistan had made contract with PSA in order to

manage the Gawadar port for about 40 years. Notwithstanding, the management of the port could remain even a decade for one reason or the other.

MAP: 01

Map of Gawadar Deep Sea Port



[16]Source: http://www.gda.gov.pk/pages/asiaregion.html

The regional players are taking keen interest in the development of the Gawadar deep sea port. China- the emerging economic power is too much interested in developing this port. China is investing 80% on development of the port. Even it is ready to take risks in this part of the volatile region. In 2002, Gawadar port was inaugurated by China. The development of the Gawadar port is considered to be instrumental in the Pak-China friendship. According to analysts, Indians believe that China is having the similar interest like developing the String of Pearls Policy in the region. The Indian Express, while quoting Wang Shida, a profound scholar at the Beijing-based ICIR (Institute of Contemporary International Relations), said that that the Gawadar port is expected to be instrumental in the development of economies on both the sides.

It offers win-win advantages for China and Pakistan. Thus, he believes that Pakistan will reap fruits of the Chinese mega project and act like a catalyst for exports from Pakistan. For China, the expert said, that it will enable China to import oil from the Middle East in cheaper terms (*Indian Express*. November 12, 2015)[17].

Broadly speaking, the Chinese interests and objectives are to extend its networking either through railway or roads in South Asian region. They intend to import oil and timber through this port. It will also be beneficial for the Chinese to import and export not only from Afghanistan but also from Central Asian countries. Chinese engineers are going to develop an airport in the vicinity of Gawadar and Dry port near the Pakistan-China border. The port of Karachi and other sources of supply like Gulf Sea, by Chinese are going to be risky, costly and lengthy. While comparing Pakistan's Gawader port with Iraninan Chahbahar port,

Pakistani expert, Abdul Qayyum Kundi, opined that the port of Gawader invariably offers more strategic and economic dividends to China than Chahbahar (Mian Abrar. February 6, 2016)[18].

In addition to that, the Chinese fear for its supplies pass through the Straits of Malacca and this part of the region is under the American influence. However, the Gawadar provides China with easy access, safer, cheaper and shorter route to the West of China. After the development of the Gawadar port, China will be able to influence in the Middle East. Similarly, with the rise of China and development of a deep sea port, Pakistan will reap its fruits. Pakistan will remain to be the hub of economic activities in this region. For Pakistan lacks technology and strategy to explore and attract foreign direct investment, the Chinese cooperation and partnership will leave a great impact, not only on Pakistan economy, but also image and stability. They both can fight and neutralize the forces of anti-development in this region.

1.5 Chinese Investments in Pakistan's Energy Sector

Since the last few decades, Pakistan is passing through multiple crises. Among these crises, the energy sector is still looming large. The routine business in Pakistan, particularly in Karachi-economic hub of Pakistan, is halted and jolted due to insecurity and mismanagement. The previous governments have failed to attract the attention of the investors in uplifting the energy sector. In order to bring it out of the economic brinkmanship and breakdown, Pakistan has been looking towards other neighbours like China, with whom it has time tested friendship.

The Chinese government has extended her cooperation in the field of energy sector. In order to materialize these things, China has developed many dams in Pakistan. Some dams are being designed, some others are under construction and still few are at the operational stage. These mega projects have been undertaken with the help and cooperation of China. A few names are given as under.

Table: 01

Name of Project	Status	Nature of project
Kot Addu power company (Kapco).	Operational	Oil- and Natural Gas-fired thermal stations
Hub Power Company	Operational	Oil-fired thermal station
Bin Qasim Power Plant	Operational	Oil- and Natural Gas-fired thermal station
Jamshoro Power Company	Operational	Oil- and Natural Gas-fired thermal stations

Guddu Thermal Station	Operational	-DO-
Lalpir and Pakgen Thermal Station	Operational	-DO-
Uch Power Plant	Operational	-DO-
Rousch Power Plant	Operational	-DO-
TNB Liberty Power Plant	Operational	-Do-
Foundation Power Company (FPCDL)	Operational	Combined Cycle Power Plant
Fauji Kabirwala FKPCL	Operational	-Do-
Gul Ahmed	Operational	; Furnace Oil
Altern Energy	Operational	Gas-fired Diesel Engine

Source:Compiled by the author

Hydro Power Projects in Pakistan are under way. Approximately, there are 48 dams which are proposed. Moreover, there are 16 dams which are said to have been working in Pakistan and some others around sixteen are under construction and still few dams feasibility reports have been prepared. The construction of various dams in Pakistan has been on the part of China. China is a time tested friend of Pakistan. It is said that China will try its level best to bring Pakistan out of the current energy crisis. Therefore, construction of multiple dams is in that connection.

1.6 Pak-China Defence Cooperation

Pakistan was carved out on the 14th of August, 1947. It was fraught with problems of multidimensional nature. For instance: refugee, distribution of resources, water, administrative, infrastructure, etc. After getting independence from the unwilling hands of the British-Hindu complex, it tries to resuscitate from the depth of poverty, ignorance, mismanagement and an abyss. Indian congress believed that the nascent state of Pakistan cannot survive even a decade. Nonetheless, with meagre resources Pakistan managed to survive.

Obviously, the colonial masters had left many issues unresolved in South Asian region. Geographically, Pakistan is surrounded by India, Iran, Afghanistan, and China. For decades, the foreign policy of Pakistan has either been Indo-centric or American-centric. India has been considered as Pakistan's enemy. It has fought four wars with India: (1947, 1965, 1971, and 1999.) Indian hegemonic designs and its belligerent

attitude have rendered many emerging states to think of alliances with one or the other country in the region. There have been various factors which have resulted in the closer defence cooperation between Pakistan and China.

Louise Merrington of Australian university wrote in his article, "the India-US-China-Pakistan Strategic Quadrilateral", on 11th April, 2012. He noted following factors that have shaped Pak-China defence cooperation: India as a regional policeman; end of the Cold War and realignments in the region; Indian rising influence in South Asia and South East Asia with the help and encouragement of America and Japan; the policy of containment or encirclement of China through America[19]. The former ambassador of Pakistan, Masood Khan, while talking to a delegation of training officers of Pakistan Air Force War College, on 29th April, 2012, was of the view that Pakistan and China are having defence cooperation on four dimensions.

These dimensions range from security, region, exchange of officers to military exchanges and exercises besides visits to each other's country[20]. However, military and technological exchanges between Pakistan and China have been considered by the USA as a violation of the MTCR (Missile Technology Control Regime) and NSG (Nuclear Supplier Group) rules. The development of Missiles like M-II and M-9 are termed by India and Americans as a violation of international law and standards. Nonetheless, Pakistan and China are of the view that Pakistan has developed its nuclear prior to the existence of NSG. Therefore, the development of Missile technology in no way violates NSG rules and regulation. Pak-China defence ties were strengthened after 1962, Indo-US nuclear deal in 2008. America intends to contain the rise of China through India, whereas, China does the same thing through Pakistan for Indians. The interests of USA-India-China overlap and intersect in South Asia and South East Asia. It is said that competition or rivalry among these powers will help further cement Pak-China relationship.

It has been the desire of Pakistan to maintain nukes at deterrence level. In this connection, China came to the help of Pakistan. It inked a nuclear comprehensive agreement in 1986. With the changing geopolitics in the region, in 1989, Chinese Prime Minister-Li-Peng and in 1996, Jiang Zemin- Chinese president visited Pakistan. They assured Pakistan to cooperate in the establishment of power plant. Not only China-Pakistan collaboration, but also other countries have participated in the different projects. In connection to this, at least two Chashma Nuclear Power Plant is currently at operational level, and CHASNUPP-3-4 is under construction. The following table shows that either indigenous or Chinese cooperation in developing nuclear technology in the country like Pakistan.

Table: 02

Aircraft/ Missile	Range	Source	Status
F-16 A/B	925 Km	US	35 Planes in inventory.
Mirage 5	1300 km	France	50 Planes inventory
Hatf-1	80-100 Km	Indigenous/China	In service
Hatf-2 (Abdali)	180 Km	Indigenous/ China	In service
Hatf-3 (Ghaznavi)	300 Km	Indigenous/ China	In service
Hatf-4 (Shaheen-1)	600-800 Km	Indigenous/China	In service
Hatf-5 (Ghauri-1)	1300-1500 Km	Indigenous/ DPRK	In service
Hatf-5 (Ghauri-2)	2000 Km	Indigenous/ DPRK	Under construction
Hatf-6 (Shaheen-2)	2000-2500 Km	Indigenous/China	Under construction
Hatf-7 (Babur)	500-700 Km	Indigenous/ China	In service
Hatf-8 (Ra'ad)	300 Km	----------	Tested in 2008

Source: Peter Lavoy, Pakistan's Nuclear Posture: Security and Survivability", *Centre for Contemporary Conflict,* 2007, pp.8-9

China and other countries have helped Pakistan to develop its missile capability from time to time. With the active participation and collaboration of China, Pakistan has been successful in manufacturing JF-17 Thunder Aircraft, K8-Trainer Aircraft, Al-Khalid Tank, F-22 Naval Frigates, HRF (Heavy Rebuild Factory) in Taxila, PAC (Pakistan Aeronauticle Complex at Kamra) KKH (Karakoram Highway) last but not the least Gawadar port. This Chinese cooperation is a thing to be praised. This amply portrays that Pakistan and China enjoy better relations. In spite of Chinese active support to Pakistan in all spheres of life, still there is a trust deficit between their relationships. It is so because Pakistan has remained in the Western camp since its inception. Therefore, this factor, in fact, derives a wedge between Pakistan and China. The rising ties between India and China in economic field also leave a big question for Pakistan. The following analysis will further suggest that China and India, despite of 1962 war have developed their trade and investment to a great extent.

1.7 India-China Rising Trade Relations: Indian Lens

After the end of the Cold War, security, political and economic dynamics of South Asian region changed from 1990-96 and from 2000 to 2011, India-China political economic and technological exchanges have witnessed a great leap forward. However, strengthening India-China relations are created mistrust in Pak-China friendship. India also perceives Pakistan a security threat. It also considers Pakistan a major hurdle in the CBMs between China and India. India-China trade reached to 50-billion dollars in 2010. Recently, the Chinese trade delegation visited India. They signed trade deals worth billions of dollars.

According to the report, at least 48 deals were inked. According to an economic survey, "the bilateral trade between India and China- two Asian competitors began their trade process in 1991. In this year, trade ratio was reached to 262 million dollars. And since then, the unprecedented economic development in both states has enhanced the level of trade amounting to 60 billion dollars in the last year. It is expected that this trade ratio will rise further to 100 billion dollars in 2015" (Rabia Yasmeen, 2011)[21].

1.8 China-India Military Ties-Pakistan's concern

No doubt, China has defence relations with Pakistan, but former's military exercise and exchanges with India could be a concern for Pakistan in the long run. In 1993, there have been reciprocal visits between India and China. After these exchanges (1993, 1994 and 1995), both sides underlined the need to strengthen political, economic and defence ties. They reached to an understanding that through dialogue and diplomacy, they can resolve all outstanding problems including border. It was reported in the 'Economic Times', in April, 04, 2011: 'Military to military exchanges paves the way for strong commitment. And this understanding with her immediate neighbour will be result oriented. They, in recent meetings have also made a commitment that the issue of visa, which sparked a hue and cry in an Indian media, would be solved in an atmosphere of trust and harmony'[22].

In addition to the rising trade and investment in each other country, joint military exercises in the Indian Ocean and defence ties raising certain questions on the part of Pakistan. "In 2004, India's the-then Army chief, Gen. N.C Vig, received warm welcome in China. Both the parties agreed to deepen defence ties. This shows return back of normal relations between the neighbouring giants and former foes" (Executive Intelligence Review, 2005)[23]. This visit was reciprocated with Chinese counterpart, Liang Guanglie and Defence Minister, Cao Guangchuan. Cao told the Indian General that: "China would like to set up its cooperation with India in the defence and security sector" Reports Xinhua, the news agency of China. Military exercises between India and China could be seen with concern in Pakistan.

However, "India and China resumed military exchanges that were halted in July-2010, after Beijing refused to provide a visa to a top Indian Commander who intended to visit China" (Vivek Raghuvanshi, 2001.). "Eight member Indian military delegations arrived in Beijing, for a six day visit. The head of the delegation was the head of a counterinsurgency into deployed in the Indian held Kashmir" (Edward Wong, 2011)[24]. The Economic Times reported on April-27, 2011, that it was a "new breakthrough and development momentum that have emerged in Sino-Indian military ties" [25].

1.9 Kashmir Enigma:The Dragon's Policy

The early 1970s saw numerous changes in geopolitical dynamics of Sino-Pak relations. Among the major changes, change of leadership in China was prominent. The policies and approaches of the Chinese leader Deng Xiaoping were largely aimed at economic development. They gave top priority to the economic development. The desire for development rendered them to keep themselves away from the spirit of nationalism and nationalistic tendencies.

They opened up the doors of their economy to the outside world. Moreover, their focus was to normalize relations with other countries, specifically what they called it as near to or adjacent to the Chinese border. In the wake of this development, relations between China and Pakistan also subjected to these sweeping changes. The most important factors behind this change were: (a) The Republic of China, given the geopolitical changes, adopted neutrality not only towards the South Asian region but also towards India-Pakistan disputes. (b) China's support and stand on certain issues: like Kashmir, also decreased. It only maintained that Kashmir issue has to resolve peacefully and in a friendly manner. (c) On many other issues, between India and China, China tone down, its support. It was obvious from the event of the Kargil crisis of 1999, and Indo-Pak military standoff in 2001-2, in which China remained almost neutral. (d) The changing Chinese attitude left an overwhelming impact upon the defence cooperation between Pakistan and China. It also abandoned support for Pakistan during its missile and nuclear program. However, open cooperation is going on even today. e) China started normalizing its relations with Pakistan's nuclear rival India since 1988.

It is believed that after the Cold War era, China has adopted a policy of neutrality over South Asian problems. Chinese changing foreign policy, increasing economic and military ties with India reflects Chinese changing attitude. Chinese current trade with India is 15-billion dollars and it is expected to rise to 100-billion dollars. "In spite of these military and economic ties between India and china doesn't reflect the complete change of latter's policy towards Pakistan" (Khokhar Amna Yousaf, 2011)[26] .

The Chinese changing foreign policy was due to political and geoeconomic and security changing in the region. "China's decision to reach a rapprochement with India was, in no sense, an indication of its change of stance on the disputed territories rather that it was the by-product of the changing international political environment, this changing situation ushered in the new pattern of working between nation states. The debt crisis, changing global ideological climate of the unipolar world demanded the developing countries to engage with the outside world" (Memon Amman, 2008)[27].

The Chinese foreign policy change was mainly due to the end of the Cold War and the simultaneous disintegration of the USSR. It created a huge gap or vacuum. And this vacuum was filled by China. It followed the non-confrontationist and non-violent policy towards its neighbours. However, closer relations between India and China obviously show that strengthening ties between two powers were changing geopolitically, economically and security dynamics of the region.

"Beijing has traditionally supported Pakistan against India, but now in the Post Cold War era, the Chinese have distanced themselves somewhat from Pakistan, in order to cultivate better relations with India," maintained Michael Yahuda, professor International Relations, London School of Economics and Political Science. The conflict over the border between China and India resulted in the former's emphasis on the Kashmir's right to of self-determination, according to the wishes of the people of Kashmir. It was crystal clear from Zhou Enlai's interview: "We were on friendly terms with India; we took an attitude of non-involvement in the Kashmir issue. We have always cherished the hope that India and Pakistan would settle the Kashmir issue and other problems in a friendly manner, with Pakistan. Despite, friendly terms with Pakistan, we have not given up our desire for friendship with India" (Ahmed Ishtiaq)[28].

"The era of 1990's have seen the fact that the Kashmir's movement of self-determination has been subject to certain ill-forces, like: extremism, religious militancy etc. The Nine-Eleven acts changed the entire climate of the region. However, the changing scenario was not favourable to the people of Kashmir. Their right of self-determination was put into a cold storage. The legitimate freedom struggle of Kashmiri's got great set back and blow" (Shingling Lin, 2011)[29]. While giving interviews to the Indian journalist, in 1980, Deng Xiaoping had said: "Kashmir is a bilateral problem between Pakistan and Indi and it should be solved by both states in an amicable manner." The issue of Jammu and Kashmir has got a wide currency in the national and international level. It is the disputed part of the land. India as well as Pakistan has fought four wars. Almost 62 years have elapsed; Kashmir has been a bone of contention between both of the nuclear rival of Asia. This disputed territory has been since long time a nuclear flash point in the South Asian region. There are different versions of Kashmir problem.

Map.02

[30]*The Economist.*
"Indian, Pakistani and Chinese border disputes Fantasy frontiers". Feb 8, 2012. http://www.economist.com/blogs/dailychart/2011/05/indian_pakistani_and_chinese_border_disputes

China, before the Cold War, supported Pakistan's stand on Kashmir. But as the time went on, it maintained its policy of neutrality after the Post Cold War era. Now the Chinese leadership holds that Kashmir is a disputed territory between India and Pakistan, therefore they themselves have to solve it in a cordial manner. Keeping in view these developments, China is now very cautious about its future relationship with India and Pakistan. These developments aside, it is also believed that China is not going to shun its Pakistani card any time soon. It has made various agreements with Pakistan that is worth billions of dollars. Huge

developments in energy, security, strategic ports and overall economic infrastructure of Pakistan are clear manifestations of Chinese commitments with Pakistan in future.

The India and China aspire to regional and global supremacy. Their ambitious policies and different approaches at the regional and international level is a manifestation of their cooperative and competitive nature of the relationship. It is said that even if Sino-Indian relations blossom, flourish and improve, will not deter the former to have friendship with Pakistan. Many a times, China has expressed her intention. And it is analysed as follows:

a) The rise of China is expected to force India to maintain peace with Pakistan.
b) China has, time and again, expressed that its ties with India, in no way, fracture its relations with Pakistan.
c) The absence of both political or territorial disputes and the Chinese strict adherence to the Five Principles of Peaceful Co-existence will further strengthen Pak-China friendship.
d) The major factor behind Pak-China friendship is common thinking and understanding of the regional and global level.
e) "Pakistan-China military structures suggest that they want continuous and long term friendship" (Fazal-ur-Rehman, 1998)[31].

1.10 Conclusion

The relations between Pakistan and China are unparalleled and exemplary. Indeed, both the countries have withstood the challenges at national, regional and global level. In this context, the rise of China at global stage; its own paradigm for development; and the new ways for interacting with regional and global powers on win-win or equal footing, have earned her a great respect and credibility among the comity of nations. Pakistan, being the neighbour of China, has the privilege to attain/reap the dividends from the emerging giant in terms of trade and investment in the region. The frequent exchange of visits between Pakistan and China leadership, inevitably, reinforces further the mutual trust and cooperation at multidimensional level. This cooperation ranges from technology, industry to political, economic, social, cultural, educational, diplomatic and military. The off-late landmark agreement CPEC (China, Pakistan Economic Corridor) was one of the watershed between two countries. This trade corridor will open up the new opportunities for the people of Pakistan in the long run and also benefit China.

Nevertheless, these developments between both the neighbours aside, the critics of Pakistan and China relations like, Dr. Qaiser Bengali-a renowned economist, expressed the highs and lows in Pak-China relations. He pointed out that China is increasing its military cooperation with India. For decades, India has been considered, Pakistan's old rival in the region. The increasing defence ties between India and Pakistan could affect the later's effective campaign on internationalizing Kasmir issue. Ironically, Pakistan and India has fought four wars in the past. Pakistan expects its time tested friend, China, to be cautious over its India policy.

This paper analysed Pakistan-China relations through the Indian lens. It highlighted the Chinese relations with India: military and economic cooperation. This article pointed out that the Pakistan-China friendship could be affected, provided the Chinese keep up their policy of defence cooperation with India. On the whole, this phenomenon might lead to Cold War/power imbalance in the South Asian region. This article thematically and critically analysed relations between Pakistan and China. It further noted that the current

political crisis in Pakistan can hamper the Chinese trade and investment process in the future in Pakistan. Thus, this paper suggests that consistence in the Chinese investment process; the policy of neutrality; win-win based relations and complementary economic ties can be pivotal in cementing Pak-China relations and could counter their common threats in the larger interests of peace and prosperity of the South Asian region.

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