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## Editorial

### Dear authors, reviewers, and readers

It has been a month since I was given the privilege to serve as the Chief Editor of the International Journal for Innovation Education and Research (IJIER). It is a great pleasure for me to shoulder this duty and to welcome you to **THE VOL-3, ISSUE-9 of IJIER** which is scheduled to be published on **30<sup>th</sup> September 2015**.

International Journal for Innovation Education and Research (IJIER) is an open access, peer-reviewed and refereed multidisciplinary journal which is published by the International Educative Research Foundation and Publisher (IERFP). IJIER aims to promote academic interchange and attempts to sustain a closer cooperation among academics, researchers, policy makers and practitioners from a wide range of disciplines, which contribute to state of the art in science, education, and humanities. It provides a forum for the exchange of information in the fields mentioned above by welcoming original research papers, survey papers, and work-in-progress reports on promising developments, case studies, and best practice papers. The journal will continue to publish high-quality papers and will also ensure that the published papers achieve broad international credibility.

The Chief Editor, appointed by the Associate Editors and the Editorial Board, is in charge for every task for publication and other editorial issues related to the Journal. All submitted manuscripts are first screened by the editorial board. Those papers judged by the editors to be of insufficient general interest or otherwise inappropriate are rejected promptly without external review. Those papers that seem most likely to meet our editorial criteria are sent to experts for formal review, typically to one reviewer, but sometimes more if special advice is needed. The chief editor and the editors then make a decision based on the reviewers' advice.

We wish to encourage more contributions from the scientific community to ensure a continued success of the journal. We also welcome comments and suggestions that could improve the quality of the journal.

I would like to express my gratitude to all members of the editorial board for their courageous attempt, to authors and readers who have supported the journal and to those who are going to be with us on our journey to the journal to the higher level.

**Thanks,**

**Dr Eleni Griva**

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## **An Appraisal Of Cottage Industrial Solid Waste Management Practices In Mubi Metropolis, Nigeria.**

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### **Abstract**

*The study examines cottage industrial solid waste management practices in Mubi Metropolis where the generation and management were dominantly the focal points. Collection of data was largely based on reconnaissance and questionnaire surveys. The survey administered a set of questionnaire to 124 cottage firms, where data collected were summarized and presented in form of percentages and tables. Consequently, descriptive and quantitative statistical analysis for valid decision making was employed. Analysis however reveals the major types of cottage firms as grain polishing or husk removal, furniture making, bakery, flour mills, water packaging and brick/block industry, where findings shows waste generated by them being peculiar to what they produce, as saw dust, grain husk, charcoal and ashes pure water bags and brick/block rubbles. Some of the waste generated are reusable and are sold as animal feed or given out to people for free which is dumped on farmland as soil amend. Concerted cottage industrial waste reuse or recycling which partly forms the cornerstones to shrinking the overwhelming urban waste problem in the area is ardently recommended.*

**KEY WORDS:** Cottage, Industry, Solid Waste, Management.

### **Introduction**

Generally, there are four ways to get rid of solid waste: dump it, bury it, burn it or compost it (Raven and Raven, 1998). In the rapidly urbanizing cities of the developing world, problem and issue of waste management has become intractable. The rapid rate of urbanization, population growth, industrialization and their consequent waste generation overwhelms the capacity of most municipal authorities to provide sufficient basic management service to handle these wastes. Solid wastes are disposed of in uncontrolled dumpsites and/or burnt, causing pollution (Zurbrugg, 1996).

Municipal solid waste (MSW) is discharged as a result of human activities such as waste produced through domestic and commercial/industrial activities in urban areas. On the other hand, cottage industrial solid waste management practices are the techniques and/or methods employed by cottage entrepreneurs in the collection, storage, transportation and disposal of solid waste generated from day to day productions.

According to Sheehan and Knapp (2000), waste problems are generally due to resource management, as a result of bad design, and ultimately, the result of bad decision making (Lombardi, 2001). However, zero waste is a new way of looking at or managing our waste stream. Instead of seeing used materials as garbage in need of disposal, they are seen as a valuable resource. Piles of trash represent jobs, financial opportunity and raw material for new products (Matsch, 2000). It involves reuse and recycling instead of our throw away norm/ideas (Oyelola and Ojo, (2004). Recovering of resource from waste is a major player in the reduction of our urban waste stream; it conserves our natural resources and more environmentally benign (Botkin and Keller, 1997; and Raven and Raven, 1998).

Metropolitan cities in developing world are the centers of economic growth particularly small scale or cottage firms, where development and implications leading to consequences of such growth and development are bound to happen. These consequences are numerous. For example, land and air pollution, solid and liquid waste disposal, unsanitary conditions, slum, encroachment etc.

Nigeria cities are rapidly growing not only demographically but in areas of economic pursuit such as cottage commodity processing among others, where various forms of waste are produced, posing serious environmental problem that emanates from poor waste collection and disposal (Sada, 1980). Poor urban refuse management has resulted in ever increasing solid waste heaps found on vacant lots and streets. Despite measures taken to address the problem, the sanitary conditions in most cities in Nigeria are still far- fetched (Omuta, 1988).

In Mubi Metropolis, wastes generation is traced not only to household or domestic chores, but equally to the production processes of numerous cottage industries found in the area though they differ at varying degrees of generation. Obviously, cottage industries generate less waste than domestic activities.

The study practically covers some aspects of Municipal Solid Waste (MSW) generation and management practices in Mubi Metropolis that concerns cottage firms because they contributes significantly to the townships waste stream. Consequently, the generation, collection and storage, transportation, and disposal practices of cottage firms in the metropolis were examined.

## **Study Area**

Mubi metropolis cut across Mubi North and Mubi South local government areas, and located in the northern part of Adamawa State (see figure 1. It lies between latitude  $10^{\circ} 14'$  and  $10^{\circ} 18'$  north of the equator and longitude  $13^{\circ} 14'$  and  $13^{\circ} 19'$  east of the Greenwich meridian (Adebayo, 2004).

## **Methods And Procedures Of Data Collection**

To collect data for the study, a reconnaissance survey identifying the various cottage firms in the area, bearing in mind the objectives of the study. One hundred and twenty four (124) cottage industries were identified, where proprietors or employees of the cottage firms were interviewed with the help of questionnaire survey. Data were collected from these cottage industries with regards to; type of firm, organizational set up, raw material used and their source(s), type and composition of waste generated, reusability of waste generated, management of non-reusable waste (collection/storage, transportation and disposal).

## **Waste Management Practices Of Cottage Industries**

### **Nature of Cottage Industries**

Data was collected regarding the status of respondents as employees or proprietors of the cottage firms, which shows 97% of the respondents as employees while 3% as proprietors. This portends that most respondent are stakeholders and are directly involved in the production process.

Data collected further reveals that of all cottage firms interviewed, only one, the Mubi Burnt Brick (1%) was government owned. The remaining one hundred and twenty three (99%) belongs to private entrepreneurs.

On how long the cottage industries have been in existence, 49% respondents indicates that their cottage firms have been existing for not less than five (5) years, 30% respondents indicated 5 to 9 years and 21% of the respondents indicated their firms have existed for over 10 years.

To be able to determine the extent, types and composition of waste generated by the industries surveyed, data was sought on industry type, whether service or production oriented. The information gathered revealed

that majority, representing (75%), i.e. two third of the cottage firms were productive industries while only a few (25%) were service industries.

The study was also interested in determining the major products manufactured by the industries especially the production industries that are likely to produce waste. This is to assess if there are by products which are generated as waste. Findings shows that majority of the cottage industries, (19%) were furniture making firms, bakery (21%), flour mills/grain offal removal (36%) and water packaging business (6%). Others are the production of red bricks, cement blocks, local drinks, buns/cake, and aluminum utensils (3%), (5%), (4%), (3%), and (3%) in that order.

### **Types and Sources of Raw Materials**

Data was collected on the types or composition of raw materials used in cottage industrial production processes. This is to determine the extent to which wastes could be generated from such industries. Data obtained shows that majority of the types and source of raw materials used by the firm's, rice, corn, wheat, timber/plywood, gravel/clay, fuel wood, generates wastes synonymous with raw materials used; grain husk or offal, polythene bags, saw dust, charcoal, ashes and brick rubbles. The study further sought to know from proprietors of these firms sources of their raw materials and data obtained shows that majority of the firms get raw materials locally (76%), 16% externally and 10% source internally and externally.

### **Waste Generation of Cottage Industries**

In the same vein, information was sought from respondents on wastes generated during production. About 92% of the respondents affirms their cottage firms generates varying types and degree of some kind of wastes, while 8% were non affirmative. Furthermore, summary of data on the composition of wastes generated as it relates to the type of industry, and the raw materials used in the process of production reveals that most of the wastes generated are grain husk (34%) saw dust (32%), charcoal/ashes (17%) polythene bags (12%) and are mainly from the service industries. Only 5% of the waste is made up of brick rubbles from burnt brick industry and block industries.

Data on estimated waste generated per day by the cottage firms were sought and it shows that 29% of respondents generate between 40 – 49kg of waste per day, 24% generate waste between 50 – 59kg, while 10% generate between 70 – 79kg and 30 – 39kg per day. The least, 5% generate between 10-19kg per day respectively. Consequently, it is evident that a substantial amount of waste is generated by the horst generators which are the cottage industries.

### **Uses of Wastes Generated from Cottage Firms**

With regards to re-usability of waste generated, data obtained shows that 80% of proprietors said greater parts of the waste they generate are reusable while 19% said wastes generated are not reusable. The most waste generated and can be used according to respondents is grain husk or offal (48%), accruing from the processing of grain like maize, guinea corn and millet. Others are 23% rice husk, 14% saw dust, 10% charcoal/ashes and 5% brick rubbles generated by rice mills, bakeries and burnt brick industry respectively.

The wastes generated as grain chaff or offal are used as animal feed according to (35%) of respondents while 32% of respondents said rice husk are deposited on farmland and burnt or set ablaze and residues (ashes) serve as soil amend, or husk, deposited to decompose though slowly, to serve as compost manure. According to 8% of respondents, saw dust are used as floor-safeguards for poultry bird litters, charcoal is used for heating, cooking and ironing of clothes (15%) and brick rubbles used as pot-hole filler on bad road (10%). data

The reusable wastes according to 96% of respondents are collected and sold out to other users whereas 4% of respondents say wastes generated are used up by their organization. Data collected also showed that animal breeders and farmers purchase the bulk of the reusable wastes for animal feeds, and for compost manure, (42% and 26% respectively), while poultry farmers that use the reusable waste account for 25% respondents and 5% respondents says they are purchased and utilized by households.

The wastes according to respondents (94%) are sold out for varying amount of cash ranging between N1000 to N1500 (\$6 to \$9) depending on the size of the bag while 6% of the respondent gives the by product out for free.

However, the researcher's personal observation in this regard shows that other reusable waste generated such as excess brick rubbles, saw dust and ashes are mainly disposed off outside the factory or within the neighborhood of workshops or bakeries, which are hence collected by final users if they so wished for free. The red bricks are used for erosion control, pothole filler, filler for marshy compounds and streets. Equally, saw dusts are used for protection of poultry floor against fowl litters, and ashes are used for pests and herbicides control especially insects that feed on foliage of plants and for the control of strigger weed (wuta-wuta), on farmlands (Table 1).

**Table 1: Types of Cottage Industries in Mubi Metropolis showing Source of Raw Materials, Product Types, Waste Generated and Uses.**

<b>Cottage Industries</b>	<b>Type/Source of Raw Materials</b>	<b>Products</b>	<b>Waste Generated</b>	<b>Use of Waste Generated</b>
Rice mill	Rice	Polished rice	Rice Husks	Little amount is utilized as soil amend (manure) by some residents as it takes long time to decompose in soil. Others dump on farm and burn them to produce ashes which infuse in the soil as soil amends.
Corn mills	Corn e.g. maize, guinea-corn, millet	Polished corn	Corn husks or offal	Animal feed/for fattening animals
Bakeries	Wheat flour, sugar, water, butter, baking powder, yeast, flavour, vegetable oil, fuel wood, aluminum, packaging, labels	Bread, buns, meat pie	Charcoal, ashes, waste- water, disused metals, polythene packages, paper	Charcoal used by tailors, dry cleaning services and washmen services, domestic heating and cooking. Ashes used to control aphid pest and strigger (wuta-wuta weeds).

Carpentry/ furniture	Timber or plants, plywood, nails vanish, paints, sand paper, tools, adhesives, foam, cloth and leather upholstery	Chairs, tables, cushions sets, side stools, doors, windows, cupboard, wardrobes, drawers etc	Saw dust, pieces of cloth, and leather, wood chips.	Saw dust is used as protection of poultry floor against bird litter.
Brick/block	Clay, sand, cement, water	Red bricks, blocks	Brick and block rubbles, waste water	Filling pot holes, erosion site, reclamation, marshy compounds.

Source: Reconnaissance Survey (2010)

### Waste Collection and Storage by Cottage Firms

Data summary on collection period of waste indicates that majority of respondents (80%) collect waste from their firms twice a week, 12% collect accumulated waste on weekly basis while 8% of respondent's sweeps and collect their waste daily.

Waste collection from the cottage firms is commercialized. Waste collection fare ranges between one thousand to three thousand naira per collection (six to eighteen dollars). Observation by the researcher shows waste that cannot be reused are collected and subsequently disposed off into erosion sites and bad roads especially wastes from burnt bricks and block manufacturing industries.

### Waste Disposal Processes by Cottage Firms

However, cottage proprietors that do not utilize the above disposal method transport waste to disposal sites mainly within the vicinity, open dumps and drainage channels. However, some wastes are given out to people that re-uses them (6%) or at worst burnt (84%), where it is done without due consideration of effects it may have on the environment (94%). Only 6% respondents are aware of the impact of open air waste incineration but still burn them openly.

## Discussion

Almost all cottage industries in the study area are privately owned, and this can be attributed to the dividends of the prevailing democratic dispensation Nigerians are experiencing with respect to the recapitalization of lending institutions. The banking and finance sector after the major reforms were strengthened. Depositors and creditors gained confidence once more and there seems to be a lot of capital where investors could pull from. Equally, government policy on poverty eradication has turned many unemployed Nigerians into small scale entrepreneurs. All this and other factors culminated into many residents in Mubi gaining the necessary assistants and consequently, became proprietors of small and medium scale industries. Most of the small scale industries are productive and not service industries, and engaged mainly in furniture making, bakeries; flour mills/grain husks removals and water packaging. Others are brick/block industries, local drinks processing and local production of aluminum utensils, each contributing to varying degree and types of waste generated.

Among the major waste types generated are grain husks from rice, maize, guinea corn, produced abundantly as the staple food of the community. Others are saw dust from numerous carpentry and furniture

workshops, charcoal and ashes, and brick rubbles from bakeries and red brick/block industries respectively. However, some of the waste generated are sold and utilized animal feeds (grain processing) excluding rice husks which are dumped with impunity. Saw dust is used by poultry farmers as floor protection from chicken droppings, ashes as well are used by farmers to control weeds (wuta-wuta), and brick rubbles are utilized for erosion control and filling of pot holes on the intra township road accordingly.

## Conclusion

This study was able to appraise the practices of a significant solid waste contributor, the cottage industry. Cottage industries such as furniture making, bakeries, flour mills/grain husk, block/brick industries and so on generate significant amount of solid waste in the area but the concerted reuse and recycling of these cottage wastes as recommended will go a long way in reducing the townships waste level.

## Recommendations

- 1) Public education/enlightenment to sensitize and mobilize cottage industrial proprietors towards a better attitude for the maintenance of environmental quality as “health is wealth” and “cleanness is next to godliness” will go a long way in addressing the waste problem.
- 2) Government in conjunction with private sectors should create waste recycling plants, and encourage or strengthen existing local recycling outfits in the area such as blacksmiths, spare part fabrications, household utensils manufacturing etc. This will generate employment and at the same time address the waste problem.
- 3) The production of organic fertilizer and biogas/bio-fuel from waste generated in the study area by acquiring the technology to do so will turn waste to wealth.

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## **An Evaluation Of The Current Endodontic Trends Among The General Dental Practitioners And Specialist In Riyadh, Ksa.**

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### **Abstract**

#### **Objective:**

*The aim of this study was to investigate about the quality and quantity of root canal treatments performed by general dental practitioners and specialists and an insight to their knowledge and attitude towards the recent innovative materials and techniques employed in the field of endodontics.*

#### **Material and methods;**

*A well-structured, questionnaire was framed and distributed among 150 general practitioners and specialists working both in private and governmental clinics, hospitals and universities. The collected data was statistically analyzed using SPSS version 18 software.*

#### **Results:**

*Out of the 1345 respondents, 45.2% performed more than 5 root canal treatments per week, 54.1% get an informed consent, 27% take pre-operative radiographs, 51% complete treatment in multiple visits, 14.7% used rubber dam isolation, 22.2% used rotary instruments, 16.3% are aware of the recent advancements in endodontics. And 77.2% of them feel satisfied with their routine endodontic treatments.*

#### **Conclusion:**

*There need to be an increase in the awareness of the standard guidelines and procedure to be followed during routine treatment, to improve the quality of treatment delivered.*

#### **Clinical significance:**

*This study signifies that most of the specialists and general dental practitioners deviated from the standard guidelines in the root canal treatment such as use of pre-operative radiographs, rubber dam isolation, appropriate armamentarium, for the procedure, and standardized techniques. So, it is essential to promulgate the current concepts and technique in endodontics through continuing dental education programs and conferences.*

### **Introduction:**

Standard of practice as defined by the American association of endodontists is the acceptable level of performance or an expectation for professional intervention, formulated by professional organizations based upon current scientific knowledge and clinical expertise. Nowadays root canal therapy is considered as a highly

prevalent treatment option in the fast growing dental practice<sup>1</sup>. It involves the introduction of innovative instruments, materials and techniques. Successful endodontic treatment depends on obtaining a fluid tight seal which is attained by adequate preparation and obturation of root canal system<sup>2</sup>. This can be achieved by maintain the standard quality of root canal treatment. Various studies were carried out to explore the standard root canal treatment carried out by practitioners. The attitude and approaches of general dental practitioner and specialists and their skills, expertise all reflect the quality of root canal treatment conducted in a country. For an improved ethical and standard clinical practice, a minimum level of competence and an eagerness for continued learning must be encouraged in the graduates during their training period in dental schools<sup>3</sup>. Standard endodontic treatment is very important in preventing disparities in endodontic treatment, carried out by general practitioners and specialist in a country.

An undergraduate curriculum guideline for endodontology was published in 2001 by the European society of endodontology to standardize the quality and quantity of dental education and clinical experience, in Europe<sup>3</sup>. Several studies have revealed that most of the dental practitioners failed to follow the guidelines for a quality root canal treatment, 4<sup>5,6</sup> in western countries like Denmark, UK, Belgium<sup>7</sup> and USA. On the other hand very few studies investigate the treatment modalities and quality of standard treatment made by general practitioners and specialists in Riyadh, KSA.

Therefore the aim of this survey, was to investigate about the quality and quantity of root canal treatments performed and also to find out about their knowledge and attitude towards the recent innovative materials and techniques employed, in order to improve the quality of the current practice by general practitioners and specialists in Riyadh. KSA, and also to attain an proper understanding about the potential problems faced by them that could explain the present standard of root canal treatments.

## Materials And Methods:

The study was registered with the research centre of Riyadh colleges of dentistry and pharmacy and was given a registration number FRP/2015/154.

### Sample selection:

A random sampling method was used. The hospitals and private clinics in Riyadh, KSA was chosen. All the doctors both general practitioners and specialists were then administered the questionnaire to assess the quantity and quality of root canal treatment performed.

### Design:

A survey among the general dental practitioners and specialists was carried out to investigate the above mentioned objective. A self-administered questionnaire was designed and framed for the study. The questionnaire included 45 close ended questions. These questioned were grouped as represented in table: 1.

### Distribution:

The self-administered questionnaire was distributed among 150 general practitioners and specialists working in both private and governmental clinics, hospitals and universities. The respondents were asked to return the completed questionnaire to the concerned staff, without any assistance from the staff who handed over the forms. The collected data was entered in a personal computer and analyzed by using SPSS version 18 software to get the results. Descriptive statistics were used together with chi-square test. The level of significance was set at  $p < 0.05$ . Unanswered questions were considered as missing values.

## Results:

Of the 150 questionnaires distributed, 135 completed response were received which is a response rate of 90% . This high response rate can be considered as a true representation of the standard protocols of endodontic treatment followed by the dentists in Riyadh, capital of KSA.

#### Practice profile:

From the total of 135 respondents, 71%(n=96) were from private and 28% (n=37) from government health care practice, 2% (n=2) were from university schools. Among which 67% (n=90) were specialists and 33% (n=44) were general practitioners. With regards to the years of experience is represented in Table-2.

With regards to the number of root canal treatment performed in a week it was found that 3% (n=4) performed 21 or more root canal treatments per week and 45.2% (n=65) performed at least 5 root canal treatments per week. Among which 64.4 % (n=87) performed root canal treatments on multirrooted teeth and 29.6% (n=40) performed single rooted RC treatments. 4.4 % (n=6) performed retreatment cases. When the results were statistically analyzed with respect to the qualification and number of root canal treatments performed in a week, it was found a significant difference ( $p=0.000$ ) between them. But was found no statistical insignificant difference between the qualification and the type of teeth performed ( $p=0.230$  ). With regards to the retreatment cases, it was found that retreatment cases was done only mostly by specialists. With regards to the question whether they felt dental school training in endodontic therapy was adequate, there was no significant difference between the general practitioners and specialists ( $p=0.010$ ) .

#### Patient preparation:

It was observed that 54.1% (n=73) of the practitioners get an informed consent from the patient prior to the root canal treatment and 43.7% (n=59) did not; among which 53 were specialists and 19 general practitioners which showed a significant difference( $p=0.002$ ) between the two.

Approximately 27.4% (n=37) always take a preoperative radiograph before root canal treatment but surprisingly 37 % (n=50) never take a preoperative radiograph. Among which who never take a preoperative radiograph were 38 specialists and 12 general practitioners but does not have a significant difference between the two as represented in Table -13 and Table-14. With regards to the question for checking the vitality of the involved tooth, 24.4%(n=33) always checked the vitality before starting the procedure but it was found that 37.8 % (n=51) never did so. On statistical analysis, between the qualification and checking the vitality of the involved tooth, there was no significant difference between the two ( $p=0.138$ ), which had 38 specialists and 13 general practitioners who never checked the vitality . With regards to the sterilization of endodontic files, 98.5% (n=133) sterilized by autoclave.

#### Local anesthetics:

Around, 80.7% (N=109) always applied topical anaesthesia before injecting local anesthetics, 15% often and 3% never did so. Around 65.2 % (n=88) used 27 gauge needle for administration, and 18 gauge was used by 12.6%(n=17).

#### Number of visits:

Approximately 51% (n=69) preferred to finish the RCT in multiple visits and 48.9%(n=66) completed in single visit endodontics. On statistical analysis, by Pearson chi-square, it was found a significant difference between the qualification and number of visits to complete endodontic treatment ( $p=0.039$ ).

#### Armamentarium used:

It was observed that 64.7 % (n=91) still never used rubber dam for isolation during endodontic treatment, only 14.7%(n=20) did so. Which showed a statistical difference ( $p=0.001$ ) between specialists and general dental practitioners. 70 of the specialists and 21 of the general practitioners never used rubber dam isolation. There was no relationship between its use and years of practice. With regards to the use of loupes or microscopes for

locating canals, it was found, 73.3 % (n=99) never used them, 16.3% often used and 3.7% always used it. With regards to the type of endodontic instruments used, only 22.2 % (n=30) used rotary instruments and 77.8% (n=105) are still using hand instruments. On statistical analysis, it was found, only 22 of the specialists and 7 of the graduates used rotary instruments and 68 of the specialists and 39 dental practitioners still used stainless steel hand instruments. But did not show a significant differences between the two ( $p=0.092$ ). Again there was no relationship between its use and years of professional practice. Among the practitioners, 88.1% (n=119) used barbed broaches for pulp extripation, 3.7 % (n=5) used H-file and 1.5% (n=2) used Gates Glidden. There was a significant difference ( $p=0.002$ ) between the specialists and general practitioners in the use of barbed broaches as represented in Table-19. Among the practitioners 80.7 % (n=109) used barbed broach as the first endodontic instrument to put in the canal. K-files were the most popular instruments. Root canal preparations done solely with K-files were 14.8% and 4.4% used H-file and the remaining in combination with the other instruments.

Sodium hypochlorite was the most popular choice as a root canal irrigating solution with 94.8 % (n=128) of the respondents using it. And the most preferred concentration was 2.5% by 25.9 % (n=35) and there was found no relation between the years of professional experience and the type of irrigants used. With regards to the number of endodontic files used per canal, 54.8 % (n=74) used in 12 canals per file while 31.9% (n=43) used in more than 12 canals per file. 5.2 % (n=7) used as single use. On statistical analysis, it was found to have a significant difference between the specialists and general dental practitioners use of files per canal ( $p=0.000$ ). Approximately 41.5 % (n=56) often used Gates Glidden drill for canal orifice widening, 39.3% used occasionally, 8.9% always used but 8.1% (n=11) never used it. There was no significant difference between the specialists and general practitioners with regards to the use of Gates Glidden.

#### Working length determination:

Conventional x-ray radiography was the most commonly used method for working length determination (40.7%) followed by the use of tactile method 35.6% and apex locators 23.7%. There was a tendency among practitioners working for more than 10 years towards using tactile sensation to estimate working length (37.25%). This decreases as years of experience decreases.

#### Cleaning, shaping and obturation of root canals :

Around 61.5 % (n=83) used step-back method for canal preparation, 19.3% (n=18) used crown down technique and 5.2% (n=7) used hybrid method of canal preparation. There was no significant difference between the qualification and years of experience for cleaning and shaping to the methods used. In this survey, it was found that 45.2 % (n=61) did not use any inter-appointment medicament, 36.3% (n=49) used calcium hydroxide and 18.5% (n=25) used formocresol dressing. 45 of the specialists, and 15 of the general practitioners from a total of 61, did not use any medicament while 33 of the specialists and 16 of the dental practitioners among 49, used calcium hydroxide. Formocresol was used by 12 of the specialists and 13 of the graduates among 25 of the respondents, which did not show any statistical significance.

It was observed that 50.4% (n=68) used calcium hydroxide based root canal sealer followed by 23.7% (n=32) used resin based sealers and 15.6% (n=21) used zinc oxide based sealer and 7% (n=10) used other root canal sealers for obturation. There was a significant difference between the qualification and type of sealer used. 55 of the specialists and 13 of the general practitioners out of 68 used calcium hydroxide based sealers, 20 of the specialists and 11 of the general practitioners out of 32 used resin-based sealers and 10 of the specialists and 11 of the general practitioners out of 21 used zinc oxide based sealer. There was no relationship between the years of experience and types of sealers used.

The vast majority of the respondents used lateral condensation obturation technique (87.4%). Few of the practitioners used vertical condensation technique.

**Procedural accidents:**

63% of the respondents would inform the patient and continue the treatment, whereas, 25.2% would not inform the patient, 5.9% refer to an endodontists, and 3% extract the teeth. Majority of the specialists, affirmed to inform the patient and continue the treatment or not inform the patient and continue. Referral to an endodontists was found very less by the general dental practitioners.

**Post obturation access restoration:**

Approximately 41.5% of the practitioners claimed to do occlusal reduction after the root canal treatment and there was found to be a significant difference ( $p=0.000$ ) between qualification and occlusal reduction after root canal treatment. With regards to the timing for post obturation filling, 52.6%( $n=71$ ) affirmed of placing the filling on the same day, followed by 25.2%( $n=34$ ) after 24 hours, 17.8%( $n=24$ ) after 7 days, and it was found that 54.8%( $n=74$ ) used composite as post obturation or final restoration followed by 12.6% glass ionomer, 7.4% amalgam filling. Years of professional experience had no influence on the choice of final restoration. 55.6% ( $n=75$ ) affirmed that they would advise the patient to place a crown after 7 days of root canal treatment.

**Radiography:**

With regards to the selection of master cone radiographs, 54.1%( $n=73$ ) never took a master cone radiograph before starting of obturation. There was a significant difference ( $p=0.000$ ) between the qualification and taking master cone radiographs. 55.6% of the respondents claimed to take only 2 radiographs, while 30.4% took 3 radiographs and 8.9% took 4 radiographs. With regards to the question for the type of radiography used, 59.3% of the practitioners still rely on conventional x-rays and 35.6% rely on digital radiography. 4% used cone beam computed tomography.

**Emergency situation:**

51.1%( $n=69$ ) would do a root canal opening then prescribe analgesics and antibiotics in case of emergency appointments and 46.7%( $n=63$ ) first prescribe analgesics and antibiotics followed by root canal openings once acute symptoms subside. There was statistically significant difference ( $p=0.026$ ) between the qualification and management of emergency appointment. But no significant difference between the years of experience and management of emergency, Table-24. Majority of the dentist (75%) never opt for an open dressing in case of emergencies.

**Use of systemic antibiotics:**

39.3% never prescribed antibiotics routinely while 3% prescribed them routinely.

**Using innovative materials and methods:**

Approximately 34.8 % ( $n=47$ ) used carrier based obturation systems, (Table-26). There was a statistically significant difference ( $p=0.004$ ) between the qualification and the newer systems used as in Table-27. With regards to the newer rotary instruments used, only 16.3 % ( $n=22$ ) used wave-1 rotary system, 3.7% used one-shape systems, and the remaining have not heard about these. With regards to the frequency of attending conference and workshops, it was observed that only 41.5% occasionally attend these programmes.

**Enhancing knowledge:**

Majority of the practitioners occasionally (41.5%) attended conferences or CE programs, 34.1% often attended, 7.4% never attended.

**Attitude of practitioners towards endodontic treatment:**

Majority of the specialists (80%) and 77.2% of the general practitioners feel happy and satisfied with the routine root canal treatment. 19.3% ( $n=26$ ) affirmed that it needs to be improved (Table-2). Our aim was mainly to

gather information about the quality and quantity of root canal treatment performed by practitioners and their knowledge and attitude towards endodontic treatment. Thus the information gathered is important and useful as it relates to the advancement in the field of endodontics in dental practice.

## **Discussion:**

The overall response rate was 90%, in the present study which is higher when compared to different other survey conducted in Turkey <sup>8</sup>, Jordan <sup>9</sup>, India <sup>10</sup>, KSA <sup>11</sup>. This study is first of its kind that gathered information on different standard procedures and techniques in endodontics and also investigates the quality and quantity of root canal treatment performed by dental practitioners. With regard to their knowledge, about the recent innovations in the field of endodontics in Riyadh, capital of KSA. Previous studies that were done was on the adoption of new endodontic technique by general practitioners in KSA in 2011 <sup>11</sup> and another one which evaluates the molar root canal treatment by general practitioners in 2010 <sup>12</sup>. But to date, there are no information that gathers data about the quality and quantity of root canal treatment and the dental practitioners attitude (both general practitioners and specialists) to the recent innovations and technologies. This result of the present study revealed the quality and quantity of root canal treatment performed by general practitioners and specialists and their use and knowledge regarding the newer innovations in the field of endodontics. To prevent low types of response rate, the data was collected personally by meeting and visiting the dental service.

### **Practice profile:**

This study showed that the number of root canal treatment performed in a week ranged from 16-20 teeth by 5.2% and 11-15 teeth by 8.9%, 6-10 teeth by 33.3%, till 5 teeth by 45.2%. There was a statistically significant difference with respect to the qualification and number of root canal treatments performed in a week. This result is in agreement with a study done by Shrestha et al in 2013, where similar results were found <sup>13</sup>. The present study shows that only 34% of the general practitioners were completing root canal treatments in single visits where as majority of them ie; 65.9% were completing in multiple visits and 55.5% of the specialists performed in a single visit where as 44.4% in multiple visits. These results in agreement with the study done by Flemish dentists <sup>5</sup> and also in USA, 34% of dentists completed the root canal treatments in one visit, which showed a high percentage of single visit root canal treatments. Whitten et al (1996) found that endodontists preferred single visits therapy, whereas general practitioners preferred multiple <sup>15</sup>. Single visit treatments have appeared to gain more popularity and increased credibility in the preclinical teaching model in America and Europe. In comparison to the specialists, the general practitioners performed more of multiple visits than single visits. This observation was in agreement with the study undertaken by Tronstad et al (2000) <sup>16</sup> in Sudan. With regards to the success rate, Iftikhar et al in 2013 found that one visit endodontic treatment was as successful as two visit endodontic treatments as evaluate by the rate of flare ups in asymptomatic molar teeth with Periapical radiolucency <sup>17</sup>. In the present study approximately 69.6% of the practitioners felt that they had adequate dental school training. These results are in agreement with a study done by Ibrahim AlShahrani et al, <sup>18</sup> where they found majority of the general dental practitioners acquired adequate dental school training.

### **Patient preparation:**

This study also found a statistically significant difference between the general practitioners and specialists in obtaining an informed consent prior to the treatment. 58.5% of the specialists get an informed consent while only 43% of the general practitioners do so. This is in agreement with a study done in Bulgaria where only 54% of the respondents get a written informed consent <sup>19</sup>. The importance of obtaining a written consent was underlined by a research done by Spanish study which was found that in 78% of the cases of dental malpractice, there was no written consent. For accurate diagnosis and preoperative assessments of difficult cases, high quality radiographs are insistent. Despite its importance, in the present study, it showed that 24.7% always took

preoperative radiographs and surprisingly 37% of the respondents never took a preoperative radiograph, among which 38 were specialists and 12 general practitioners. This figure was considerably low compared to the data released by Orafi and Rushton<sup>20</sup>, Palmer et al<sup>21</sup> and Ravenshad et al<sup>22</sup> who stated that 83.9%, 98.5% and 72% of the participants used preoperative radiographs. As performing root canal treatment without a preoperative radiograph is below the standard of care, it appears that the participants are not complying with endodontic guidelines<sup>23</sup>. With regards to the type of radiography used, it was found that 59.3% still rely on conventional x-rays. This is in agreement with a similar study done by Hamid Razavian et al in 2014 where it was found that it might be due to the diagnostic potential of conventional x-ray system for the detection of voids and for the preoperative diagnostic purpose was superior to digital imaging system. The number of radiographs exposed during treatment varied from two to four, with more than half of the practitioners (60% of the specialists and 45.4% of the general practitioners) relied on a total of only 2 radiographs. This is in agreement with the study done by Ravanshad et al in 2008, where majority of dentists took 2 radiographs<sup>24</sup>. With regards to the sterilization of endodontic files, in this study it was found that 98.5% of respondents sterilized their files before treatment while 1.5% often did so. This findings was in agreement with the study done by Talha M et al<sup>25</sup> in 2015, there it was found 93.3% sterilized by autoclaving. Endodontic files if not sterilized properly might pose the threat of transmission risks of Creutzfeldt-Jakob disease infectivity, which is incurable, fatal disease and the causative agent an abnormal Prion protein resistant to conventional sterilization procedures<sup>26</sup>.

#### Local anesthetics:

In a present study, it was observed that 80.7% applied topical anesthesia before injecting local anesthetics and 3% never did so. This is in agreement with a study done by Kavita et al<sup>27</sup> in (2000) where it was found 86% of the respondents used topical anesthesia before injecting local anesthesia. However, the perception on effectiveness of topical anesthetics' varied. 65.2% of the respondents used 27 gauge needle for local anaesthetic administration. This is in agreement with the study done by Kavita et al where 53% used 27 gauge needles for injection. 27 gauge needles are advisable for all injection techniques if the aspiration percentage is low, according to Malamad<sup>28</sup>. A study by Terry et al 2006, it was found that when it comes to injection pain and needle gauge size does not matter<sup>29</sup>.

#### Armamentarium used:

Rubber dam isolation is considered as a standard of care in endodontics<sup>30</sup>. In spite of the well-known advantages of rubber dam, the majority of the dentists do not always use a rubber dam during operative and endodontic procedures<sup>31,32</sup>. Unfortunately, in the present study it was observed that 64.7% still never used rubber dam for isolation during endodontic treatment. Among which 7 were specialists and 21 general practitioners. There was no relation between the use of rubber dam between specialists and general practitioners, indicating that its use is declining. These results are very much similar to the results of other international studies<sup>33,34,35</sup>. Similar findings were found in Sudan (2%) and among Flemish dentists (3.4%)<sup>36</sup>. This results also in agreement with a study done in KSA where only 3% of the respondents were using rubber dam for isolation. This can directly affect the standard of root canal treatment and decreases the success rate (Christein 1994)<sup>37</sup>. To promote the use of rubber dam, there has to be an emphasis in education and increased awareness of the importance of rubber dam in daily practice. Majority of the dentists (77.8%) in the present study were using stainless steel hand instruments for root canal preparations and only 22.2% used nickel titanium rotary instruments. This is in agreement with a study done in KSA by Azhar et al (2014)<sup>38</sup> where similar findings were observed. 41.5% often used Gates Glidden burs to aid entrance into the canal orifice while 8% never did so.

#### Irrigation:

Clinicians are deprived of a proper method or instrumentation technique to obtain complete debridement of the root canal due to the complex canal anatomy<sup>39</sup>. Sodium hypochlorite has proven to be a effective antimicrobial

agent (Bystrom and Sundqvist 1983)<sup>40</sup>. Thus an antimicrobial irrigating solution is needed to debride the canals by chemical means. In the present study, 94.8% used sodium hypochlorite with 2.5% concentration as an irrigating solution. The same results were shown among dentists of Switzerland<sup>41</sup>. 62% used diluted sodium hypochlorite for irrigation purpose, this might be due to the reason that dilute concentration reduces the caustic effects of sodium hypochlorite on oral and periapical tissues. These results confirm that sodium hypochlorite is still considered as the gold standard for irrigation<sup>42, 43</sup>.

#### Working length determination:

Determination of working length is the most crucial step in endodontics. In the present study, only 40.7% of the participants used conventional radiographs for working length determination while it was disappointing that 35.6% of the respondents relied on tactile method and 23.7% on apex locators. Unfortunately this result shows that the armamentarium used is not in par with the present day modern endodontic practice. This is in agreement with the study done by Azhar et al<sup>38</sup> in KSA, where it was found majority of the practitioners used radiographs and tactile sensation for determination. Palmer et al found that 57.3% of the practitioners in north west of England use radiographs as the only method for establishing working length<sup>21</sup>. The use of tactile sensation to determine working length cannot be recommended because, the instrument may bind against the canal walls at any position along their length or perforate apically. (Dummer et al 1984)<sup>46</sup>. An accurate working length could be achieved by the combination of conventional radiographic techniques with modern electronic apex locators<sup>47</sup>.

#### Cleaning, shaping and obturation:

The step back method of canal preparation was the most commonly used (61.5%) among the practitioners. In a study by the Flemish dentists used the step back technique<sup>48</sup>. But still 13.3% of the practitioners still used the standardized method. In another study 60.4% of Flemish dentists used standardized filling technique. (oral health). The standard technique has some disadvantages like overpreparation, which could result in incomplete obturation of the root canal system. Even though, Calcium hydroxide being recognized as the standard intra canal medicament for inert-appointment dressing<sup>49</sup>, in the present study calcium hydroxide was used by only 36.3% of the respondents which was slightly less than Flanders (Belgium) 69% and 63% in North Jordan, but 45.2% did not use any medicament. 18.5% used formocresol. These findings are in consistent with the previous findings by Sudanese dentists, Iranian dentists, were 37% used calcium hydroxide<sup>49</sup>. The use of calcium hydroxide as an intracanal medicament has to be encouraged among practitioners. It has been found to be the material of choice by the western worlds.

In the current study, almost 67% of the specialists and 27.2% of the general practitioners recorded no use of radiography to determine the master cone position. This is in agreement with a study done by Ashwini et al 2013 that found only 15.8% used master cone determination radiograph<sup>51</sup>.

The most popular root canal sealer among the practitioners was calcium hydroxide sealers which among these more were the specialists 50.4%, 23.7% resin based sealers and 15.6% zinc oxide eugenol based sealers. Numerous methods have been advocated to obturate the root canal system, each claims of their ease, its efficiency and superiority. Majority of the practitioners used lateral condensation obturation techniques (87.4%). This is one of the universally acknowledged and most commonly used technique<sup>52</sup>. The finding of this study is in agreement with the finding by K Fouzan which found 65% used cold lateral condensation<sup>12</sup>. In a survey of Qualtrough et al 1999 cold lateral condensation remained the most popular undergraduate teaching technique<sup>52</sup>. With regard to the timing of placement of post obturation filling, 52.6% affirmed placing it on the same day.

54.8% claimed of using composite as a final access restoration material. Post operative pain is a common finding after root canal treatment. In the present study 41.5% of the practitioners claimed to do occlusal reduction after root canal treatment. Pain after endodontic treatment is of serious concern both to dentists and patients. These are two schools of thought regarding this issue. In a study by Rosenberg P A ,1998 <sup>54</sup>, it was found that occlusal reduction should prevent post-operative pain in these patients whose teeth initially exhibit pulp vitality, percussion sensitivity, preoperative pain and absence of periradicular radiolucency. But in another study by Shama et al 2014 <sup>55</sup>, it was found that occlusal reduction did not provide any reduction in post-operative pain in teeth with irreversible pulpitis, and mild tenderness to percussion. So it can be concluded that this procedure is dependent upon the case being treated with. The present study 52.6% affirmed of placing the post obturation permanent access restoration on the same day 25.2% after 24 hours, 17.8% after 7 days. These results are in agreement with the study done in South Africa <sup>56</sup> that showed 41% immediately restored with the permanent restorative material. 38% waited for 1 week, 47% for 2- 6 weeks. As per the ESE quality guideline <sup>57</sup> the tooth should be completely restored to prevent any bacterial recontamination of the canal. The present study results stated that 54.8% used composite restoration, 12.6% glass ionomer cements, 7.4% amalgam filling. These results were similar to a study done in 2012 where majority of the practitioners used composite final restoration. Economic consideration might be a reason for practitioners using cheaper resin composites instead of onlay restorations. To prescribe antibiotics for an endodontic case that has endodontic infection and should have a systemic involvement ie; high grade fever, swelling, lymphadenopathy, timing; otherwise antibiotics is not justified. In the present study 39.3% never prescribed antibiotics, but 34.8% occasionally and 20.7% often prescribe them. With consideration to the qualification, it was found that general dental practitioners often prescribe antibiotics for routine endodontic cases. This is in par with the previous study done in Spain, India and US, 31% and 37.6% of respondent practitioners prescribed antibiotics<sup>58</sup>. Thus the practitioners should not ignore the scientific basis of antibiotics prescription and should not neglect the current guideline for antibiotic prescription.

#### Emergency situation:

The prior management of an abscess developed from acute apical Periodontitis should be to relieve the pressure first then continue with the endodontic therapy. The immediate management should be to relieve the pressure and then carry on with endodontic therapy. In the present study 46.7% of the respondents still first prescribe antibiotics and analgesics for such emergency situations. Systemic antibiotics provide no additional benefit over drainage of the abscess <sup>59</sup>. This is prescribed only when drainage cannot be achieved. A large majority of practitioners (75%), do not leave the tooth open for draining. Alfred Walker was the first dentist to advice against the practice of leaving teeth open for drainage. Ha asserted, this method is as unscientific as it is antiquated<sup>60</sup>.

#### Use of innovative methods:

In the present study only 16.3% used wave 1 rotary instruments, 3.7% used one shape systems, and the remaining have not heard about this. This results is similar to another study done by Khalid S in 2010 <sup>12</sup>, were 97% of the practitioners were still using stainless steel hand instruments.

#### Endodontic treatment satisfaction:

It was interesting to observe that 80% of the specialists and 77.2% of the general dental practitioners feel happy and satisfied with their routine endodontic treatments. But 19.3% still affirmed that it needs to be improved. This is in agreement with a study done by Ibrahim et al 2014, which found similar findings. A number of studies (Pit ford et al 1983 <sup>62</sup>, Saunder et al 1997 <sup>63</sup>, De Moor et al 2000<sup>64</sup>), have revealed that much of the endodontic provisions fall below the international standards of care.

## Conclusion:

This study investigated the current status of endodontic treatment practiced by general dental practitioners and specialists. Considering the high response rate, this study can give a true picture of the current scenario in endodontic practice. Based on the results of our study, it can be concluded that most of the general dental practitioners and specialists apply methods not accepted by contemporary dental profession and are still not following the standards of endodontic treatment. There need to be an increase in the awareness of the standard guidelines and procedure to be followed during routine treatment, to improve the quality of treatment delivered. And most importantly improving the knowledge about the newer materials and technique by attending the continuing dental education programs in endodontics to improve the standard of treatment. However a future surveys and studies are needed to re-evaluate these trends.

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## **Boko Haram Activities: A Threat To Business Education In Northern Nigeria**

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### **Abstract**

*Nigeria has witnessed insurgency from this terrorist group called Boko Haram from 2009. They unleash terror and fear in the minds of every Nigerian. There is mass destruction of government properties, bombing of churches, Mosques and other public places, assassination of prominent individuals, burning of schools occasioned by sporadic shooting of innocent citizens. The Federal Government of Nigeria saw these demands as treasonable, unreasonable and unacceptable and in an attempt to purge the group of its excesses, Mohammed Yusuf the leader was killed in 2009 which brought about violence and bombardment of northern Nigeria. This paper therefore looked at some of the challenges posed by this group to business education programme in Northern Nigeria and also proffered recommendations.*

### **Introduction**

“Boko Haram” is a multi-language phrase. The phrase was derived from Hausa and Arabic Languages respectively, “Boko” in Hausa Language means “Western education”, and “Haram” in Arabic Language means “forbidden”. So “Boko Haram” Literally means “western education is forbidden”. The real name of “Boko Haram” is “**Jama’atul Ahlus Sunnah Lidda’awati Wal-Jihad**”, which translates to “People who committed to the propagation of prophet’s teachings and Jihad”.

Boko Haram has been in existence since 2001, but did not become popular until 2009 when they participated actively in the sectarian violence in Northern Nigeria, specifically in Borno, Bauchi and Yobe (Musa, 2011). The group unleash terror and fear in minds of every Nigerian. They participated in destructions of police stations, government properties, bombing of mosques and churches, assassination of prominent personalities, burning of schools and many other unethical practices condemned by Islam.

Northern Nigeria has suffered low enrolment rate in education sector. Ruquyyatu (2013) blamed this on the effect of long standing effect of Islamic education as most parents are yet to embrace western education. To such parents, western education is tied to the bible and it is an indirect way of changing their religion. Secondly, the security situation in the Northern Nigeria also comes to play. The constant threat posed by Boko Haram which started in 2009 and other extremists religious sect like the Jama’atu Anbarul Muslimna FinBadilas Sudan, undermines efforts at improving education in the region. These groups have carried out several attacks and issued threats to schools in the North in some of these attacks, teachers were killed or injured and structure razed

The leader of Boko Haram, Muhammed Yusuf was killed in 2011 when late President of Nigeria, Umaru Musa Yar’adua directed the policemen to wipe the group away completely. To them, all these atrocities are reprisal of what policemen did to their group upon the commandment of late president.

Before 2009, Northern Nigeria witnessed several forms of terrorism like “Maitatsine” in Kano (1980) Bulunkutu in Borno (1982). There is also a deliberate and systematic use of violence to destroy, kill, maim and intimidate or wipe away completely some tribes from some parts of Northern Nigeria these includes Zangon-Kataf and Jos (Halidu, 2012).

These forms of terrorism or destructions are politically motivated, even though; some may have other ancillary motives (Obioma, 2012). What is worthy of noting is the incapability of the government to deal with the perpetrators of these problems. Many investigation panels were set-up but government remains mute on their recommendations. Abiye (2011) noted that domestic terrorism arose in Nigeria because emergent militant groups took advantage of government's inefficient actions and inactions in dealing with the fundamental elements of nationhood.

Business Education is education meant to prepare students for useful living. The main purpose of it is to prepare students for higher education and for a useful living. Education of any type could not be imparted by teacher nor received by the students when there is chaos and anarchy.

### **Boko Haram activities and Business Education in Northern Nigeria.**

Business education in Northern Nigeria, specifically in Borno, Yobe and Adamawa States faces challenges, amongst which are:

**1. Community:** The Community are where the students, parents and schools are set-up. A peaceful community produces a more brilliant student, intelligent teachers, good atmosphere for investment and a place where everyone could feel the spirit of belongingness. Business Education can flourish successfully when the community is at peace. However, where a community is disturbed due to shooting, bombing, maiming, kidnapping and many forms of unethical practice, business education faces challenges. Ajayi (2011) enumerated the following activities of Boko Haram which directly affected community and posed a great challenge to business education:

*In January 2010, Boko Haram Struck in Borno at Dala Atemden ward killing four people. In September 7, 2010, 700 inmates were freed from Bauchi prison by Boko Haram. In December 2010, a market was bombed in Maiduguri and many people were killed. In April, 2011, Independent National Electoral Commission Maiduguri was bombed. 22<sup>nd</sup> April, 2011, 14 inmates were freed by Boko Haram in Yola. 29<sup>th</sup> April 2011, multiple bombings occurred, November 2011, witnessed coordinated bombing and shooting on police facilities in Potiskum and Damaturu Yobe state, where 180 people died, January 5<sup>th</sup> and 6<sup>th</sup> 2012, multiple bombings in Kano.*

Sani (2012), enumerated that, Boko Haram insurgents attacked Baga Community on 16/4/2013 and Bama Community in 17/4/2013, killing many innocent citizens and setting ablaze all their farm products and houses.

In a catastrophic situation like this, business education could not be imparted to any student. The parents and the students are always in constant fear of what will happen to them today or the next day. The challenge of Business education in Northern Nigeria due to community problems of Boko Haram insurgency has taken a new dimension. In the month of April, 2014, more than 10 villages were destroyed in Borno, Yobe and Adamawa and all the communities were homeless. In June 2014, Attagara village, Gwoza Local Government, Borno State, 400 villages were killed. Business education programme being a skilled oriented could not operate under this kind of situation.

**2. Students:** students are the beneficiaries of teaching. They could be primary school pupils, secondary school student or higher institutions of learning students. Learning takes place when there is a

conducive atmosphere, adequate motivation and above all facilities and infrastructures. In Northern Nigeria, especially Borno, Yobe and Adamawa States, students in general and Business education in particular faces a lot of challenges for effective learning. Many primary schools, secondary schools and some tertiary institutions were vandalized, destroyed and burnt. The students' lives are at stake and therefore many of them forcefully withdraw from the schools to save their lives. According to the Guardian (2013), in Yobe state, a school was attacked and more than 40 children lost their lives. This was in addition to 3,600 victims since 2009 in the wake of attacks and massacres led by Boko Haram as well as reprisal from the regular army.

According to the Nation (2011), the areas with the lowest number of children in school are Northern region of Nigeria and more specifically areas hit by Boko Haram insurgents. Yobe state has 78 percent, Borno state 71 percent and Adamawa state 47 percent. Therefore Boko Haram has dealt a fatal blow on the enrolment of pupils and students to schools. Parents and pupils live in perpetual fear of attacks and this poses a great challenge to Business Education. School attendance is essential for any academic activity, where there is security problem, definitely the rate of attendance will decline, Hakilu (2010) says that irrespective of age, sex and nationality, once there is an attack by Boko Haram, the survivors often dread staying in such places and may hesitate sending their children to school.

At the last quarter of 2013, Federal Government College Bunu Yadi, Yobe State, a comprehensive secondary school was burnt and dozens of students killed and some were abducted. In April, 2014 over 200 final year girls were abducted at Government Girls secondary school Chibok and the whole school set ablaze. All these atrocities poses a great challenge to business education.

**3. Teachers:** The disseminators of knowledge and role model are teachers. Teachers in general are not spared by Boko Haram insurgents and therefore could not be able to properly disseminate the knowledge to the students. In the midst of bombing and maiming, many teachers lost almost all their belongings and are presently living in hunger and poverty. In most attacks, the teachers are directly or indirectly affected. In a situation where students are killed, schools burnt, students abducted, the teachers psychological state of affairs could not be at ease to impart the knowledge.

Above all, where there are no students, no classes, no laboratories, no place to live and no food, how could a teacher perform his primary assignment? In this year's teachers' day, it was reported that 130 teachers were killed in Borno, Yobe and Adamawa state since the commencement of the insurgency. This scenario greatly affected their morale and also poses a challenge to business education.

**4. Philanthropists:** In every community, there are important personalities who help in one way or the other. In Borno, Yobe and Adamawa states, the philanthropists assist in building schools, giving scholarship to students. They often possesses industries where many people get job and therefore, reduces unemployment. Amongst the aims of business education is to prepare students to be self-reliant. This was the reason for Students Industrial Work Experience Scheme (SIWES) in the curriculum.

The students, in most cases get their SIWES experience from the companies owned by the philanthropists. In Borno, Yobe, and Adamawa states, Business education faces challenges due to assassination of some important philanthropists. In the first quarter of 2013, Bukar Mandara, a respected elderly person, proprietor and philanthropists was killed. This metamorphose to closure of many of his privately owned companies that employs many graduates (Business Education Inclusive) and stoppage of many of his scholarship programmes. Also, on 30<sup>th</sup> May, 2014, Emir of Goza, was killed by Boko Haram insurgent. Killing of this emir greatly affected every aspect of education in Goza community which is located in Southern Borno and which produces almost half of the students of Borno state.

## Conclusion

Northern Nigeria's image is negatively affected by the activities of Boko Haram insurgents. Their unwanted activities have crippled the socio-economic and educational life of the entire geo-political zone. Maiming, Kidnapping, suicide bombing attack, destroying schools, killings of students and teachers greatly poses challenges to business education programme in the zone. This has helped in no small measure to make the zone less developed educationally and a lot of unemployed people due to lack of business education programme being effectively undertaken.

## Recommendations

It is therefore recommended that:

- (a) The state of emergency imposed to the three states should be taken up seriously by the government.
- (b) There should be enough security to protect all the schools in the three states.
- (c) The civilian joint task force (JTF) should be converted to Nigerian army or policemen.
- (d) The communities should be given arms to protect themselves, their children and their schools.

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## “The Situation of SMEs / SMIs / VSEs in Algeria” Through a Case Study

Dr. LAID Mohammed & Miss CHERIFI Mouldjillali.

### Abstract:

*The economic structure is composed of large, medium, small and very small companies. The classification of these companies as such, is done by the 01-18 law of December 12th, 2001 bearing guidance on the promotion of SMEs, by the employment size, the turnover, the balance sheet total as well as the compliance with the criteria of independence.*

*The study performed from samples representing the average, small and very small businesses, activating in different sectors, revealed that:*

- *Overall, the investment is rising steadily since 2009.*
- *The turnover is also increasing, but disproportionately.*
- *Employment is more or less stable during the whole period but the staff cost is in slight increase.*

*The result and the economic profitability have started to come out of the red zone only from the financial year of 2012.*

**Keywords:** small- medium -business-investment- turnover-employment- Economic profitability.

### 1. Introduction:

We consider it judicious, in the introduction, to define the company in general and then specifically the SMEs.

#### A. General Definition of the Enterprise:

It is commonly admitted that the company is the main unit of any economic structure. Overall, the definition of the company is given by the doctrine in different forms; nevertheless the legal definition is given only by the Ordinance 03-03 concerning the competition, as amended and supplemented by law 08-12 of June 25<sup>th</sup>, 2012 and the law 10-05 of August 15<sup>th</sup>, 2010.

##### a- Doctrinal Definition:

The doctrine defines the company as a coordinated set of organs, arranged in specific purposes to fulfill certain functions, in implementation of more or less complex and repetitive operations that result in delivery to the market some goods or services whose sales generates a result.

On the other hand, the company is defined as a hierarchical human group that implements intellectual resources, physical, financial; to extract, transform, transmit, distribute wealth or produce services, in accordance with the objectives set by management. Personal or collegial, involving varying degrees, motives of profit and social utility.

**Statutory Definition:** The Algerian legal definition of the enterprise is given only by article N°03 of the Ordinance 03-03 of July 19<sup>th</sup>, 2003<sup>1</sup>, as follows:

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<sup>1</sup>Concerning competition.

"Any natural or legal person whatever its nature, exerting a sustainable way of production, distribution, services or import."

## B. Definition of SME, SME and VSEs:

### a- Definition:

In accordance with article N°04 of the framework law concerning promoting the SMEs N°01-18 of December 12<sup>th</sup>, 2001, the small business/small and medium industries (SMEs/ SMIs) is defined, regardless of its legal status as a company producing goods and / or services:

- Employing (01) to (250) persons.
- Whose annual turnover does not exceed 2 billion dinars or whose annual balance sheet total does not exceed 500 million dinars.
- And that meets the criteria of independence.

The article n° 05 of the 01-18 law defines medium business as a business employing 50 to 250 people and whose turnover is comprised between 200 million and 2 billion Dinars or whose annual balance sheet total is comprised between 100 and 500 million dinars.

The article n°06 defines small business as a company employing 10 to 49 persons and whose annual turnover does not exceed 200 million dinars and whose annual balance sheet total does not exceed 100 million dinars.

The article n° 07 defines the very small business and micro enterprise as a business employing 01 to 09 employees and achieving a turnover of less than 20 million dinars or whose annual balance sheet total does not exceed 10 million dinars.

### b- Table of illustration:

<u>SMEs:</u>		
Workforce —————> 1 – 250 Employees.		
Turnover or Balance Sheet Total —————> Turnover ≤ 2 billion dinars or Balance Sheet Total ≤ 500 Million Dinars.		
Independence —————> The capital is not owned as to 25% or more by one or more other companies do not meet the definition of an SME.		
<u>Medium Enterprise:</u>	<u>Small Enterprise:</u>	<u>Very Small Enterprise:</u>
<ul style="list-style-type: none"> <li>• 50-250 employees.</li> <li>• 200 million ≤ Turnover ≤ 2 billion dinars or 100 million dinars total balance sheet ≤ 500 million dinars.</li> </ul>	<ul style="list-style-type: none"> <li>• 10-49 employees</li> <li>• Turnover ≤ 200 million dinars or Total balance sheet ≤ 100 million dinars.</li> </ul>	<ul style="list-style-type: none"> <li>• 1 - 9 employees.</li> <li>• Turnover &lt; 20 million dinars or Balance sheet total ≤ 10 million dinars.</li> </ul>

## 2. Point Situation of the SMEs/ SMIs and VSE:

The situation of SMEs / SMIs is illustrated through the study of a sample of about ten<sup>2</sup> enterprises, all size and all types are combined, this means that the population under study is composed of:

- EPE SPA SP/HASSI AMEUR.

<sup>2</sup>They are true examples from reality.

- EPE SPA EN/EL BAYEDH.
- SARL O Z/ MASCARA.
- SARL IRRHY/ MASCARA.
- SARL (SPA) TRANS / ORAN.
- SARL (SPA) HSC / MASCARA.
- SARL ZEG / MASCARA.
- E I « TH HANF »/ MASCARA.
- E I “BEN ML”/ MASCARA.
- E I “L ALI”/ MASCARA.

Our study was limited to the actual parameters of classification of these enterprises and definition of economic profitability.

This study produced the following results:

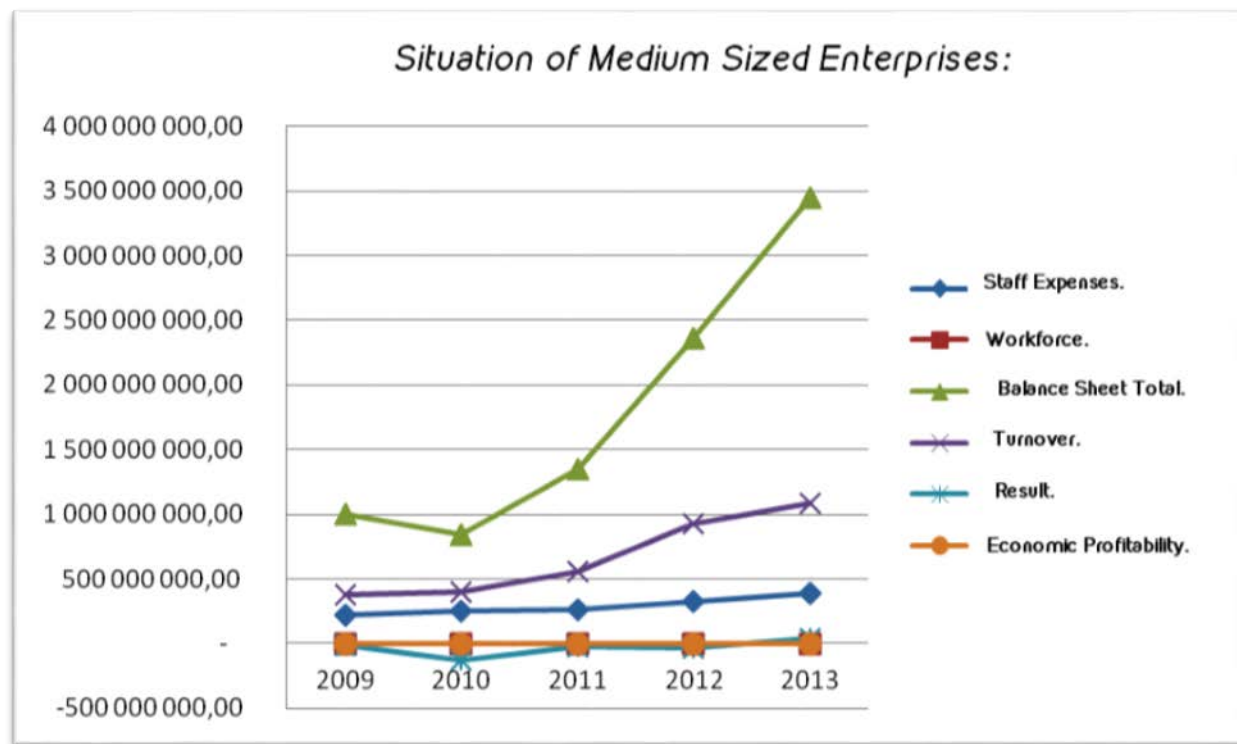
#### A. Sizing :

##### 1. Medium Sized Enterprises:<sup>3</sup>

Enterprises:	Sector:	Year:	Staff expenses :	Size :	Workforce :	Balance Sheet Total:	Turnover:	Result:	Economic Profitability:
SP	Building Industry	2009	44.144.110,56	Medium	92	118.575.798,00	63.459.239,00	5.890.862,00	0,05
		2010	46.543.247,00		97	223.732.203,00	79.817.991,00	5.285.482,00	0,02
		2011	41.265.146,82		86	208.603.653,00	35.174.774,00	- 12.886.212,00	-0,06
		2012	39.825.664,96		83	344.787.483,00	51.260.276,00	- 59.415.175,00	-0,17
		2013	46.543.247,00		97	512.162.445,73	72.285.906,00	31.797.350,00	0,06
EN	Building Industry	2009	168.800.500,00	Medium	486	703.689.963,00	247.014.769,00	- 12.341.590,00	-0,02
		2010	165.000.400,00		462	338.662.845,00	174.275.342,00	- 130.047.724,0 0	-0,38
		2011	179.222.148,65		500	547.035.067,00	318.731.956,00	- 19.303.560,00	-0,04
		2012	227.970.573,00		636	1.112.341.734,00	528.658.650,00	8.182.994,00	0,01
		2013	265.248.780,00		740	1.800.737.113,00	697.064.954,00	1.661.232,00	0,00
TRANS	Transportation of Oil Products	2009	5.316.888,00	Small	19	176.238.049,00	69.401.625,00	-5.421.881,00	0,03
		2010	37.348.435,00	Medium	90	283.808.079,00	145.599.200,00	1.139.341,00	0,00
		2011	40.925.718,43		202	590.168.276,00	207.466.563,00	6.342.875,00	0,01
		2012	57.000.942,21		232	906.154.047,00	346.331.180,00	19.948.431,00	0,02
		2013	71.775.823,15	Midsized enterprise	313	1.131.308.951,00	314.376.255,00	6.584.768,00	0,01

Established by researchers from the table above.

<sup>3</sup>Balance sheets of the SP- EN - TRAN's companies over five years.

**Comment:**

- Since 2010, the investment is growing continuously.
- The turnover takes the same trend as the investment, but in a disproportionate manner to the importance of the investment.
- The investment has not impacted the employment which followed the same level during the entire period.
- The economic profitability remains beyond the investment made.

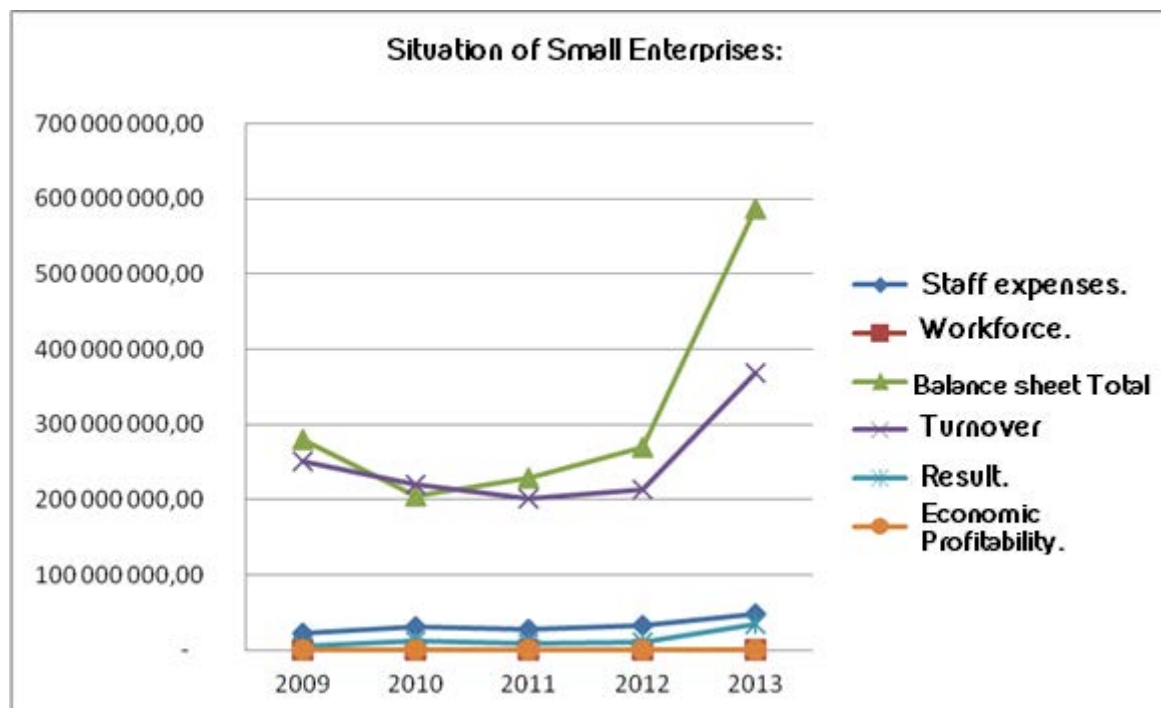
**2. Small Enterprises:<sup>4</sup>**

Enterprises:	Sector:	Year :	Staff expenses :	Size :	Workforce :	Balance Sheet Total:	Turnover:	Result:	Economic Profitability :
IRRHY	Hydro-agricultural Products Distribution	2009	7.259.189,00	Small	26	67.746.192,00	26.243.061,00	- 5.854.828,00	- 0,09
		2010	7.613.120,72		28	60.013.972,00	27.476.908,00	1.474.087,00	0,02
		2011	7.206.305,85		25	75.223.809,00	31.241.039,00	557.993,00	0,01
		2012	5.745.984,27		20	99.656.383,00	23.658.209,00	586.287,00	0,01
		2013	7.579.124,79		27	215.809.299,00	118.454.115,00	20.639.028,00	0,10
HSC	Seeds Production	2009	8.201.108,39	Small	14	188.834.010,00	58.138.997,00	1.369.769,00	0,01
		2010	13.473.249,49		23	110.477.031,00	42.075.258,00	2.290.397,00	0,02
		2011	9.950.755,29		17	107.098.104,00	18.953.284,00	743.714,00	0,01
		2012	13.950.900,73		25	113.225.872,00	33.243.807,00	2.991.743,00	0,03

<sup>4</sup>Balance sheets of the IRRHY – HSC – TH HANF – ZEG companies over five years.

		2013	26.227.693,3 7		47	298.967.327,00	39.258.415,00	8.613.696,00	0,03
TH HANF	Building Industry	2009	6.735.835,00	Small	36	19.919.361,00	70.435.341,00	9.509.602,00	0,48
		2010	8.800.613,00		39	29.616.849,00	94.503.539,00	7.880.932,00	0,27
		2011	8.494.921,00		37	41.188.397,00	83.058.309,00	5.712.607,00	0,14
		2012	10.540.643,0 0		40	50.500.159,00	73.482.243,00	4.995.068,00	0,10
		2013	12.248.758,0 0		50	59.389.171,00	105.173.961,00	5.683.792,00	0,10
ZEG	Gas Station	2009	982.800,00	VSE	5	3.322.612,00	95.657.637,00	1.034.097,00	0,31
		2010	1.360.800,00		7	4.633.059,00	56.147.280,00	497.615,00	0,11
		2011	1.474.200,00		8	5.700.357,00	69.148.688,00	1.471.498,00	0,26
		2012	2.177.280,00	Small	12	7.013.180,00	82.382.286,00	1.554.633,00	0,22
		2013	2.177.280,00		12	12.638.710,00	106.360.305,00	335.703,00	0,03

Established by researchers from the table above.



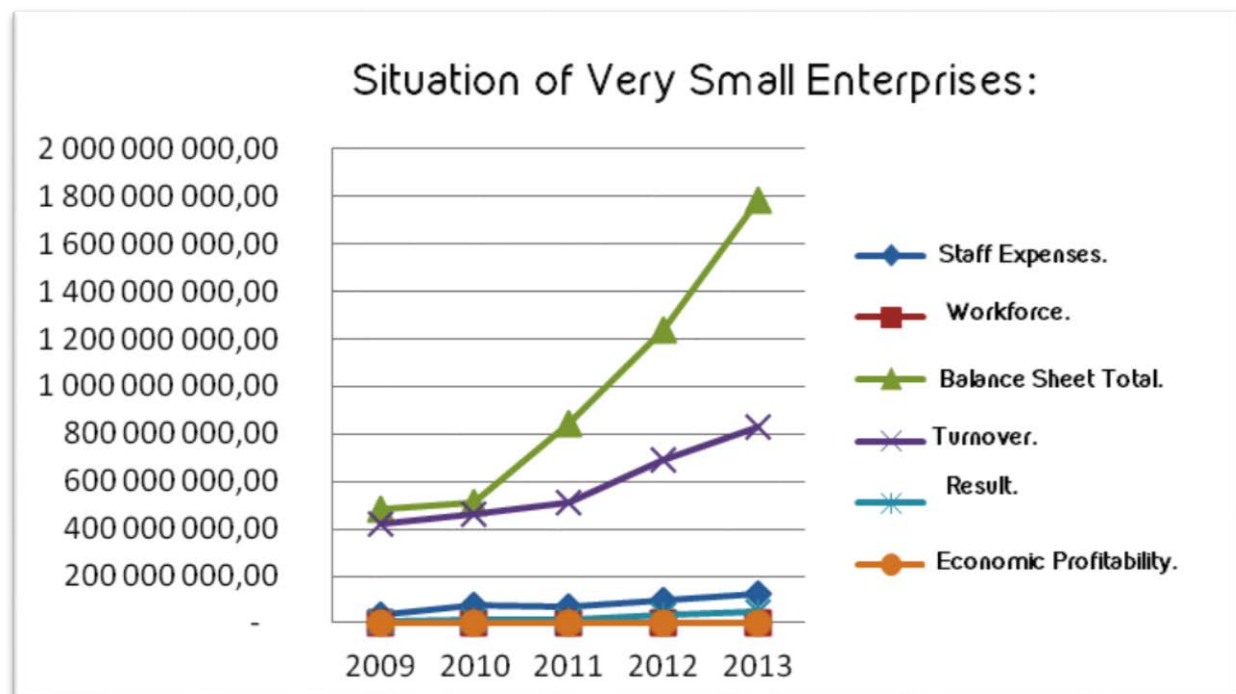
#### Comment:

- Investments are increasing from 2010. This is explained primarily by the appropriations granted and the consolidation measures taken by the authorities.
- The impact of the investments did not take effect until the 2011 financial year, to greatly increase from fiscal year 2012.
- Employment has maintained the same level during the period. The costs relating thereto have almost maintained the same level, and that, except for the slight increase seen in 2013.
- The result and profitability of investments almost followed the same trend as personnel expenses, which mean a slight increase in 2013.

### 3. Very Small Enterprises:<sup>5</sup>

Enterprises:	Sector:	Year :	Staff expenses :	Size :	Workforce:	Balance Sheet Total:	Turnover:	Result:	Economic Profitability:
BEN ML	Building Industry	2009	782 309,00	VSE	2	11 814 557,00	12 501 616,00	1 499 659,00	0,13
		2010	1 689 943,00		2	14 211 961,00	24 614 315,00	1 900 936,00	0,13
		2011	1 322 858,00		2	14 552 016,00	7 746 136,00	728 302,00	0,05
		2012	1 615 317,00		2	34 263 854,00	20 104 500,00	2 150 056,00	0,06
		2013	1 364 427,30		2	32 937 958,00	26 682 486,00	2 746 563,00	0,08
O Z	Fuel transport	2009	907 200,00	VSE	3	6 798 868,00	13 063 951,00	364 107,00	0,05
		2010	907 200,00		3	2 746 101,00	10 951 956,00	349 130,00	0,13
		2011	907 200,00		3	2 685 767,00	10 386 680,00	423 793,00	0,16
		2012	907 200,00		3	10 874 007,00	12 949 476,00	529 370,00	0,05
		2013	1 209 600,00		4	9 983 888,00	13 630 142,00	547 070,00	0,05
L Ali	Gas Station	2009	1 088 640,00	VSE	6	7 204 939,00	73 950 323,00	1 559 128,00	0,22
		2010	1 675 651,00		6	5 908 518,00	64 655 851,00	575 533,00	0,10
		2011	1 822 500,00		6	9 368 312,00	80 029 294,00	798 090,00	0,09
		2012	1 760 439,00		6	13 795 384,00	98 426 748,00	2 306 405,00	0,17
		2013	2 141 640,00		8	19 075 027,00	103 216 592,00	4 509 006,00	0,24

Established by researchers from the table above.



<sup>5</sup>Balance sheets of the BEN ML – O Z – L Ali companies over five years.

**Comment:**

With the exception of sales following a growing trend, other sizes face the same direction as those relating to small businesses.

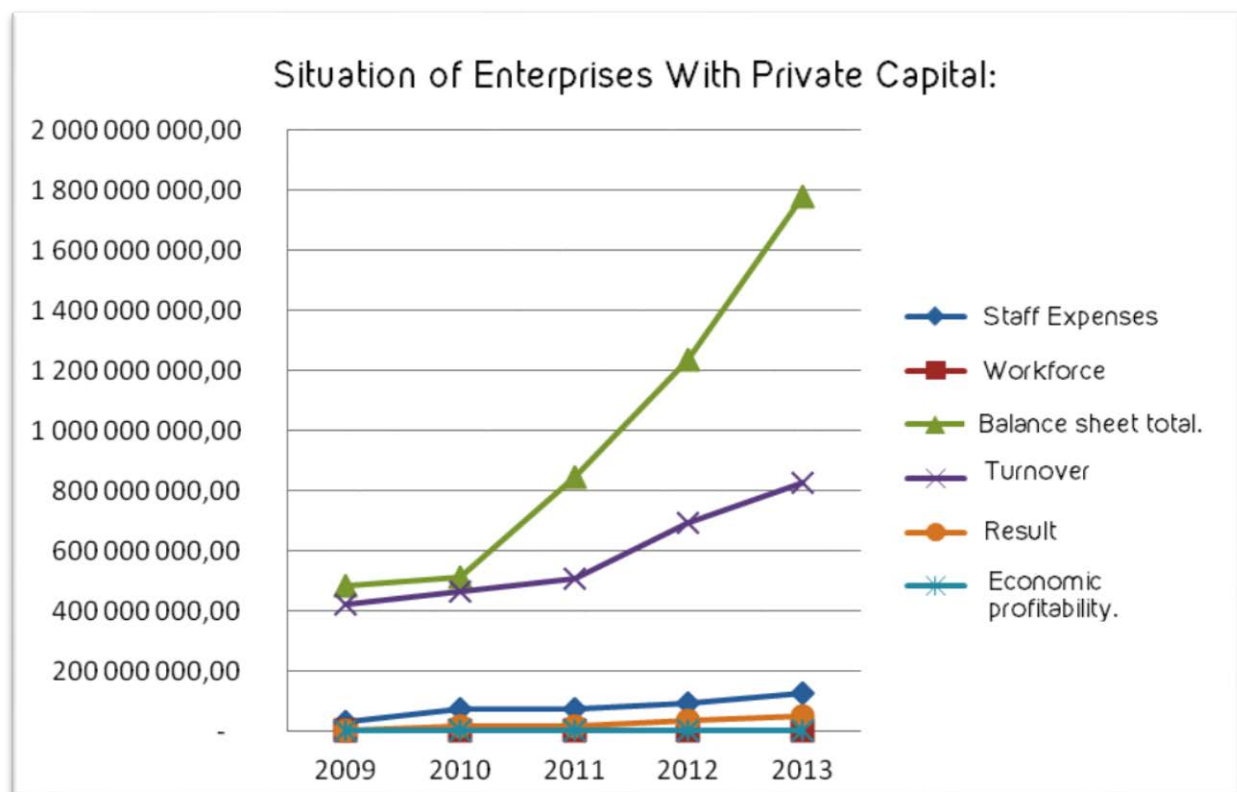
**B. Order by Legal Nature:****1. Origin of Capital:****a. Enterprises With Private Capital:<sup>6</sup>**

Enterprises:	Sector:	Year :	Staff expenses :	Size :	Workforce:	Balance Sheet Total:	Turnover:	Result:	Economic Profitability:
TRANS	Transportation of Oil Products	2009	5 316 888,00	Small	19	176 238 049,00	69 401 625,00	- 5 421 881,00	- 0,03
		2010	37 348 435,00		90	283 808 079,00	145 599 200,00	1 139 341,00	0,00
		2011	40 925 718,43		202	590 168 276,00	207 466 563,00	6 342 875,00	0,01
		2012	57 000 942,21		232	906 154 047,00	346 331 180,00	19 948 431,00	0,02
		2013	71 775 823,15		313	1 131 308 951,00	314 376 255,00	6 584 768,00	0,01
IRRHY	Hydro-agricultural Products Distribution	2009	7 259 189,00	Average	26	67 746 192,00	26 243 061,00	- 5 854 828,00	- 0,09
		2010	7 613 120,72		28	60 013 972,00	27 476 908,00	1 474 087,00	0,02
		2011	7 206 305,85		25	75 223 809,00	31 241 039,00	557 993,00	0,01
		2012	5 745 984,27		20	99 656 383,00	23 658 209,00	586 287,00	0,01
		2013	7 579 124,79		27	215 809 299,00	118 454 115,00	20 639 028,00	0,10
HSC	Seeds Production	2009	8 201 108,39	Midsize enterprise	14	188 834 010,00	58 138 997,00	1 369 769,00	0,01
		2010	13 473 249,49		23	110 477 031,00	42 075 258,00	2 290 397,00	0,02
		2011	9 950 755,29		17	107 098 104,00	18 953 284,00	743 714,00	0,01
		2012	13 950 900,73		25	113 225 872,00	33 243 807,00	2 991 743,00	0,03
		2013	26 227 693,37		47	298 967 327,00	39 258 415,00	8 613 696,00	0,03
TH HANF	Building Industry	2009	6 735 835,00	Small	36	19 919 361,00	70 435 341,00	9 509 602,00	0,48
		2010	8 800 613,00		39	29 616 849,00	94 503 539,00	7 880 932,00	0,27
		2011	8 494 921,00		37	41 188 397,00	83 058 309,00	5 712 607,00	0,14
		2012	10 540 643,00		40	50 500 159,00	73 482 243,00	4 995 068,00	0,10
		2013	12 248 758,00		50	59 389 171,00	105 173 961,00	5 683 792,00	0,10
ZEG	Gas Station	2009	982 800,00	Small	5	3 322 612,00	95 657 637,00	1 034 097,00	0,31
		2010	1 360 800,00		7	4 633 059,00	56 147 280,00	497 615,00	0,11
		2011	1 474 200,00		8	5 700 357,00	69 148 688,00	1 471 498,00	0,26
		2012	2 177 280,00		12	7 013 180,00	82 382 286,00	1 554 633,00	0,22
		2013	2 177 280,00		12	12 638 710,00	106 360 305,00	335 703,00	0,03
BEN ML	Bu	2009	782 309,00	VS E	2	11 814 557,00	12 501 616,00	1 499 659,00	0,13

<sup>6</sup>Balance sheets of the TRANS - IRRHY – HSC – TH HANF – ZEG – BEN ML – OZ – L Ali companies over five years.

		2010	1 689 943,00		2	14 211 961,00	24 614 315,00	1 900 936,00	0,13
		2011	1 322 858,00		2	14 552 016,00	7 746 136,00	728 302,00	0,05
		2012	1 615 317,00		2	34 263 854,00	20 104 500,00	2 150 056,00	0,06
		2013	1 364 427,30		2	32 937 958,00	26 682 486,00	2 746 563,00	0,08
OZ	fuel transport	2009	907 200,00	Small	3	6 798 868,00	13 063 951,00	364 107,00	0,05
		2010	907 200,00		3	2 746 101,00	10 951 956,00	349 130,00	0,13
		2011	907 200,00		3	2 685 767,00	10 386 680,00	423 793,00	0,16
		2012	907 200,00		3	10 874 007,00	12 949 476,00	529 370,00	0,05
		2013	1 209 600,00		4	9 983 888,00	13 630 142,00	547 070,00	0,05
L Ali	Gas Station	2009	1 088 640,00	Small	6	7 204 939,00	73 950 323,00	1 559 128,00	0,22
		2010	1 675 651,00		6	5 908 518,00	64 655 851,00	575 533,00	0,10
		2011	1 822 500,00		6	9 368 312,00	80 029 294,00	798 090,00	0,09
		2012	1 760 439,00		6	13 795 384,00	98 426 748,00	2 306 405,00	0,17
		2013	2 141 640,00		8	19 075 027,00	103 216 592,00	4 509 006,00	0,24

Established by researchers from the table above.



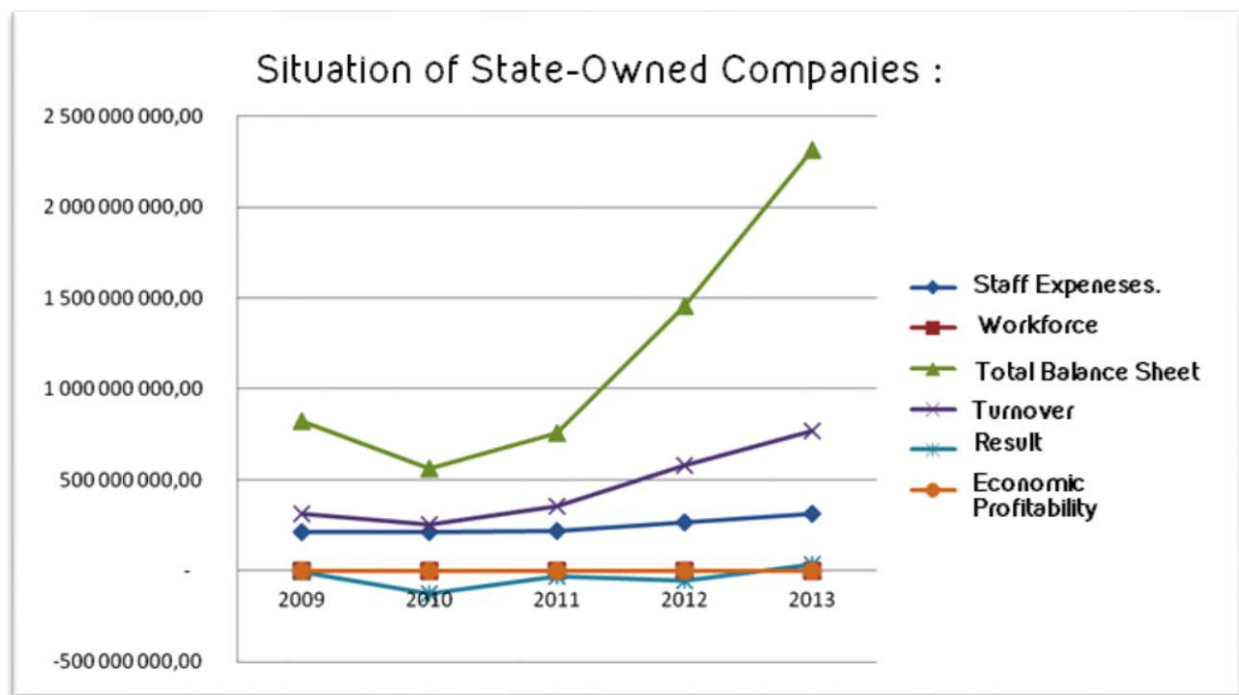
#### **Comment:**

- The investments are in sharp continuous increasing.
- The turnover figures follow the same trend as investments.
- The workforce is keeping the same level for the entire period. Nevertheless, the staff costs are in continuous increase this can be explained by the increase in salaries.
- The results follow the same direction as the staff costs. However, economic profitability remains beyond the investments made.

b. State-owned Enterprises:<sup>7</sup>

Enterprises:	Sector:	Year :	Staff expenses :	Size :	Workforce :	Balance Sheet Total:	Turnover:	Result:	Economic Profitability:
SP	Building Industry	2009	44 144 110,56	Average	92	118 575 798,00	63 459 239,00	5 890 862,00	0,05
		2010	46 543 247,00		97	223 732 203,00	79 817 991,00	5 285 482,00	0,02
		2011	41 265 146,82		86	208 603 653,00	35 174 774,00	- 12 886 212,00	- 0,06
		2012	39 825 664,96		83	344 787 483,00	51 260 276,00	- 59 415 175,00	- 0,17
		2013	46 543 247,00		97	512 162 445,73	72 285 906,00	31 797 350,00	0,06
EN	Building Industry	2009	168 800 500,00	Average	486	703 689 963,00	247 014 769,00	- 12 341 590,00	-0,02
		2010	165 000 400,00		462	338 662 845,00	174 275 342,00	- 130 047 724,00	- 0,38
		2011	179 222 148,65		500	547 035 067,00	318 731 956,00	- 19 303 560,00	- 0,04
		2012	227 970 573,08		636	1 112 341 734,00	528 658 650,00	8 182 994,00	0,01
		2013	265 248 780,00		740	1 800 737 113,00	697 064 954,00	1 661 232,00	0,00

Established by researchers from the table above.

**Comment:**

- Investments increased since the financial year 2010.

<sup>7</sup>Balance sheets of the SP – EN companies over five years.

- The turnover, although it is growing, too, from the 2010 financial year it remains disproportionate to the importance of investments made.
- The workforce remains on the same horizontal line during the entire period.
- The staff costs also remain on the same line.
- The result and the economic profitability follow a negative trend during the period from 2009 to 2012 to achieve a slight increase in 2013

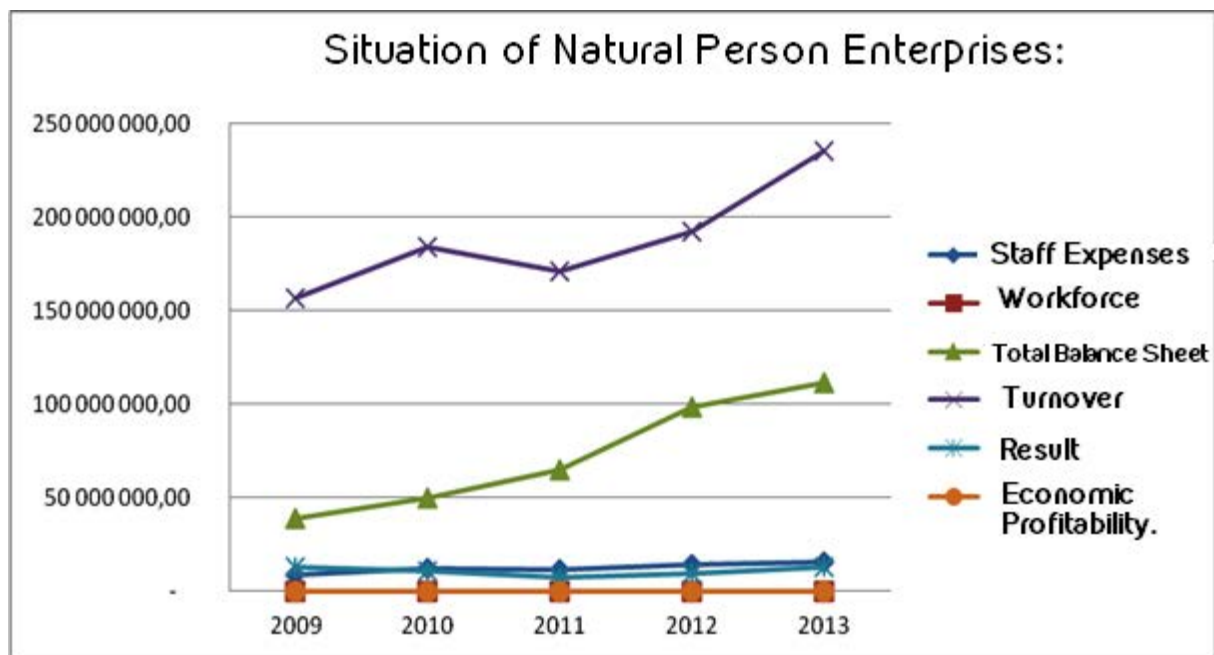
## 2. Legal form:

### a. A Natural Person Enterprise:<sup>8</sup>

Enterprises:	Sector:	Year :	Staff expenses :	Size :	Workforce :	Balance Sheet Total:	Turnover:	Result:	Economic Profitability:
TH HANF	Building Industry	2009	6 735 835,00	Small	36	19 919 361,00	70 435 341,00	9 509 602,00	0,48
		2010	8 800 613,00		39	29 616 849,00	94 503 539,00	7 880 932,00	0,27
		2011	8 494 921,00		37	41 188 397,00	83 058 309,00	5 712 607,00	0,14
		2012	10 540 643,00		40	50 500 159,00	73 482 243,00	4 995 068,00	0,10
		2013	12 248 758,00		50	59 389 171,00	105 173 961,00	5 683 792,00	0,10
BEN ML	Building Industry	2009	782 309,00	VSE	2	11 814 557,00	12 501 616,00	1 499 659,00	0,13
		2010	1 689 943,00		2	14 211 961,00	24 614 315,00	1 900 936,00	0,13
		2011	1 322 858,00		2	14 552 016,00	7 746 136,00	728 302,00	0,05
		2012	1 615 317,00		2	34 263 854,00	20 104 500,00	2 150 056,00	0,06
		2013	1 364 427,30		2	32 937 958,00	26 682 486,00	2 746 563,00	0,08
L Ali	Gas Station	2009	1 088 640,00	VSE	6	7 204 939,00	73 950 323,00	1 559 128,00	0,22
		2010	1 675 651,00		6	5 908 518,00	64 655 851,00	575 533,00	0,10
		2011	1 822 500,00		6	9 368 312,00	80 029 294,00	798 090,00	0,09
		2012	6 735 835,00		36	19 919 361,00	70 435 341,00	9 509 602,00	0,48
		2013	8 800 613,00		39	29 616 849,00	94 503 539,00	7 880 932,00	0,27

Established by researchers from the table above.

<sup>8</sup>Balance sheets of the TH HANF – BEN ML – L Ali companies over five years.

**Comment:**

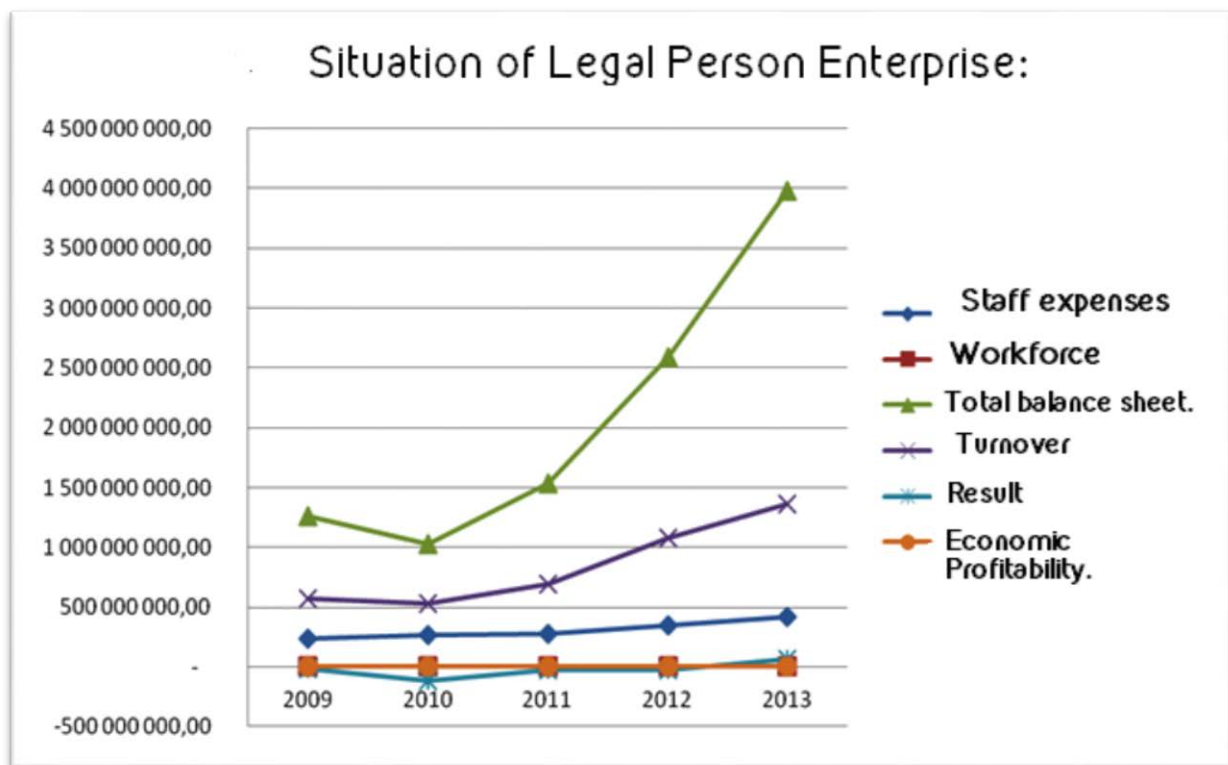
- The investments are in continuous increase.
- The turnover is much higher compared to investments which are in continuous increase.
- The Workforce and staff costs are relatively stable throughout the entire period.
- The result and the economic profitability are positive but clearly in equality with the turnover realized.

b. Legal Person Enterprise:<sup>9</sup>

Enterprises:	Sector:	Year :	Staff Expenses :	Size :	Workforce :	Balance Sheet Total:	Turnover:	Result:	Economic Profitability:
SP	Building Industry	2009	44 144 110,56	Average	92	118 575 798,00	63 459 239,00	5 890 862,00	0,05
		2010	46 543 247,00		97	223 732 203,00	79 817 991,00	5 285 482,00	0,02
		2011	41 265 146,82		86	208 603 653,00	35 174 774,00	- 12 886 212,00	-0,06
		2012	39 825 664,96		83	344 787 483,00	51 260 276,00	- 59 415 175,00	-0,17
		2013	46 543 247,00		97	512 162 445,73	72 285 906,00	31 797 350,00	0,06
EN	Building Industry	2009	168 800 500,00	Average	486	703 689 963,00	247 014 769,00	- 12 341 590,00	- 0,02
		2010	165 000 400,00		462	338 662 845,00	174 275 342,00	- 130 047 724,00	- 0,38
		2011	179 222 148,65		500	547 035 067,00	318 731 956,00	- 19 303 560,00	-0,04
		2012	227 970 573,08		636	1 112 341 734,00	528 658 650,00	8 182 994,00	0,01

<sup>9</sup>Balance sheets of the SP – EN – TRANS – IRRHY - HSC – ZEG – OZ companies over five years.

		2013	265 248 780,00		740	1 800 737 113,00	697 064 954,00	1 661 232,00	0,00
TRANS	Transportation of Oil Products	2009	5 316 888,00	Small	19	176 238 049,00	69 401 625,00	- 5 421 881,00	- 0,03
		2010	37 348 435,00	Average	90	283 808 079,00	145 599 200,00	1 139 341,00	0,00
		2011	40 925 718,43		202	590 168 276,00	207 466 563,00	6 342 875,00	0,01
		2012	57 000 942,21		232	906 154 047,00	346 331 180,00	19 948 431,00	0,02
		2013	71 775 823,15	Midsize enterprise	313	1 131 308 951,00	314 376 255,00	6 584 768,00	0,01
IRRHY	Hydro-agricultural Products Distribution	2009	7 259 189,00	Small	26	67 746 192,00	26 243 061,00	- 5 854 828,00	- 0,09
		2010	7 613 120,72		28	60 013 972,00	27 476 908,00	1 474 087,00	0,02
		2011	7 206 305,85		25	75 223 809,00	31 241 039,00	557 993,00	0,01
		2012	5 745 984,27		20	99 656 383,00	23 658 209,00	586 287,00	0,01
		2013	7 579 124,79		27	215 809 299,00	118 454 115,00	20 639 028,00	0,10
HSC	Seeds Production	2009	8 201 108,39	Small	14	188 834 010,00	58 138 997,00	1 369 769,00	0,01
		2010	13 473 249,49		23	110 477 031,00	42 075 258,00	2 290 397,00	0,02
		2011	9 950 755,29		17	107 098 104,00	18 953 284,00	743 714,00	0,01
		2012	13 950 900,73		25	113 225 872,00	33 243 807,00	2 991 743,00	0,03
		2013	26 227 693,37		47	298 967 327,00	39 258 415,00	8 613 696,00	0,03
ZEG	Gas Station	2009	982 800,00	VSE	5	3 322 612,00	95 657 637,00	1 034 097,00	0,31
		2010	1 360 800,00		7	4 633 059,00	56 147 280,00	497 615,00	0,11
		2011	1 474 200,00		8	5 700 357,00	69 148 688,00	1 471 498,00	0,26
		2012	2 177 280,00	Small	7 013 180,00	82 382 286,00	1 554 633,00	7 013 180,00	0,22
		2013	2 177 280,00		12 638 710,00	106 360 305,00	335 703,00	12 638 710,00	0,03
OZ	Fuel Transport	2009	907 200,00	VSE	6 798 868,00	13 063 951,00	364 107,00	6 798 868,00	0,05
		2010	907 200,00		2 746 101,00	10 951 956,00	349 130,00	2 746 101,00	0,13
		2011	907 200,00		2 685 767,00	10 386 680,00	423 793,00	2 685 767,00	0,16
		2012	907 200,00		10 874 007,00	12 949 476,00	529 370,00	10 874 007,00	0,05
		2013	1 209 600,00		9 983 888,00	13 630 142,00	547 070,00	9 983 888,00	0,05



Established by researchers from the table above.

**Comment:**

- Investments are increasing since 2010.
- The turnover has increased since 2010 but significantly below the investment.
- The result has the smallest increase since 2010, but disproportionately in relation to investment and the realized turnover.
- Stable employment and personnel expenses increased slightly.

**C. Situation of all of the SMEs / SMIs/VSEs:<sup>10</sup>**

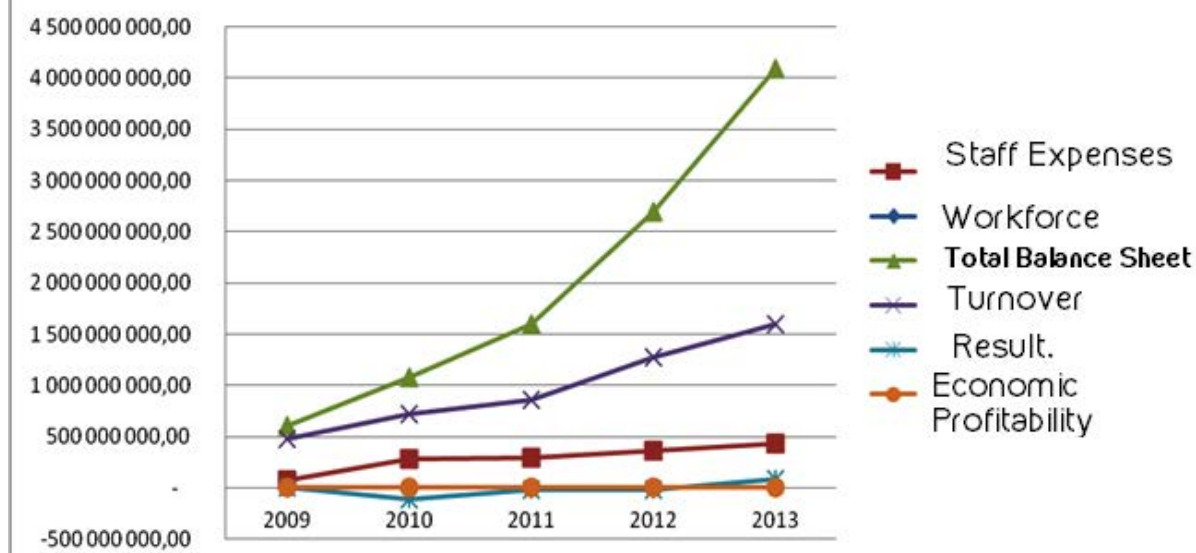
Enterprises:	Sector:	Year :	Staff expenses :	Size :	Workforce :	Balance Sheet Total:	Turnover:	Result:	Economic Profitability:
SP	Building Industry	2009	44 144 110,56	Average	92	118 575 798,00	63 459 239,00	5 890 862,00	0,05
		2010	46 543 247,00		97	223 732 203,00	79 817 991,00	5 285 482,00	0,02
		2011	41 265 146,82		86	208 603 653,00	35 174 774,00	- 12 886 212,00	- 0,06
		2012	39 825 664,96		83	344 787 483,00	51 260 276,00	- 59 415 175,00	- 0,17
		2013	46 543 247,00		97	512 162 445,73	72 285 906,00	31 797 350,00	0,06
EN	Building Industry	2009	168 800 500,00	Average	486	703 689 963,00	247 014 769,00	- 12 341 590,00	- 0,02

<sup>10</sup>"The encrypted data were extracted from the fiscal balance sheets of companies named above, and over five years."

		2010	165 000 400,00		462	338 662 845,00	174 275 342,00	- 130 047 724,00	- 0,38
		2011	179 222 148,65		500	547 035 067,00	318 731 956,00	- 19 303 560,00	- 0,04
		2012	227 970 573,08		636	1 112 341 734,00	528 658 650,00	8 182 994,00	0,01
		2013	265 248 780,00		740	1 800 737 113,00	697 064 954,00	1 661 232,00	0,00
TRANS	Transportation of Oil Products	2009	5 316 888,00	Small	19	176 238 049,00	69 401 625,00	- 5 421 881,00	- 0,03
		2010	37 348 435,00	Average	90	283 808 079,00	145 599 200,00	1 139 341,00	0,00
		2011	40 925 718,43		202	590 168 276,00	207 466 563,00	6 342 875,00	0,01
		2012	57 000 942,21		232	906 154 047,00	346 331 180,00	19 948 431,00	0,02
		2013	71 775 823,15	Midsize enterprise	313	1 131 308 951,00	314 376 255,00	6 584 768,00	0,01
IRRHY	Hydro-agricultural Products Distribution	2009	7 259 189,00	Small	26	67 746 192,00	26 243 061,00	-5 854 828,00	- 0,09
		2010	7 613 120,72		28	60 013 972,00	27 476 908,00	1 474 087,00	0,02
		2011	7 206 305,85		25	75 223 809,00	31 241 039,00	557 993,00	0,01
		2012	5 745 984,27		20	99 656 383,00	23 658 209,00	586 287,00	0,01
		2013	7 579 124,79		27	215 809 299,00	118 454 115,00	20 639 028,00	0,10
BEN ML	Building Industry	2009	782 309,00	VSE	2	11 814 557,00	12 501 616,00	1 499 659,00	0,13
		2010	1 689 943,00	Average	2	14 211 961,00	24 614 315,00	1 900 936,00	0,13
		2011	1 322 858,00		2	14 552 016,00	7 746 136,00	728 302,00	0,05
		2012	1 615 317,00		2	34 263 854,00	20 104 500,00	2 150 056,00	0,06
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HSC	Seeds Production	2009	13 473 249,49	Small	23	110 477 031,00	42 075 258,00	2 290 397,00	0,02
		2010	9 950 755,29		17	107 098 104,00	18 953 284,00	743 714,00	0,01
		2011	13 950 900,73		25	113 225 872,00	33 243 807,00	2 991 743,00	0,03
		2012	26 227 693,37		47	298 967 327,00	39 258 415,00	8 613 696,00	0,03
		2013	6 735 835,00		36	19 919 361,00	70 435 341,00	9 509 602,00	0,48
TH HANF	Buildi ng Indus try	2009	8 800 613,00	Small	39	29 616 849,00	94 503 539,00	7 880 932,00	0,27

		2010	8 494 921,00		37	41 188 397,00	83 058 309,00	5 712 607,00	0,14
		2011	782 309,00		92	118 575 798,00	63 459 239,00	5 890 862,00	0,05
		2012	10 540 643,00		40	50 500 159,00	73 482 243,00	4 995 068,00	0,10
		2013	12 248 758,00		50	59 389 171,00	105 173 961,00	5 683 792,00	0,10
ZEG	Gas Station	2009	982 800,00	VSE	5	3 322 612,00	95 657 637,00	1 034 097,00	0,31
		2010	1 360 800,00		7	4 633 059,00	56 147 280,00	497 615,00	0,11
		2011	1 474 200,00		8	5 700 357,00	69 148 688,00	1 471 498,00	0,26
		2012	2 177 280,00	Small	12	7 013 180,00	82 382 286,00	1 554 633,00	0,22
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OZ	fuel transport	2009	907 200,00	VSE	3	6 798 868,00	13 063 951,00	364 107,00	0,05
		2010	907 200,00		3	2 746 101,00	10 951 956,00	349 130,00	0,13
		2011	907 200,00		3	2 685 767,00	10 386 680,00	423 793,00	0,16
		2012	907 200,00		3	10 874 007,00	12 949 476,00	529 370,00	0,05
		2013	1 209 600,00		4	9 983 888,00	13 630 142,00	547 070,00	0,05
L Ali	Gas Station	2009	1 088 640,00	VSE	6	7 204 939,00	73 950 323,00	1 559 128,00	0,22
		2010	1 675 651,00		6	5 908 518,00	64 655 851,00	575 533,00	0,10
		2011	1 822 500,00		6	9 368 312,00	80 029 294,00	798 090,00	0,09
		2012	1 760 439,00		6	13 795 384,00	98 426 748,00	2 306 405,00	0,17
		2013	2 141 640,00		8	19 075 027,00	103 216 592,00	4 509 006,00	0,24

Situation of the SMEs / SMLs / VSEs in Algeria:



Established by researchers from the table above.

### **General Synthesis:**

Generally, investment is increasing steadily since 2009. The turnover is also increasing but disproportionately. Employment is more or less stable during the entire period but staff costs increased slightly. The result and the economic profitability have started to come out of the red zone as from the 2012 fiscal year.

### **Importance of SMEs / SMIs / VSEs:**

In the past it was believed that the size of a company reflects its importance and its weight. In fact, average, small and very small companies show their importance, particularly in the areas of:

- Creating Wealth, value added and growth.
- Job creation and social stability.

Additionally to training offered by these companies, they are the preferred market for bankers. Should be noted that large companies in developed and emerging countries, are opting often for public savings to finance their development or reinvestment.

In Algeria, long marginalized SMEs and relegated to second place behind the large public companies, which takes almost all budgets plans and development programs, they occupy two decades a prominent place in the economic system. And, through the panoply of regulations governing the creation of businesses and the upgrade device.

However, all these measures are insufficient in the absence of complementary measures of support and recovery of firms in difficulty.

The waves of dissolution and liquidation of thousands of companies during the 1990s and 2000s attest.

The current legislation governing of bankruptcy and judicial settlement, allowed under the regulation of the Commercial Code<sup>11</sup> remain practically inactive. The alert procedure provided by article 715-11 of the Commercial Code and articles 23 and 25 of the law 10-01 of 06-29<sup>th</sup>-2010<sup>12</sup>, is still insufficient and incomplete. And the opposite of what happens in developed countries, particularly in France where the alert procedure can lead to the judge of the commercial court who can recommend the most appropriate measures to turn the company.

### **CONCLUSION:**

In a market such as ours, without investment expenditure rationalization and without a safe and supportive environment, we can't achieve the desired objectives that are primarily the wealth and employment. Wealth is locally.

**"Small streams make great rivers"**

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<sup>11</sup> Article 215 to 388

<sup>12</sup> Relating to the accounting profession of auditor and of Chartered Accountants

## References:

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Study of a sample of firms(intellectual honesty, the companies referred to were distorted), listed as follows:

- EPE SPA SP/HASSI AMEUR.
- EPE SPA EN/EL BAYEDH.
- SARL O Z/ MASCARA.
- SARL IRRHY/ MASCARA.
- SARL (SPA) TRANS / ORAN.
- SARL (SPA) HSC / MASCARA.
- SARL ZEG / MASCARA.
- E I « TH HANF »/ MASCARA.
- E I "BEN ML"/ MASCARA.
- E I "L ALI"/ MASCARA.

## The International Criminal Court: Antecedents, History, and Prospects

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### Abstract

*The principle of domestic jurisdiction in international law makes national governments responsible for protecting their citizens, investigating alleged abuses of human rights in their countries and bringing the perpetrators to justice. They governments may also extradite those accused of abuse of human rights to any other states prepared to give them a fair trial. Problem arises however, when governments are unable or unwilling to perform this duty or are themselves perpetrators of these crimes. Thus, millions of people have fallen victims of genocide, crimes against humanity and serious violations of humanitarian laws. But only very few of these perpetrators have been brought to justice in national courts as many governments claim sanctuary under the principle of domestic jurisdiction. The need therefore arises for the international community to act in order to protect helpless or defenseless citizens from being victims of crimes against humanity and human rights abuses, by bringing the perpetrators of these crimes to justice. The thrust of this article therefore, is that the creation of the International Criminal Court (ICC) fills this void by fulfilling a central and pivotal goal in international jurisprudence. This article, therefore, provides insights and lessons into the history and prospects of the International Criminal Court. These are insights and lessons that are too important and too costly to ignore in the 21<sup>st</sup> century understanding of international criminal justice system.*

**Keywords:** International Law, International Criminal Court, Genocide, Crimes against Humanity and Human Rights Violations

### Introduction

The attempt by the international community to establish a permanent and credible international Tribunal or court to try persons who commit war crimes has a long and checkered history which culminated in the establishment of the International Criminal Court. Thus, since the First World War, the international community had sought to establish a court to prosecute perpetrators of major international crimes like aggression, genocide, crimes against humanity and war crimes. About half a century ago, on the experience of the former Nuremberg Tribunal, an International Military Tribunal (IMT) which was established in 1945 by the various Allied Powers to try the Nazi war criminals, the International Military Tribunal for the Far East (IMTFE) to try the political and military leaders of the defeated Germany and the European Axis powers at Nuremberg and their Japanese counterparts at Tokyo. These tribunals suffered credibility crisis which was worsened by the cold war. However, outraged by the unprecedented brutality and impunity in the crisis in the former Yugoslavia in the Balkan Peninsular, Cambodia and Rwanda in Central Africa, Ad-hoc war crimes tribunals were set up to try and punish war criminals in these war zones (International Criminal Tribunal for the Yugoslavia (ICTY) and International Criminal Tribunal for Rwanda (ICTR), under the resolution of the security council while the special court for

Sierra Leone (SCSL) was established by the agreement between the United Nations and the Government of Sierra Leone (Barnes, 2015; Anoushirvani, 2010). But these were temporary tribunals established to respond to the human rights violations in those countries.

The success of these ad-hoc tribunals provided impulse and momentum for the establishment of the International Criminal Court (ICC) as a permanent court for the trial and punishment of war criminals. Thus, Editorial Board (2015:1) assert that “it was position as a way to replicate with a permanent court what had accomplished in previous tribunals, such as the Nuremberg trial after World War II and South Africa’s Truth and Reconciliation Commission, which probed human rights violations of the Apartheid era.” Thus, member states of the newly founded UN recognized the necessity to pledge themselves to the creation of a new system of international justice. They recognized that an international criminal court was an essential element in building respect for human rights throughout the world, but the court was never set up. Many state governments have been reluctant to pursue the establishment of such a court because of its potential to limit their own sovereignty and political options (Ciampi, 2006). However, in theory, such a court could only bring to justice those who were responsible for the crimes of genocide, crimes against humanity and serious violations of humanitarian laws (Editorial Board, 2015). “Currently 114 states are ICC members. Fifteen are Asia states; eighteen are Eastern European; twenty-five are Latin American and Caribbean states; twenty-five are Western European and other states; and thirty-one are from Africa, making Africa the region with the most member states” (Barnes, 2015:1589).

With the eventual establishment of the international criminal court, the international community could bring to justice those accused of the most outrageous crimes against human rights and humanitarian law in proceedings which guarantee all recognized safeguards for fair trial adopted by the international community. It would hold individuals personally responsible for planning, ordering or committing gross crimes under international law. It would prosecute them whether they were committed in war or peace and regardless of whether the perpetrators were leaders or subordinates, civilians or members of military, paramilitary or police forces. According to the statute, the court would complement prosecutions in national courts; acting when states were unwilling or unable to bring perpetrators to justice (Abass, 2006).

The International Criminal Court (ICC) was established through a treaty adopted in Rome on July 17, 1998 by 120 States which ratified its Statute. It is called the Rome Statute of the ICC, 2002 (hereinafter referred to as the ICC Statute). According to Articles 5, 6, and 7 of the ICC Statute, the Court has jurisdiction over four categories of core crimes of concern to the international community namely: genocide, crimes against humanity, war crimes and the crime of aggression (Barnes, 2015; Bassiouni, 1970; Ciampi, 2006).

The ICC’s jurisdiction over the above crimes became effective after July 1, 2002 when the Rome Treaty entered into force upon the deposit of the sixtieth instrument of ratification. One of the most critical developments under the Rome Statute is that nobody has immunity from prosecution including heads of State or Government, members of Parliaments, governments, commanders and superiors of military or civilian forces (Article 28, ICC Statute). The International Court of Justice, the principal judicial organ of the United Nations (UN), was designed to deal primarily with disputes between States. It has no jurisdiction over matters involving individual criminal responsibility. The principle of *nullum crimen sine lege* is applicable here. The maxim states that there can be no crime committed, and no punishment meted out, without a violation of penal law as it existed at the time of its drafting. Another consequence of this principle is that only those penalties that had already been established for the offence at the time when it was committed can be imposed. This maxim finds expression in Article 34 (1) of UN Charter. It states that: “*Only States may be parties in cases before the Court.*” Article 22 (1) of the ICC Statute states that: “*A person shall not be criminally responsible under this Statute unless the conduct in question constitutes, at the time it takes place, a crime within the jurisdiction of the Court*” (Ciampi, 2006).

However, the preambles of both the UN Charter and the ICC Statute convey the same international perspective by states. The UN Charter portrays a determination of states “*to save succeeding generations from*

*the scourge of war...*" (Ian, 1983), and in the ICC Statute, states are "*mindful that during this century millions of children, women and men have been victims of unimaginable atrocities that deeply shock the conscience of humanity*" (Abass, 2006). Consequent upon the above, this article perceives the ICC Statute as an instrument that fortifies international resolve to save succeeding generations from the scourge of war, and to ensure that those responsible for perpetrating unimaginable atrocities on women and children are criminally responsible before the international criminal justice system. It must be noted however that the ICC is a recent Statute yet to be ratified by many states. It follows therefore that the article's analysis is centered primarily on the provisions of the Statute provisions. This is reinforced by the fact that the cases that have appeared before it are very few, and few scholars have conducted research on the Court (Barnes, 2015).

## **The Evolution and Conceptualization of the ICC**

According to Bassiouni (1970), it has been a long academic debate to identify the legal nature of international crimes committed by individuals and considered as serious violations of the rules of international humanitarian law. However Schwarzenberger (1968) traces the earliest trial for war crimes to Peter Von Hagenbach, in the year 1474. Hagenbach, the governor, had been placed at the helm of the government of the fortified city of Breisach, by his boss, Charles the Bold, Duke of Burgundy (1433-1477), known to his enemies as Charles the Terrible. The governor, overzealously following his master's instructions, introduced a regime of arbitrariness, brutality and terror in order to reduce the population of Breisach to total submission. Murder, rape, illegal taxation and the wanton confiscation of private property became generalized practices. All these violent acts were committed against inhabitants of the neighboring territories, including Swiss merchants on their way to the Frankfurt Fair. A large coalition of countries (Austria, France, Bern and the towns of Upper Rhine) put an end to the ambitious goals of the powerful Duke. When Hagenbach was finally defeated, instead of remitting the case to an ordinary tribunal, an ad hoc court was set, consisting of 28 judges of the allied coalition of states and towns. The tribunal was a real international court, set up to try Hagenbach, for compliance with superior orders, and Charles the Bold himself was also tried for the atrocities he ordered.

According to the explanation of Schinder (1988:5), a further leap was made in the twentieth century, after the First World War. The Treaty of Versailles of June 28, 1919, in its Articles 228 and 229, established the right of the Allied Powers to try and punish individuals responsible for "violations of the laws and customs of war." The German government therefore had the duty to hand over all persons accused, in order to permit them to be brought before an allied military tribunal. Article 227 indicted those guilty of "international morality and the sanctity of treaties." The Allied Powers agreed to establish a special tribunal composed of judges appointed by the United States, Great Britain, France, Italy and Japan to try the accused. In its decision, the tribunal will be guided by the highest motives of international policy, with a view of vindicating the solemn obligations of international undertakings and the validity of international morality. The provisions of this article anticipated the category of "crimes against peace."

After the Second World War, Brownlie (1989:16) observed that a movement started up within the international community which clearly began to engender a deeper consciousness of the need to prosecute serious violations of the laws of war, with regard to both the traditional responsibility of states, and the personal responsibility of individuals. The horrible crimes committed by the Nazis and the Japanese led to a quick conclusion of agreements among Allied Powers and to the subsequent establishment of the Nuremburg and Tokyo International Military Tribunals "for the trial of war criminals whose offences have no particular geographical location whether they be accused individually or in their capacity as members of organizations or groups or in both capacities". This provision is stated in Article 1 of the London Agreement for the Prosecution and Punishment of the Major War Criminals of the European Axis, of August 8, 1945.

Later in 1948, the United Nations (UN) first recognized the need to establish an international criminal court to prosecute crimes such as genocide. Raphael Lemkin coined the term genocide which in Latin means

“geno” (tribe or ethnic group) and “cide” (massacre). Simply, genocide meant ‘to carry out massacre on an ethnic group.’ He served, alongside Professor H. Donnedieu de Vabres and V. Pella, as expert advisers to the Secretariat of the International Law Commission, responsible for the Convention relating to genocide. In resolution 260 of December 9, 1948, the General Assembly, *"recognizing that at all periods of history genocide has inflicted great losses on humanity; and being convinced that, in order to liberate mankind from such an odious scourge, international co-operation is required"*, adopted the Convention on the Prevention and Punishment of the Crime of Genocide. Article I of that convention characterizes genocide as "a crime under international law", and article VI provides that persons charged with genocide *"shall be tried by a competent tribunal of the State in the territory of which the act was committed or by such international penal tribunal as may have jurisdiction . . ."*

Since that time, the question of the establishment of an international criminal court has been considered periodically. In December 1989, in response to a request by Trinidad and Tobago, the UN General Assembly asked the International Law Commission to resume work on an international criminal court with jurisdiction to include drug trafficking. Then, in 1993, the conflict in the former Yugoslavia erupted and quickly escalated with cases of atrocities that amount to war crimes, crimes against humanity and genocide -- in the guise of "ethnic cleansing". The situation once again captured international attention and outrage of gross violation of human rights. In an effort to bring an end to this widespread human suffering, the UN Security Council, under resolution 827 of May 25, 1993, established the ad hoc International Criminal Tribunal for the Former Yugoslavia (ICTY), with jurisdiction for the “prosecution of persons responsible for serious violations of international humanitarian law committed in the territory of the former Yugoslavia since 1991.” Later, in 1994, following the Rwandan genocide, which was a slaughter of an estimated 800,000 Tutsis by Hutus, the UN Security Council, under resolution 955 of November 8, 1994, intervened and created the International Criminal Tribunal for Rwanda (ICTR) for the prosecution of persons responsible for genocide and other serious violations of international humanitarian law committed in the territory of Rwanda and Rwandan citizens responsible for genocide and other such violations committed in the territory of neighboring states, between January 1, 1994 and December 31, 1994.

At its fifty-second session, the General Assembly decided to convene the UN Diplomatic Conference of Plenipotentiaries on the Establishment of an international criminal court, which subsequently held in Rome, Italy, from June 15 to July 17, 1998, to finalize and adopt a convention on the establishment of an international criminal court. One of the primary objectives of the UN is securing universal respect for human rights and fundamental freedoms of individuals throughout the world. In this connection, few topics are of greater importance than the fight against impunity and the struggle for peace and justice and human rights in conflict situations in today's world. The establishment of a permanent ICC is seen as a decisive step forward. The Court is now a reality, and it can be said that one of the prospects of it is promise of universal justice (Anoushirvani, 2010). But is it meeting this promise? This is one of the major questions our forthcoming paper tries to answer.

## **The Purpose of the International Criminal Court**

One of the major innovations of ICC is the need, as every criminal law will have, to deter future war criminals. In this dimension, the Court is significant as an instrument to deter future war criminals and contribute to global security, promote human rights and good governance in all states. With particular reference, in principle, the court represents a message to all potential warlords around that globe that they must be aware that depending on how a conflict develops, there is an international tribunal before which those who violate the laws of war and humanitarian law will be held accountable. Seating at The Hague, Netherlands as its headquarters, ICC is not constrained by time and place limitations. It will be able to act more quickly than if an ad hoc tribunal had to be established.

The ICC also serves as an instrument to bringing an end to conflicts. Once investigations start as to the perpetrators of the crimes, there is every reason for the conflict to cease as most of them begin to escape to other

States while others are arrested or in the verge of it. The ICC Statute provides an opportunity for the international community of states to combat crimes through provisions against international conspiracy like criminals that engage in organized crime, transnational or international criminal activities such as drug trafficking; and political organizations that commit genocide, war crimes and crimes against humanity (Albanese, 2011; Gastrow, 2011; Nwebo and Ubah, 2015; Paraschiv, 2013; Ubah et al, 2015). Similarly, terrorist organizations such as Al Qaeda have membership networks that stretch across most of the globe and use their international reach to engage in illegal activities in Africa, Asia and other parts of the world (Davis, 2012; Hanlon, 2009; Levi, 2012; Fitchtelberg, 2006; Shelley, 2005).

Thus, according to Article 25 of the ICC Statute, a person shall be criminally responsible and liable for punishment for a crime within the jurisdiction of the Court if that person commits such a crime as an individual, jointly with another or through another person, regardless of whether that other person is criminally responsible. He is also responsible if he orders, solicits or induces the commission of such a crime which in fact occurs or is attempted. Again, if, for the purpose of facilitating the commission of such a crime, a person aids, abets or otherwise assists in its commission or its attempted commission, including providing the means for its commission, he is criminally responsible (Anoushirvani, 2010; Abass, 2006; Ciampi, 2006). Pape (2002) takes the view that injustice in the efforts to allocate criminal responsibility for war crimes may occur because war crimes are often born of extreme political opportunism and desperation. Witnesses are ready to lie to convict sworn enemies and impartial witnesses are, at times, nearly impossible to find. Truth is particularly elusive when evidence sites are despoiled, the lines of command are blurred and official orders are secret.

## The Prospects of International Criminal Court Invigorated

The prospects of the ICC mainly are conceptualized here in terms of the wisdom and strength of its jurisdiction. The Court deals with the most serious crimes committed by individuals: genocide, crimes against humanity, and war crimes. These crimes are specified in the Statute and are carefully defined to avoid ambiguity or vagueness. Crimes of aggression will also be dealt with by the Court when determination has been reached on the definition, elements and conditions under which the Court will exercise jurisdiction.

According to Article 6 of the ICC Statute, "genocide" means any of the following acts committed with intent to destroy, in whole or in part, a national, ethnical, racial or religious group, as such: (a) Killing members of the group; (b) Causing serious bodily or mental harm to members of the group; (c) Deliberately inflicting on the group conditions of life calculated to bring about its physical destruction in whole or in part; (d) Imposing measures intended to prevent births within the group; (e) Forcibly transferring children of the group to another group (Abass, 2006; www. icc-cpi-int.).

The crime of genocide is unique because of its element of *dolus specialis* (special intent) which requires that the crime must be committed with 'intent to destroy'. The International Criminal Tribunal for the Former Yugoslavia, Appeals Chamber, states that "Among the grievous crimes this tribunal has the duty to punish, the crime of genocide is singled out for special condemnation and opprobrium (*The Prosecutor v. Kristic*).” Crimes against humanity cover those specifically listed prohibited acts when committed as part of a widespread or systematic attack directed against any civilian population.

Aggression as a crime under the Court is still to be given a clear definition. Article 5 (2) of the Rome Statute is to the effect that "the Court shall exercise jurisdiction over the crime of aggression once a provision is adopted.....defining the crime and setting out the conditions under which the Court shall exercise jurisdiction with respect to this crime. Such a provision shall be consistent with the relevant provisions of the Charter of the United Nations.” However, soon, the definition of aggression is going to be determined without much controversy (Ciampi, 2006). Generally, it includes a violent attack or threats by one state against another state, particularly its territorial rights (The Random House College Dictionary).

The act may be considered legitimate in cases of national defense or counter-terrorism policies. A line must be drawn between the two, so that terrorists do not make use of the term aggression to escape punishment. Criminal responsibility will be applied equally to all persons without distinction as to whether he or she is a Head of State or government, a member of a government or parliament, an elected representative or a government official. Nor may such official capacity constitute a ground for reduction of sentence. The fact that a crime has been committed by a person on the orders of a superior does not normally relieve that person of criminal responsibility. Thus article 27(1) is to the effect that "...immunities or special procedural rules which may attach to the official capacity of a person, whether under national or international law, shall not bar the Court from exercising its jurisdiction over such a person." This principle in international criminal justice is known as command responsibility, the Yamashita or Medina Standard.

Sanford and Stephen (1989) points out that the Yamashita Standard is based upon the precedent set by the United States Supreme Court in the case of the Japanese General Tomoyuki Yamashita. He was prosecuted for atrocities committed by troops under his command in the Philippines, and was charged with unlawfully disregarding and failing to discharge his duty as a commander to control the acts of members of his command by permitting them to commit war crimes (US Military Tribunal, Nuremberg Judgment, October 28, 1948).

The Medina Standard is based upon the massacre at My Lai which United States captain Ernest Medina failed to prevent. The principle holds that a commanding officer, being aware of a human rights violation or a war crime, will be held criminally liable when he does not take action. Thus command responsibility is an omission mode of individual criminal responsibility: the superior is responsible for crimes committed by his subordinates and for failing to prevent or punish them (Keman and Hamilton, 2003).

A military commander is criminally responsible for crimes committed by forces under his or her command and control. Criminal responsibility also arises if the military commander knew or should have known that the forces were committing or were about to commit such crimes, but nevertheless failed to prevent or repress their commission. There is responsibility of commanders and other superiors. A military commander is criminally responsible for crimes within the jurisdiction of the Court committed by forces under his or her effective command and control. This will be as a result of his or her failure to exercise control properly over such forces. He must have known that the forces were committing or about to commit such crimes. Secondly, it should be shown that the military commander or person failed to take all necessary and reasonable measures within his or her power to prevent or repress their commission or to submit the matter to the competent authorities for investigation and prosecution (Article 28, ICC Statute).

Those crimes enshrined in the ICC Statute are often committed by or with the approval of governments. It is unlikely that a government sponsoring genocide, war crimes or crimes against humanity would consent to the prosecution of its nationals for his or her participation. The ICC Statute therefore annuls municipal legislation granting immunity to heads of state or military commanders. Most decisions of the International Criminal Tribunal for the Yugoslavia (ICTY) and International Criminal Tribunal for Rwanda (ICTR) have applied the principle of command responsibility. The *Kambanda* Judgment (Case No. ICTR 97-23-S) for example, in which former Rwandan Prime Minister was tried and sent to 30 years imprisonment, represents a new accountability of political leadership at the national level with regard to a prime minister. Similarly, in the ICTY Judgment of *Prosecutor v. Naser Oric* (Case No. IT-03-68), Oric, Srebrenica's Muslim wartime commander was convicted and sentenced for failing to prevent the murder of four persons and for the cruel treatment of five Serb individuals detained in the eastern Bosnian town of Srebrenica between December 1992 and March 1993.

Though this trend has been progressing unhindered, a contradictory position was taken by the International Criminal Justice (ICJ) in the case of *Belgium v. Congo* (ICJ, Arrest Warrant Case, 2002). The case involved the validity of an international warrant for the arrest of the then Congolese Minister of Foreign Affairs on the ground that he had committed serious violations of international humanitarian law. The judges unanimously held that customary international law grants incumbent foreign ministers, absolute immunity from

criminal jurisdiction and inviolability, for as long as they hold their office. This position appears to have diluted the developing international customary rule that suspends legal immunity whenever a grave international crime has been committed.

The ICC should not infringe on the jurisdiction of national courts. It will not supersede, but will complement national jurisdiction (Article 1, ICC Statute). Barnes (2011) claims that the ICC Statute, provides national courts with primary jurisdiction to prosecute heinous crimes, but that this primacy is not absolute because a state may lose its primacy when it manifests unwillingness or inability to exercise its jurisdiction over a specific case. Thus national courts will continue to have priority in investigating and prosecuting crimes within their jurisdiction. If a national court is willing and able to exercise jurisdiction, the ICC cannot intervene and no nationals of that State can be brought before it except in cases referred to it by the UN Security Council acting under Chapter VII of the UN Charter dealing with "Action with respect to threats to the peace, breaches of the peace, and acts of aggression." Article 39 of the UN Charter states that "the Security Council shall determine the existence of any threats to the peace, breaches of the peace, and acts of aggression and shall recommend, or decide what measures shall be taken to maintain or restore international peace and security."

The principle of universal jurisdiction is very important and has been mentioned by the ICC Statute. According to this principle, states can claim jurisdiction over persons whose alleged crimes were committed outside the boundaries of the prosecuting state, regardless of nationality or country of residence. In 1993, the Belgium Parliament voted on the law on universal jurisdiction, thus giving it power to judge people accused of war crimes, crimes against humanity or genocide. The Belgium court succeeded in 2001 to arrest and convict, four Rwandans for their involvement in the Rwandan genocide. In September 2005, Chad's former President and dictator Hissen Habre was indicted for crimes against humanity, torture, war crimes and other human rights violations by the Belgium court. Arrested in Senegal following requests from Senegalese courts, he was put under house arrest to be sent to Belgium. The Belgian court faced a quick explosion of suits. For instance, former Israelis Prime Minister Ariel Sharon was accused of involvement in the 1982 Sabra-Shatila massacre in Lebanon, and some Israelis deposed a suit against Yasser Arafat for his presumed responsibility for terrorist actions (Barnes, 2011).

In 2003, Iraqi victims of a 1991 Baghdad bombing deposed a suit against George H.W Bush, Collin Powell and Dick Cheney. Confronted with this sharp increase in deposed suits, Belgium established the condition that the accused person must be Belgian or present in Belgium. Universal jurisdiction is premised on the concept that certain crimes are so serious that all humanity has reason to bring the perpetrators to justice, regardless of the place of the offence or of the nationalities of the offenders or victims. The question of consent versus the universality principle has been raised. Abass (2006), asserts that the requirement of the consent of the state on whose territory the crime was committed would be unnecessary if the court's basis of jurisdiction were universality.

The jurisdictional relationship between the ICC and nonparty states became a subject of academic debate in 2001. Scharf (2001), the then US Ambassador-at-Large for War Crimes issues, stated that the Rome Treaty of the ICC "purports to establish an arrangement whereby United States armed forces operating overseas could be conceivably prosecuted by the international court even if the United States (US) has not agreed to be bound by the treaty.... contrary to the most fundamental principles of treaty law." The US later secured the adoption of Security Council resolutions no. 1422 (2002), 1487 (2003), 1497 (2003), 1593 (2005) and launched a campaign for the conclusion of bilateral non-surrender agreements. On June 30, 2002, when the Rome Statute was about to enter into force, the US declared that it would vote against a resolution renewing for six months the mandate of the UN Mission in Bosnia and Herzegovina (UNMIBH) and threatened to do the same with respect to all other UN peacekeeping operations if US military personnel participating in such operations were not granted an exemption from the ICC jurisdiction. None of the resolutions above can be qualified as an exercise of the Security Council's power to request the ICC not to commence or proceed with investigations or prosecutions under Article 16 of the Rome Statute, as this provision was not conceived to cover future and

hypothetical cases. It should be observed that by adopting resolutions 1422 and 1487 it would seem that the Security Council acted *ultra vires*, since no threat to the peace can be found in order to justify the exercise of Chapter VII powers.

On August 1, 2003, the Security Council adopted resolution 1497, authorizing the establishment of a Multinational Force in Liberia in order to support the peace process in that country. Paragraph 7 provides that “current or former officials or personnel from a contributing state, which is not a party to the Rome Statute of the ICC, shall be subject to the exclusive jurisdiction of that contributing State for all alleged acts or omissions arising out of or related to the Multinational Force or UN Stabilization Force in Liberia, unless such exclusive jurisdiction has been expressly waived by that contributing state.” According to Roscini (2006), the above resolutions prevent the exercise of the ICC jurisdiction over nationals or personnel of all states nonparties to the Rome Statute, not just of the US. Thus, a state non-party not wishing that its personnel participating in peacekeeping missions enjoy the permanent or temporary exemption by the ICC jurisdiction could only ask the Security Council to amend the resolutions and remove the exemption with regard to its nationals and personnel.

The problem of the possible exercise of jurisdiction over nationals of non-parties is exacerbated by the fear of the US that the Prosecutor might start *proprio motu* (of his own motion) politically motivated proceedings against US citizens participating in military operations abroad. The US has also criticized the disparity between the Rome Statute and several provisions of its Constitution such as those providing for immunities of state officials and for the right to be tried by a jury; the inclusion of the crime of aggression, which might affect the primary responsibility of the Security Council in the maintenance of international peace and security; as well as the idea of subject for liability for certain actions the US might take to protect their national security and foreign policies which the ICC might find problematic. The risk highlighted by the US is that senior US officials may be at risk of criminal prosecution for national security decisions involving such matters as responding to acts of terrorism, preventing the proliferation of weapons of mass destruction, and deterring aggression (American Service members’ Protection Act, Section 2002, Para.9; Abass, 2006; Barnes, 2015).

## Conclusion

In sum, this article has made serious effort in examining the antecedents, evolution, and development of the International Criminal Court (ICC). It has also surveyed its perspectives, problems and prospects. Thus, according to Article 13 (a) (b) and (c), of the ICC Statute, cases come before the International Criminal Court in one of three ways: the UN Security Council may refer a “situation” using its powers under Chapter VII of the UN Charter regardless of where or by whom the crime or crimes in question were committed; a situation may be referred to the Prosecutor by a country that has ratified the Rome Statute; or the Prosecutor may initiate an investigation on his or her own (but may only pursue it with the approval of the Pre-Trial Chamber). Except in the case of a Security Council referral, the ICC will only be able to exercise jurisdiction over crimes committed by nationals or on the territory of countries that have ratified the Rome Statute of the ICC (Adel, 2006; Pillay, 2002).

Without the pioneering work of the ICTR and the ICTY, it would have been difficult to create the ICC. The ICTR serves as an important bridging device between the immediacy of the crises of the moment that led to its creation and the long term quest for a permanent global framework of international criminal justice. With the adoption in July 1998 of the Statute of a permanent ICC by 120 States at a Diplomatic Conference of Plenipotentiaries in Rome, the latter vision has been realized. The ICTR delivered the first judgment in history for the crime of genocide, as well as the first conviction of an individual for rape as a crime against humanity in the case of *Prosecutor v. Jean Paul Akayesu* in September 1998. In the same month, it became the first international tribunal to convict a head of government for genocide. This was Jean Kambanda, former Rwandan Prime Minister and head of government at the time of the genocide, who was sent to life imprisonment. He is

currently serving prison sentence in Mali, one of the African countries that have entered into agreements with the UN to enforce the international tribunal's sentences (Barnes, 2015; Ciampi, 2006).

Judge Pillay (2002) asserts that President of the ICTR, observes that the concept of universal jurisdiction is a perfect illustration of the globalization of justice. It is an important avenue to tackle impunity not only in the future, but even at present – at a time when so many violations of humanitarian law are occurring in many part of the global but appear to be caught in between the cracks of the architecture of international justice because, on the one hand, the ad hoc tribunals do not have jurisdiction over the events that generate these crimes and, on the other, the ICC has just become operational and will not have retrospective jurisdiction. Some observers query whether it will not be victors' justice, or the justice of the strong against the weak. Has the international community been selective in the conflicts it has chosen to address? Africans share these reservations. The challenge facing the international community is to ensure that an architecture of justice is established that truly enforces the rule of law, binding the strong as well as the weak in the international system.

Be that as it may with all its shortcomings, the establishment of the International Criminal Court provides a watershed in the historical struggle by the International community to create a permanent court for the trial and punishment of war criminals and to fill the gap left by national criminal jurisdictions in this area. Thus, with the establishment of the court and its effective functioning, proactive machinery for global crime management with the potentiality of enthroning good governance and democratic values around the global can be achieved if administered evenly, fairly and justly and these are issues upon which many African leaders have major concern with the court and the examination of the concern of African leaders about ICC can be too important and too costly to ignore for the future of the court. As a result, we have made it the focal issue of our forthcoming article (Nwebo and Ubah, 2016).

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## Distribution of Order Parameter for Kuramoto Model

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### Abstract

*The synchronization in large populations of interacting oscillators has been observed abundantly in nature, emerging in fields such as physical, biological and chemical system. For this reason, many scientists are seeking to understand the underlying mechanism of the generation of synchronous patterns in oscillatory system. The synchronization is analyzed in one of the most representative models of coupled phase oscillators, the Kuramoto model. The Kuramoto model can be used to understand the emergence of synchronization in networks of coupled, nonlinear oscillators. In particular, this model presents a phase transition from incoherence to synchronization. In this paper, we investigated the distribution of order parameter  $\gamma$  which describes the strength of synchrony of these oscillators. The larger the order parameter  $\gamma$  is, the more extent the oscillators are synchronized together. This order parameter  $\gamma$  is a critical parameter in the Kuramoto model. Kuramoto gave a initial estimate equation for the value of the order parameter by giving the value of the coupling constant. But our numerical results show that the distribution of the order parameter is slightly different from Kuramoto's estimation. We gave an estimation for the distribution of order parameter for different values of initial conditions. We discussed how the numerical result will be distributed around Kuramoto's analytical equation.*

### Introduction

In the past decades, the synchronization in complex networks has been a research topic in many areas of physics, biology and engineering [References]. Synchronization is the process by which interacting, oscillating objects affect each others phases that they spontaneously lock to common frequency. In other words, each oscillators frequency has locked onto the same values as all the other oscillators [References]. Synchronization has been observed in many real-world systems, such as networks of pacemaker cells in the heart [2, 43], circadian pacemaker cells in the suprachiasmatic nucleus of the brain [3] and stellate cells in the entorhinal cortex layer II of the brain [1], large populations of fireflies [4], superconductors [11], laser light [44] and microwave oscillators [6].

Synchronization always related to "rhythm", and it also means some interaction or coupling of oscillating systems. If we have an active oscillating system, it contains an internal source of energy that is transformed into oscillatory movement. The oscillators continue to generate the same rhythm until the source of energy expires. In 2- oscillators system, There are two basic types of synchronization: Anti-phase and in-phase synchronization. In both cases, an oscillator is locked in a fixed position comparing to the other one, and both of the oscillators are moving in a rotating frame. In a large oscillators system, if a number of oscillators are gathered together, we usually consider one cluster to be one single oscillator. There is one article describe synchronization problems [33], they address mechanical oscillators and dynamical systems. Another precise and mathematical introduction to the emergence of synchronization can be found in [13, ?], which include some interesting synchronization like fireflies flashing together. We can find an introduction to the synchronization theory illustrated by various biological examples like transcranial brain stimulation given in [34], [15] [46]. A theory of synchronization of self-sustained oscillators was developed Stratonovich[9]. The influence of noise on

mutual synchronization of two oscillators and the effect of fluctuating parameters are described by A. N. Malakhov [10].

Among many models that have been proposed to address synchronization phenomena, one of the most successful models is the Kuramoto model [18]. Y. Kuramoto developed this model in phase approximation that allows a description of globally coupled oscillators. This model can be used to understand the generation of synchronization in large networks of coupled, nonlinear oscillators. It also represents a synchronization in large populations and synchronization of distributed systems. In particular, this model presents a second-order phase transition from incoherence to synchronization. Kuramoto model describes a phase interaction which generates some interesting synchronization phenomena for globally weak coupling of large number of nonlinear oscillators. Kuramoto found that there is a certain value of the coupling constant,  $K_C$ , we call it a critical value, above which synchronization can occur, and below which it cannot. For any distribution of the natural frequencies of the oscillators, he was able to calculate  $K_C$ . For example, for a Lorentzian distribution of natural frequencies,  $K_C$  is just equal to the full width at half-max of the Lorentzian curve. For other distributions, the formula for  $K_C$  is more complex, but we can still calculate it [8].

## Kuramoto model

In the 1960s, scientists began to build mathematical models for synchronization in many natural systems. Particularly, Arthur Winfree's model became very popular. He gave a model in which each oscillator's phase is determined by combining the state of all of the oscillators. In his model, the rate of change of the phase of an oscillator is determined by its own natural frequency  $\omega_i$  and the state of all of the other oscillators combined. Each oscillator's sensitivity to the combination is represented as a function  $Y$ , and its own contribution to the combination is given by a function  $X$ . Then each oscillator has an equation to describe how its phase changes [12] [13] [14]:

$$\theta_i' = \omega_i + \sum_{j=1}^N X(\theta_j) Y(\theta_i) \quad (1)$$

Here  $\theta_i$  is the phase of oscillator,  $\theta_i'$  is the rate of change of phase of oscillator,  $\omega_i$  is the natural frequency of oscillator  $i$ , and  $N$  is the total number of oscillators.

Winfree made numerical simulations and analytical approximations for this model and found that if the coupling is large enough, the oscillators could synchronize.

In 1975, Japanese scientist Yoshiki Kuramoto was inspired by Winfree's works, and he began exploring the behavior of collective synchronization. He used the following assumptions:

1. The oscillators are almost identical.
2. The coupling among oscillators is small.

After some complicated mathematical averaging, he proved that long term dynamics of any system of almost identical, weakly coupled limit cycle oscillators system have the following governing equation [8, 13]:

$$\dot{\theta}_i = \omega_i + \sum_{j=1}^N \Gamma_{ij}(\theta_j - \theta_i) \quad (2)$$

Here the interaction function  $\Gamma_{ij}$  determines the form of coupling between oscillator  $i$  and oscillator  $j$ .

Kuramoto assumed that each oscillator takes part in affecting other oscillators. He called the interaction "global coupling".

He further assumed that the coupling were equally weighted can be expressed by a sin function of the difference of phases.

$$\Gamma_{ij}(\theta_j - \theta_i) = \frac{K}{N} \sin(\theta_j - \theta_i) \quad (3)$$

This derives the govern equations for Kuramoto model:

$$\theta'_i = \omega_i + \frac{K}{N} \sum_{j=1}^N \sin(\theta_j - \theta_i) \quad (4)$$

Here K is the coupling constant, and N is the total number of oscillators. The model assumed that N is very large, i.e large number of oscillators. The natural frequencies  $\omega_i$  distributed by a probability density function  $g(\omega)$ , and it is symmetric about some value  $\Pi$ :  $g(\Pi+\omega) = g(\Pi-\omega)$ .

To simplify the governing equation of Kuramoto model, we need to define the order parameter, the order parameter describes the "mean field of the system".

Let us write the governing equations of Kuramoto model in terms of order parameter:

$$re^{i\psi} = \frac{1}{N} \sum_{j=1}^N e^{i\theta_j} \quad (5)$$

Here  $\psi$  is the average phase of all the oscillators.

The order parameter  $r$  is distributed between 0 and 1. When  $r = 1$ , we say that the oscillators are asynchronous, it also means their phases are completely spread around the unit circle. The synchrony measure  $r$  is also called the phase coherence.

### The formulations of the Relations between the Order Parameter $r$ and the Critical Point $K_c$

The modulus of  $r$ , is a measure of the coherence of the oscillator system, it describes how close the oscillators are together. If we increase the order parameter, the phases of the oscillators will get closer together. The graphs in Fig. 1 show the order parameter being an arrow pointing from the center of the circle.

Let us consider (5): Multiplying both sides by  $e^{-i\theta_i}$  we get:

$$re^{i(\psi-\theta_i)} = \frac{1}{N} \sum_{j=1}^N e^{i(\theta_j-\theta_i)} \quad (6)$$

$$r \sin(\psi - \theta_i) = \frac{1}{N} \sum_{j=1}^N \sin(\theta_j - \theta_i) \quad (7)$$

Therefore, Equation (4) may be rewritten as

$$\dot{\theta}_i = \omega_i + Kr \sin(\psi - \theta_i) \text{ for } i = 1, 2, \dots, N.$$

The corresponding stationary density:

$$\rho = \begin{cases} \frac{\delta[\theta - \psi - \sin^{-1}(\frac{w}{Kr})]}{C} H(\cos \theta) & \text{when } |\omega| < Kr \\ \frac{1}{|\omega - Kr \sin(\theta - \psi)|} & \text{when } |\omega| \geq Kr \end{cases} \quad (9)$$

A

r= 0.2490

r= 0.6056

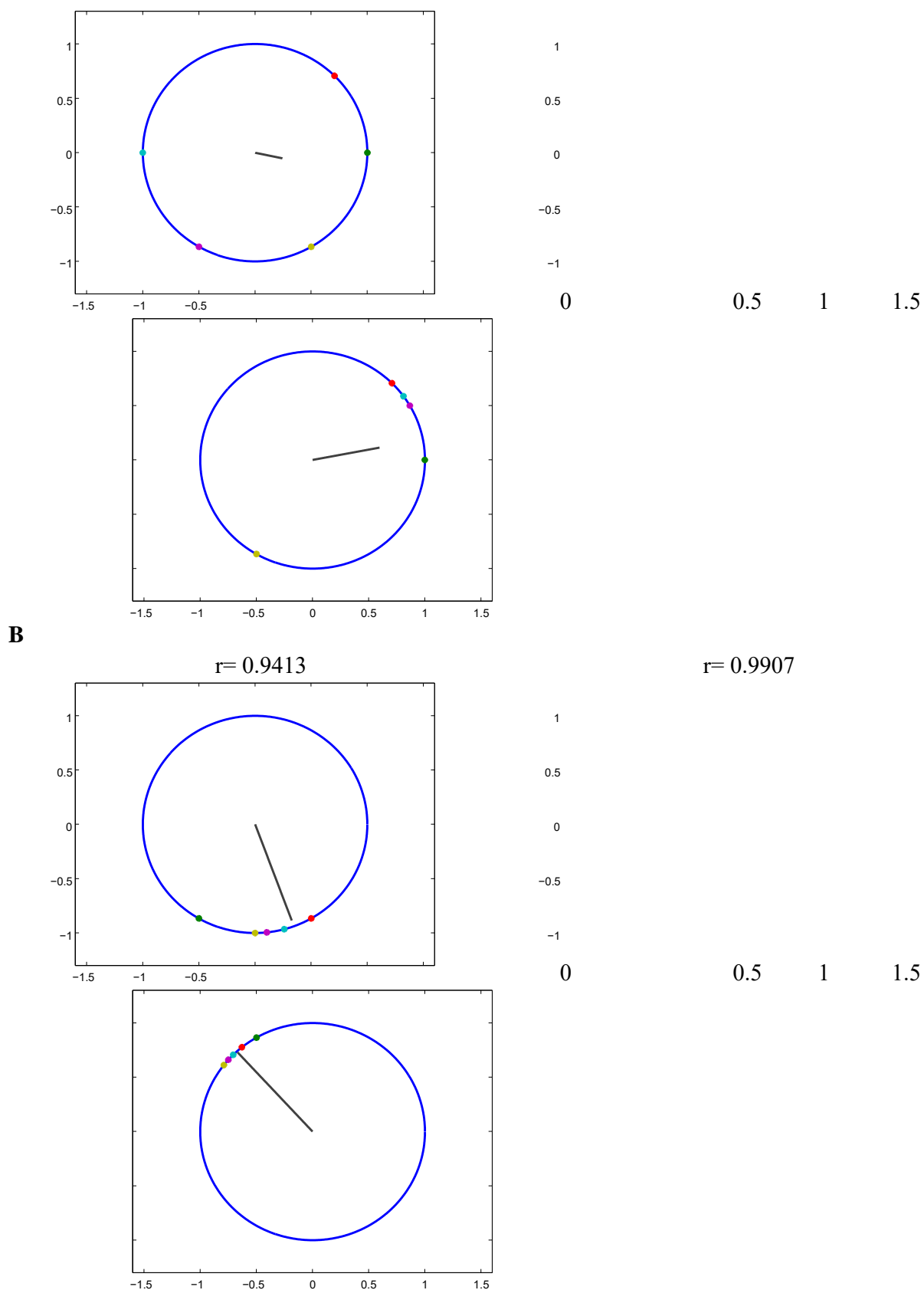


Figure 1: The order parameter is represented by the vector pointing from the center of the unit circle.

Here  $H(x)$  is the Heaviside unit step function.

We take the natural frequency density function to be the Lorentzian density, defined as

$$g(\omega) = \frac{\gamma}{\pi(\gamma^2 + \omega^2)} \quad (10)$$

Actually  $r(t)$  does not depend on time or  $\psi(t)$  and  $\psi(t)$  rotates uniformly at an angular frequency  $\phi$ . We can set up a frame of reference that is rotating at the same frequency. Hence  $r(t)$  is stationary. So we can set  $\psi(t)$  to any constant value. Without loss of generality, set  $\psi(t) \equiv 0$  in the rotating frame. So we get

$$\dot{\theta}_i = \omega_i - Kr \sin \theta_i \quad (11)$$

and correspondingly, the stationary density function is

$$\rho = \begin{cases} \delta[\theta - \sin^{-1}(\frac{\omega}{Kr})] H(\cos \theta), & \text{when } |\omega| < Kr \\ \frac{C}{|\omega - Kr \sin \theta|}, & \text{when } |\omega| \geq Kr \end{cases} \quad (12)$$

then

$$\begin{aligned} re^{i\psi} &= re^{i0} = r \\ &= \frac{1}{N} \sum_{j=1}^N e^{i\theta_j} = \langle e^{i\theta} \rangle \\ &= \langle e^{i\theta} \rangle_{\text{lock}} + \langle e^{i\theta} \rangle_{\text{unlock}} \end{aligned}$$

According to (12)

$$\begin{aligned} \text{Compute the contribution of unlocked oscillators:} \\ \int_{-\pi}^{\pi} \int_{-\infty}^{\infty} \langle e^{i\theta} \rangle_{\text{unlock}} e^{i\theta} \rho(\theta, \omega) g(\omega) d\omega d\theta \\ = \int_{-\pi}^{\pi} \int_{Kr}^{\infty} e^{i\theta} \rho(\theta, \omega) g(\omega) d\omega d\theta + \int_{-\pi}^{\pi} \int_{-\infty}^{-Kr} e^{i\theta} \rho(\theta, \omega) g(\omega) d\omega d\theta \\ = I_1 + I_2 \end{aligned} \quad (13)$$

where

$$\begin{aligned} I_1 &= \int_{-\pi}^{\pi} \int_{Kr}^{\infty} e^{i\theta} \rho(\theta, \omega) g(\omega) d\omega d\theta \\ I_2 &= \int_{-\pi}^{\pi} \int_{-\infty}^{-Kr} e^{i\theta} \rho(\theta, \omega) g(\omega) d\omega d\theta \end{aligned}$$

Let  $\theta' = \theta - \pi$ , then

$$I_1 = - \int_{-2\pi}^0 \int_{Kr}^{\infty} e^{i\theta'} e^{i\pi} \rho(\theta' + \pi, \omega) g(\omega) d\omega d\theta'$$

Since  $\rho(\theta' + \pi, \omega) = \rho(\theta', \omega)$ ,  $g(-\omega) = g(\omega)$ ,  $e^{i\pi} = -1$ , we hence have

$$I_1 = - \int_{-2\pi}^0 \int_{Kr}^{\infty} e^{i\theta'} e^{i\pi} \rho(\theta', \omega) g(\omega) d\omega d\theta'$$

Because the periodic boundary condition, we can shift  $\theta'$  interval with any constant. So we can shift the integral interval to right with  $\pi$ .

So

$$I_1 = - \int_{-\pi}^{\pi} \int_{Kr}^{\infty} e^{i\theta'} e^{i\pi} \rho(\theta', \omega) g(\omega) d\omega d\theta' = -I_2 \quad (14)$$

According to (13),

$$\langle e^{i\theta} \rangle_{\text{unlock}} = I_1 + I_2 = 0$$

So the unlocked oscillators have no contributions.

The locked oscillators are centered symmetrically on 0, therefore  $\langle \sin \theta \rangle_{\text{lock}} = 0$  and

$$Kr \int = \langle e^{i\theta} \rangle_{lock} = \langle \cos \theta \rangle_{lock}$$

$$= \cos(\theta(\omega))g(\omega)d\omega - Kr$$

Consider (11) and (12)

$$r = \int_{-\pi/2}^{\pi/2} \cos \theta g(Kr \sin \theta) Kr \cos \theta d\theta$$

$$= Kr \int_{-\pi/2}^{\pi/2} \cos^2 \theta g(Kr \sin \theta) d\theta \quad (15)$$

This implies

$$1 = K \int_{-\pi/2}^{\pi/2} \cos^2 \theta g(Kr \sin \theta) d\theta$$

When make  $r \rightarrow 0^+$  in the above equation, we can find the critical point  $K_c$  at which the order parameter rises from zero.

$$1 = K_c \int_{-\pi/2}^{\pi/2} \cos^2 \theta g(0) d\theta$$

$$= K_c g(0) \int_{-\pi/2}^{\pi/2} \cos^2 \theta d\theta = K_c g(0) \frac{\pi}{2}$$

Hence

$$K_c = \frac{2}{\pi g(0)} \quad (16)$$

Plug in (10): the function of  $g(w)$

$$1 = K \int_{-\pi/2}^{\pi/2} \cos^2 \theta \frac{\gamma}{\pi(\gamma^2 + K^2 r^2 \sin^2 \theta)} d\theta$$

$$= \frac{K\gamma}{\pi} \int_{-\pi/2}^{\pi/2} \frac{1 - \sin^2 \theta}{\gamma^2 + K^2 r^2 \sin^2 \theta} d\theta$$

$$= -\frac{\gamma}{Kr^2} + \frac{Kr}{\pi} \left(1 + \frac{\gamma^2}{K^2 r^2}\right) \int_{-\pi/2}^{\pi/2} \frac{d\theta}{\gamma^2 + K^2 r^2 \sin^2 \theta}$$

$$= -\frac{\gamma}{Kr^2} + 2\frac{Kr}{\pi} \left(1 + \frac{\gamma^2}{K^2 r^2}\right) \int_0^\infty \frac{d(\tan \theta)}{\gamma^2 \sec^2 \theta + K^2 r^2 \tan^2 \theta}$$

$$= -\frac{\gamma}{Kr^2} + 2\frac{Kr}{\pi} \left(1 + \frac{\gamma^2}{K^2 r^2}\right) \int_0^\infty \frac{du}{\gamma^2(1+u^2) + K^2 r^2 u^2}$$

$$= -\frac{\gamma}{Kr^2} + \frac{\sqrt{K^2 r^2 + \gamma^2}}{Kr^2}$$

Therefore we have

$$Kr^2 = -\gamma + \sqrt{K^2 r^2 + \gamma^2}$$

and hence

$$r = \sqrt{1 - \frac{2\gamma}{K}} \quad (17)$$

To make the process of synchronization clear, the graphs Fig. 2 shows how the order parameter  $r$  rises as the coupling  $K$  between oscillators is increased. Numerical curves are taken from 500 oscillators with natural frequencies distributed with Lorentzian distribution:

Numerical and Theoretical curve of phase synchronization

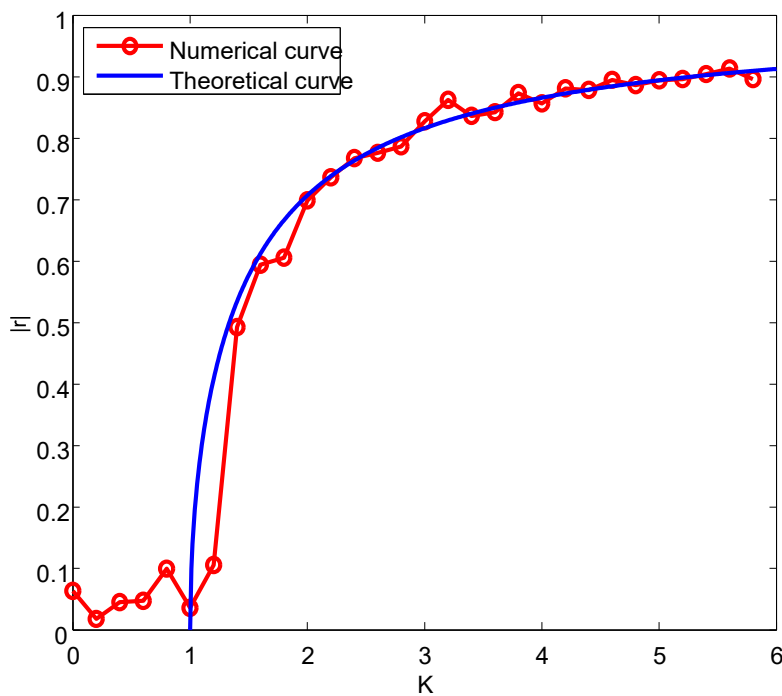


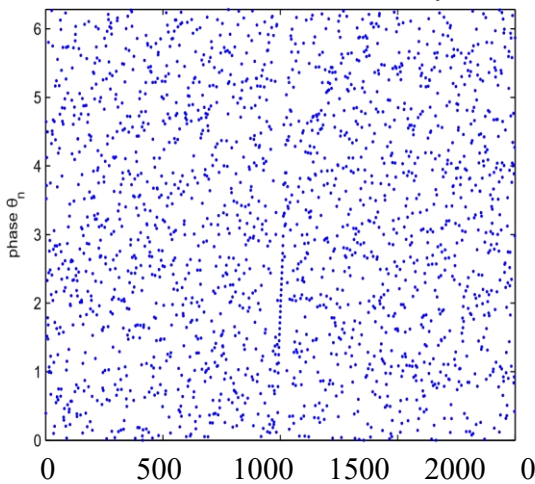
Figure 2: Numerical curve and analytical curve for order parameter by changing K

$$g(\omega) = \frac{\gamma}{\pi(\gamma^2 + \omega^2)}$$

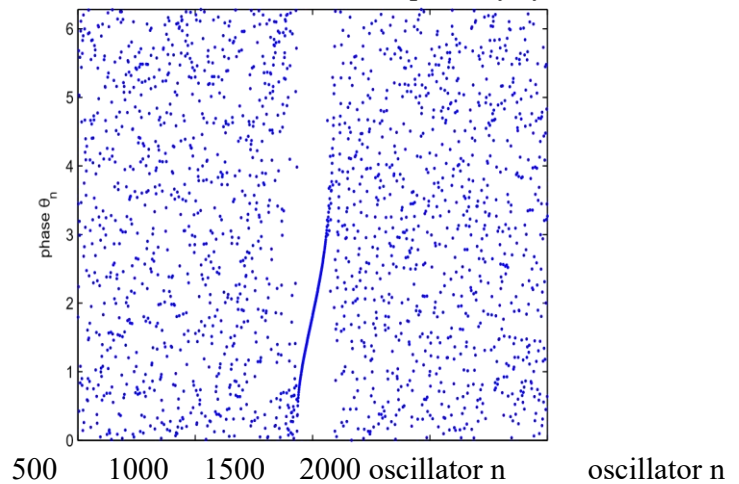
with  $\gamma = 0.5$ . Analytical curve is given by (17), according to (16),  $K_c = 1$ .

There is another way to visualize the synchronization: There are three graphs in Figure 3. The oscillators are numbered from the lowest to highest natural frequency, natural frequencies also distributed by Lorentzian distribution.

$k=0.7$ ; 2000 oscillators not synchronized



$k=1$ ; 2000 oscillators start to partially synchronized



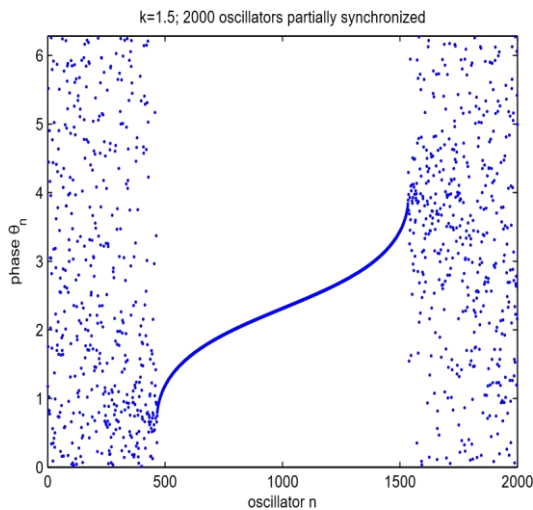


Figure 3: The synchronize phase  $\theta_n$  of 2000 oscillators, take  $K=0.7, 1, 1.5$

$$g(\omega) = \frac{\gamma}{\pi(\gamma^2 + \omega^2)}$$

with  $\gamma = 0.5$ .

So

$$K_c = \frac{2}{\pi g(0)} = 1$$

, We can see obvious partial synchronization at or above  $K_c$ .

## Results

### The Density Functions of Locked Terms and Unlocked Terms

To prove that the locked terms and unlocked terms are independent, we first try to get the probability density function of locked terms and unlocked terms separately.

Suppose the probability density function of locked terms is  $f(y)$ , then it satisfies the following equation:

$$P(y \leq \cos \theta \leq y + dy | \theta \text{ locked}) = f(y) dy$$

$$\frac{P(\arccos(y + dy) \leq \theta \leq \arccos y)}{P(\theta \text{ locked})} = f(y) dy$$

For  $y > 0$ ,

$$LHS = \frac{2P(\sin(\arccos(y + dy)) \leq \frac{\omega}{kr} \leq \sin(\arccos y))}{P(\theta \text{ locked})}$$

This derives

$$\begin{aligned} P(\theta \text{ locked}) &= \int_{-kr}^{kr} \frac{\gamma}{\pi(\gamma^2 + \omega^2)} d\omega = \frac{2}{\pi} \arctan\left(\frac{kr}{\gamma}\right) \\ P(\sin(\arccos(y + dy)) \leq \frac{\omega}{kr} \leq \sin(\arccos y)) &= P(kr \sin(\arccos(y + dy)) \leq \omega \leq kr \sin(\arccos y)) \\ &= P(kr \sqrt{1 - (y + dy)^2} \leq \omega \leq kr \sqrt{1 - y^2}) \\ &= \int_{kr \sqrt{1 - (y + dy)^2}}^{kr \sqrt{1 - y^2}} \frac{\gamma}{\pi(\gamma^2 + \omega^2)} d\omega \\ &= \frac{1}{\pi} \int_{\frac{kr}{\gamma} \sqrt{1 - (y + dy)^2}}^{\frac{kr}{\gamma} \sqrt{1 - y^2}} \frac{du}{1 + u^2} \\ &= \frac{1}{\pi} \left( \arctan\left(\frac{kr}{\gamma} \sqrt{1 - y^2}\right) - \arctan\left(\frac{kr}{\gamma} \sqrt{1 - (y + dy)^2}\right) \right) \end{aligned}$$

$$\text{Let } \alpha = \arctan\left(\frac{kr}{\gamma} \sqrt{1 - y^2}\right) - \arctan\left(\frac{kr}{\gamma} \sqrt{1 - (y + dy)^2}\right)$$

As  $dy \rightarrow 0$ ,  $\alpha \rightarrow 0$ ,  $\alpha \rightarrow \tan \alpha$

So

$$\alpha \rightarrow \tan \alpha = \frac{\frac{kr}{\gamma}(\sqrt{1-y^2} - \sqrt{1-(y+dy)^2})}{1 + (\frac{kr}{\gamma})^2 \sqrt{1-y^2}(1-(y+dy)^2)}$$

As  $dy \rightarrow 0$ ,

$$\frac{k r y dy}{\gamma \sqrt{1-y^2}} \frac{1}{1 + (kr/\gamma)^2 \sqrt{1-y^2}} \rightarrow \frac{k r y \gamma \sqrt{1-y^2} dy}{\gamma^2 (1-y)^2 + (kr(1-y^2))^2}$$

This derives the density function: for  $0 \leq y \leq 1$ ,

$$f(y) = \frac{k r \gamma y \sqrt{1-y^2}}{\arctan(\frac{kr}{\gamma})(\gamma^2(1-y^2) + (kr(1-y^2))^2)}$$

The density function of unlocked term satisfies:

$$P(y \leq \cos \theta \leq y + dy | \theta \text{ unlocked}) = f(y) dy$$

For  $0 \leq y \leq 1$ ,  $y \leq \cos \theta \leq y + dy$ .

$$\text{So } \sqrt{1-(y+dy)^2} \leq \sin \theta \leq \sqrt{1-y^2}, d\theta = \frac{dy}{\sqrt{1-y^2}}$$

$$\text{or } -\sqrt{1-y^2} \leq \sin \theta \leq -\sqrt{1-(y+dy)^2}, d\theta = \frac{dy}{\sqrt{1-y^2}}$$

$$\rho(\theta, \omega) = \frac{C}{|\theta'|} = \frac{C}{|\omega - kr \sin \theta|}$$

So

$$1 = \int_{-\pi}^{\pi} \rho(\theta, \omega) d\theta = C \int_{-\pi}^{\pi} \frac{d\theta}{|\omega - kr \sin \theta|}$$

Which derives

$$C = \frac{\sqrt{\omega^2 - (kr)^2}}{2\pi}$$

So

$$P(y \leq \cos \theta \leq y + dy | \theta \text{ unlocked}) = \frac{P(y \leq \cos \theta \leq y + dy, |\omega| > kr)}{P(|\omega| > kr)}$$

$$= \frac{P(-\sqrt{1-(y+dy)^2} \leq \sin \theta \leq -\sqrt{1-y^2}, |\omega| > kr)}{P(|\omega| > kr)}$$

$$+ \frac{P(-\sqrt{1-y^2} \leq \sin \theta \leq -\sqrt{1-(y+dy)^2}, |\omega| > kr)}{P(|\omega| > kr)}$$

$$= \frac{\int_I g(\omega) \int_{I_1} \rho(\theta, \omega) d\theta d\omega + \int_I g(\omega) \int_{I_2} \rho(\theta, \omega) d\theta d\omega}{2 \int_{kr}^{\infty} \frac{\gamma}{\pi(\gamma^2 + \omega^2)} d\omega}$$

$$\begin{aligned} A_1 &= \int_I g(\omega) \int_{I_1} \rho(\theta, \omega) d\theta d\omega \\ &= \frac{1}{2\pi} \int_I \frac{\gamma}{\pi(\gamma^2 + \omega^2)} \int_{I_1} \frac{\sqrt{\omega^2 - (kr)^2}}{|\omega - kr \sqrt{1-y^2}|} d\theta d\omega \\ &= \frac{1}{2\pi^2} \int_I \frac{\gamma}{\gamma^2 + \omega^2} \int_{I_1} \frac{\sqrt{\omega^2 - (kr)^2}}{|\omega - kr \sqrt{1-y^2}|} \frac{dy}{\sqrt{1-y^2}} d\omega \end{aligned}$$

As  $dy \rightarrow 0$ ,  $d\theta \rightarrow 0$ ,  $I_1 \rightarrow 0$ ,  $I_2 \rightarrow 0$

$$\begin{aligned} A_1 &\rightarrow \frac{1}{2\pi^2} \left( \int_I \frac{\gamma}{\gamma^2 + \omega^2} \frac{\sqrt{\omega^2 - (kr)^2}}{\omega - kr \sqrt{1-y^2}} \frac{1}{\sqrt{1-y^2}} d\omega \right) dy \\ &= \frac{1}{2\pi^2 \sqrt{1-y^2}} \int_I \frac{\gamma}{\gamma^2 + \omega^2} \frac{\sqrt{\omega^2 - (kr)^2}}{|\omega - kr \sqrt{1-y^2}|} d\omega dy \end{aligned}$$

$$\begin{aligned}
A_2 &= \int_I \int_{I_2} g(\omega) \rho(\theta, \omega) d\theta d\omega \\
&= \frac{1}{2\pi^2} \int_I \int_{I_2} \frac{1}{\sqrt{1-y^2}} \frac{\gamma}{\gamma^2 + \omega^2} \frac{\sqrt{\omega^2 - (kr)^2}}{|\omega + kr\sqrt{1-y^2}|} dy d\omega \\
&= \left( \frac{1}{2\pi^2 \sqrt{1-y^2}} \int_I \frac{\gamma}{\gamma^2 + \omega^2} \frac{\sqrt{\omega^2 - (kr)^2}}{|\omega + kr\sqrt{1-y^2}|} d\omega \right) dy
\end{aligned}$$

This derives

$$A_1 + A_2 = \frac{1}{2\pi^2 \sqrt{1-y^2}} \left( \int_I \frac{\gamma \sqrt{\omega^2 - (kr)^2}}{\gamma^2 + \omega^2} \left( \frac{1}{|\omega + kr\sqrt{1-y^2}|} + \frac{1}{|\omega - kr\sqrt{1-y^2}|} \right) d\omega \right) dy$$

Similarly, for  $-1 \leq y < 0$ ,

$$\begin{aligned}
A_1 + A_2 &= \frac{1}{2\pi^2 \sqrt{1-y^2}} \int_I \frac{\gamma \sqrt{\omega^2 - (kr)^2}}{\gamma^2 + \omega^2} \left( \frac{1}{|\omega + kr\sqrt{1-y^2}|} + \frac{1}{|\omega - kr\sqrt{1-y^2}|} \right) d\omega dy \\
&= \frac{\gamma}{2\pi^2 \sqrt{1-y^2}} \int_I \frac{\sqrt{\omega^2 - (kr)^2}}{\gamma^2 + \omega^2} \frac{2|\omega|}{\omega^2 - (kr)^2(1-y^2)} d\omega dy \\
&= \frac{2\gamma}{\pi^2 \sqrt{1-y^2}} \int_{kr}^{\infty} \frac{\omega \sqrt{\omega^2 - (kr)^2}}{(\gamma^2 + \omega^2)(\omega^2 - (kr)^2(1-y^2))} d\omega dy \\
&= \frac{\gamma}{\pi^2 \sqrt{1-y^2}} \int_{\alpha}^{\infty} \frac{\sqrt{t-\alpha}}{(t+\gamma^2)(t-\alpha(1-y^2))} dt dy \\
&= \frac{\gamma}{\pi^2 \sqrt{1-y^2}} \int_0^{\infty} \frac{\sqrt{t}}{(t+\alpha+\gamma^2)(t+\alpha y^2)} dt dy
\end{aligned}$$

$\Rightarrow$

$$\begin{aligned}
\frac{P(y \leq \cos \theta \leq y + dy, |\omega| > kr)}{P(|\omega| > kr)} &= \bar{f}(y) dy \\
&= \frac{\gamma}{\pi^2 \sqrt{1-y^2}} \frac{1}{1 - \frac{2}{\pi} \arctan(\frac{kr}{\gamma})} \int_0^{\infty} \frac{\sqrt{t} dt dy}{(t+\alpha+\gamma^2)(t+\alpha y^2)} \\
&= \frac{\gamma}{\pi \sqrt{1-y^2}} \frac{1}{\pi - 2 \arctan(\frac{kr}{\gamma})} \int_0^{\infty} \frac{\sqrt{t} dt dy}{(t+\alpha+\gamma^2)(t+\alpha y^2)}
\end{aligned}$$

$\Rightarrow$

$$\begin{aligned}
\bar{f}(y) &= \frac{\gamma}{\pi \sqrt{1-y^2} (\pi - 2 \arctan(kr/\gamma))} \int_0^{\infty} \frac{\sqrt{t} dt}{(t+\alpha+\gamma^2)(t+\alpha y^2)} \\
&= \frac{\gamma}{\sqrt{1-y^2} (\pi - 2 \arctan(kr/\gamma))} \frac{1}{\sqrt{\alpha+\gamma^2} + \sqrt{\alpha y^2}} \\
&= \frac{\gamma}{\sqrt{1-y^2} (\pi - 2 \arctan(kr/\gamma))} \frac{1}{\sqrt{(kr)^2 + \gamma^2} + kr|y|}
\end{aligned}$$

So we have the density function  $f$  for locked part and  $\bar{f}$  for unlocked part:

$$(18) \quad f(y) = \frac{k r \gamma y \sqrt{1-y^2}}{\arctan(\frac{kr}{\gamma})(\gamma^2(1-y^2) + (kr(1-y^2))^2)}$$

$$(19) \quad \bar{f}(y) = \frac{\gamma}{\sqrt{1-y^2} (\pi - 2 \arctan(kr/\gamma)) (\sqrt{(kr)^2 + \gamma^2} + kr|y|)}$$

To prove the locked terms are independent, we want to show that the sum of any two locked terms satisfies the analytical probability density function derived by convolution law:

If X and Y are two locked terms, Z is the sum of X and Y:

$$Z = X + Y$$

$$E(e^{iZ}) = \int_{-\infty}^{\infty} e^{iu} f_z(u) du \quad (20)$$

$$\Rightarrow \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} e^{i(u-x-y)} f_x(x) f_y(y) dx dy \quad (21)$$

$$= \int_{-\infty}^{\infty} e^{iu} \int_{-\infty}^{\infty} f_x(x) f_y(u-x) dx du \quad (22)$$

$$f_z(u) = \int_{-\infty}^{\infty} f_x(x) f_y(u-x) dx$$

Similarly, to prove the unlocked terms are independent, we can also get the analytical probability density function of two unlocked terms by the convolution law:

If  $X^-$  and  $Y^-$  are two unlocked terms,  $Z^-$  is the sum of  $X^-$  and  $Y^-$ :

$$Z^- = X^- + Y^-$$

$$E(etz^-) = \int_{-\infty}^{\infty} e^{tu} f_z^-(u) du \quad (23)$$

$$= \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} e^{t(x+y)} f_x^-(x) f_y^-(y) dx dy \quad (24)$$

$$= \int_{-\infty}^{\infty} e^{tu} \int_{-\infty}^{\infty} f_x^-(x) f_y^-(u-x) dx du \quad (25)$$

$$\Rightarrow f_z^-(u) = \int_{-\infty}^{\infty} f_x^-(x) f_y^-(u-x) dx$$

In the following figures, we compare the numerical and analytical result for the density functions, the numerical result of density function for one oscillator satisfies the analytical result very well. The analytical density function of the sum of two locked oscillators and two unlocked oscillators are given by convolution law separately, and we also compare the results, the numerical curve also approximate the analytical curve very well. This shows the locked oscillators are independent and unlocked terms are also independent.

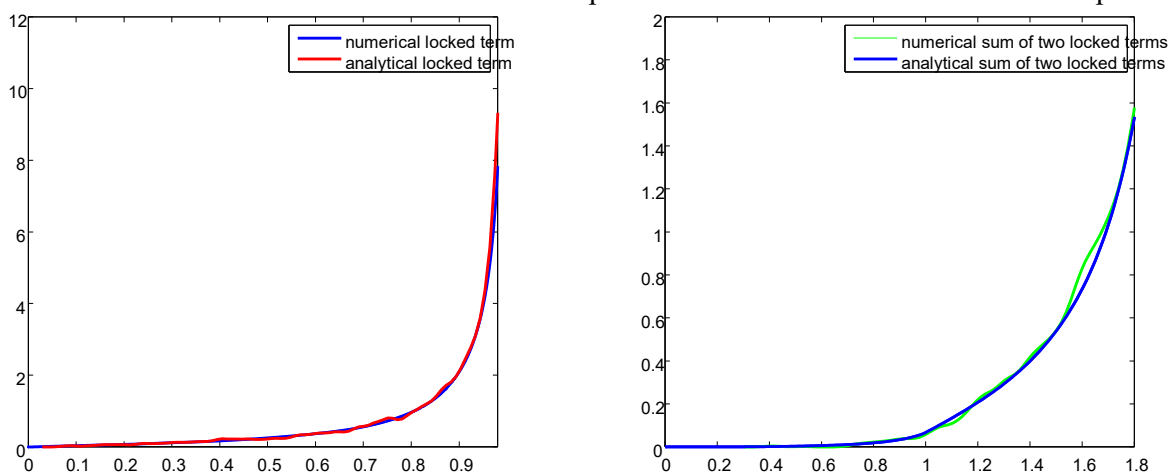


Figure 4: Comparison of the numerical and analytical density function for the locked oscillators and the sum of two locked oscillators

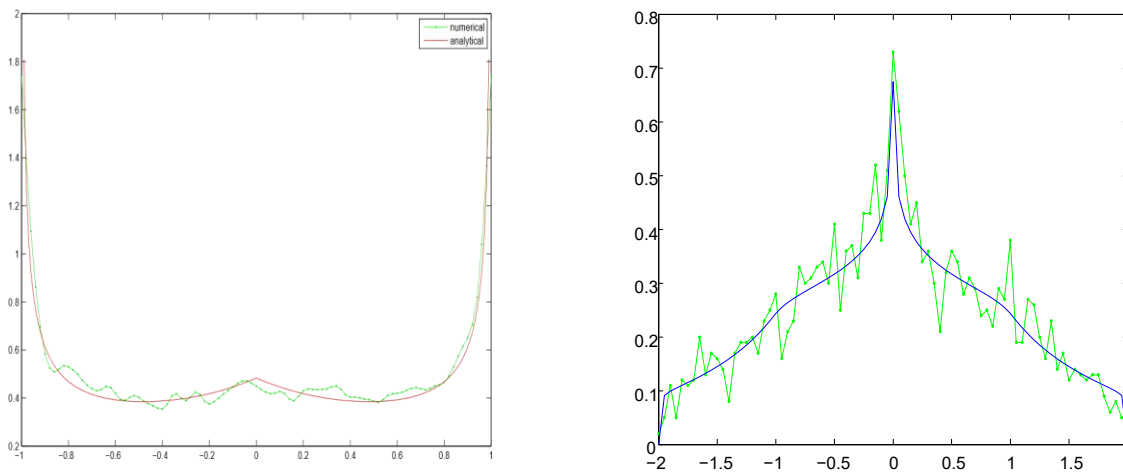


Figure 5: Comparison of the numerical and analytical density function for the unlocked oscillators and the sum of two unlocked oscillators

### The Distribution of Order Parameter $r$

If we set  $\psi \equiv 0$  (in a rotating frame), then  $\sum_{j=1}^N \sin \theta_j = 0$ .

The order parameter satisfies the following equation:

$$r = \frac{1}{N} \sum_{j=1}^N e^{i\theta_j} = \frac{1}{N} \sum_{j=1}^N \cos \theta_j \quad (26)$$

According to the analysis on the drift term, we know that the contribution of the drift term is 0. Namely

$$r = \langle \cos \theta \rangle_{lock} + \langle \cos \theta \rangle_{unlock}$$

$$\approx \langle \cos \theta \rangle_{lock}$$

There are totally  $N$  terms  $\theta_1, \theta_2, \dots, \theta_N$ . Without loss of generality, we suppose the first  $n$  terms  $\theta_1, \theta_2, \dots, \theta_n$  are synchronized, and the last  $N-n$  terms  $\theta_{n+1}, \theta_{n+2}, \dots, \theta_N$  are not synchronized. Here

$$0 < n < N.$$

From equation (26), we get

$$\begin{aligned} r &= \frac{1}{N} \sum_{j=1}^N e^{i\theta_j} = \frac{1}{N} \sum_{j=1}^N \cos \theta_j \\ &= \frac{1}{N} \sum_{j=1}^n \cos \theta_j + \frac{1}{N} \sum_{j=n+1}^N \cos \theta_j \end{aligned} \quad (27)$$

Suppose  $S_1 = \sum_{j=1}^n \cos \theta_j$ ,  $S_2 = \sum_{j=n+1}^N \cos \theta_j$ ,  $S = \sum_{j=1}^N \cos \theta_j$ , then

$$S_1 + S_2 = S = Nr$$

and

$$S_2 \approx 0, S_1 \approx S = Nr$$

For a fixed number  $N$ , if we also fix a series of natural frequency  $\omega_1, \omega_2, \dots, \omega_N$ , and these series of natural frequency satisfies the Lorentzian distribution very well-proportionally, the density function is

$$g(\omega) = \frac{\nu}{\pi(\nu^2 + \omega^2)}$$

Take different series of initial values of  $\theta_j$ ,  $j = 1, 2, \dots, N$ .

These series of  $\theta_j$  are taken randomly which satisfy uniformly distribution. We will get different values of order parameter  $r$  for each series of  $\theta_j$ ,  $j = 1, 2, \dots, N$ .

Question: When the value of  $N$  is very large, what is the distribution of the value of order parameter  $r$ ?

When  $N$  is large,  $n$  and  $N-n$  are large. According to central limit theorem,

$$\frac{S_1 - n\mu_1}{\sigma_1\sqrt{n}} \sim N(0, 1)$$

. Here  $\mu_1$  and  $\sigma_1$  are the mean and variance of locked terms  $\cos\theta_j, j = 1, 2, \dots, n$ .

$$\frac{S_2 - (N - n)\mu_2}{\sigma_2\sqrt{N - n}} \sim N(0, 1)$$

Here  $\mu_2$  and  $\sigma_2$  are the mean and variance of unlocked terms  $\cos\theta_j, j = n + 1, n + 2, \dots, N$

We know that  $S_1$  and  $S_2$  both satisfy Gaussian distribution. From equation (27) the order parameter

$$r = \frac{1}{N}(S_1 + S_2)$$

is the linear combination of Gaussian distributed functions. So  $r$  also satisfies Gaussian distribu-

tion. The variance of  $S_1$  is  $\sigma_1^2 n$  and the variance of  $S_2$  is  $\sigma_2^2 (N - n)$ ,

$\sigma$  satisfies the following equation:

$$\sigma = \frac{1}{N^2}(\sigma_1^2 n + \sigma_2^2 (N - n))$$

. So the question is reduced to calculate the value of  $\sigma_1$  and  $\sigma_2$ .  $\sigma_1$  is the variance of locked terms  $\cos\theta_1, \cos\theta_2, \dots, \cos\theta_n$ .  $\sigma_1 = \text{Var}(\theta)_{\text{locked}} = E(\cos^2 \theta)_{\text{locked}} - (E(\cos \theta)_{\text{locked}})^2$

$$E(\cos^2 \theta)_{\text{locked}} = \frac{\int_{-\pi/2}^{\pi/2} \cos^2 \theta g(Kr \sin \theta) Kr \cos \theta d\theta}{\int_{-\pi/2}^{\pi/2} g(Kr \sin \theta) Kr \cos \theta d\theta} \quad (28)$$

Here

$$\begin{aligned} \int_{-\pi/2}^{\pi/2} \cos^2 \theta g(Kr \sin \theta) Kr \cos \theta d\theta &= \frac{Kr\nu}{\pi} \int_{-\pi/2}^{\pi/2} \frac{\cos^3 \theta}{\nu^2 + K^2 r^2 \sin^2 \theta} d\theta \\ &= \frac{2\nu}{\pi Kr} \left( \frac{\nu^2 + K^2 r^2}{Kr\nu} \arctan\left(\frac{Kr}{\nu}\right) - 1 \right) \\ \int_{-\pi/2}^{\pi/2} g(Kr \sin \theta) Kr \cos \theta d\theta &= \frac{Kr\nu}{\pi} \int_{-\pi/2}^{\pi/2} \frac{\cos \theta}{\nu^2 + K^2 r^2 \sin^2 \theta} d\theta \\ &= \frac{2}{\pi} \arctan\left(\frac{Kr}{\nu}\right) \end{aligned}$$

Plug these results into the equation (28), we can get

$$E(\cos^2 \theta)_{\text{locked}} = \frac{\nu}{Kr} \left( \frac{\nu^2 + K^2 r^2}{Kr\nu} - \frac{1}{\arctan\left(\frac{Kr}{\nu}\right)} \right) \quad (29)$$

The variance of unlocked terms is

$$\sigma_2 = \text{Var}(\theta)_{\text{unlocked}} = E(\cos^2 \theta)_{\text{unlocked}} - (E(\cos \theta)_{\text{unlocked}})^2$$

$$\begin{aligned} E(\cos^2 \theta)_{\text{unlocked}} &= \int_{-\pi/2}^{\pi/2} \int_{|\omega| > Kr} \cos^2 \theta \frac{Cg(\omega)}{|\omega - Kr \sin \theta|} d\theta d\omega \\ &= 2 \int_{-\pi/2}^{\pi/2} \int_{\omega > Kr} \cos^2 \theta \frac{Cg(\omega)}{|\omega - Kr \sin \theta|} d\theta d\omega \end{aligned}$$

and

$$\begin{aligned} E(\cos \theta)_{\text{unlocked}} &= \int_{-\pi/2}^{\pi/2} \int_{|\omega| > Kr} \cos \theta \frac{Cg(\omega)}{|\omega - Kr \sin \theta|} d\theta d\omega \\ &= 2 \int_{-\pi/2}^{\pi/2} \int_{\omega > Kr} \cos \theta \frac{Cg(\omega)}{|\omega - Kr \sin \theta|} d\theta d\omega \end{aligned}$$

$$\text{Here } g(\omega) = \frac{\nu}{\pi(\nu^2 + \omega^2)}, \quad C = \frac{\sqrt{\omega^2 - K^2 r^2}}{2\pi}.$$

These integrals are relatively hard to simplify, but we can use numerical methods to get the variance of the unlocked terms. The variance of order parameter  $r$  is  $\sigma = \frac{1}{N^2}(\sigma_1^2 n + \sigma_2^2 (N - n))$ .

i.e

$$\frac{r - \text{mean}(r)}{\frac{1}{N} \sqrt{\sigma_1^2 n + \sigma_2^2 (N - n)}} \sim N(0, 1) \quad (30)$$

Taking 1000 series of uniformly distributed initial values  $\theta_1, \theta_2, \dots, \theta_N$ , we can get 1000 values of order parameter  $r$ . The order parameter  $r$  approximately satisfies Gaussian distribution, the equation for this distribution is (30). The graphs in Figure 6 compare the LHS of (30) with  $N(0,1)$  (standard normal distribution). The blue line is the density function of standard normal distribution, the red line is the density function of the distribution of LHS function.

### Conclusion

Kuramoto model is important for us to understand the dynamics of synchronization among genetic oscillators. Kuramoto already give a theoretical predict for the order parameter  $\gamma$  which describes

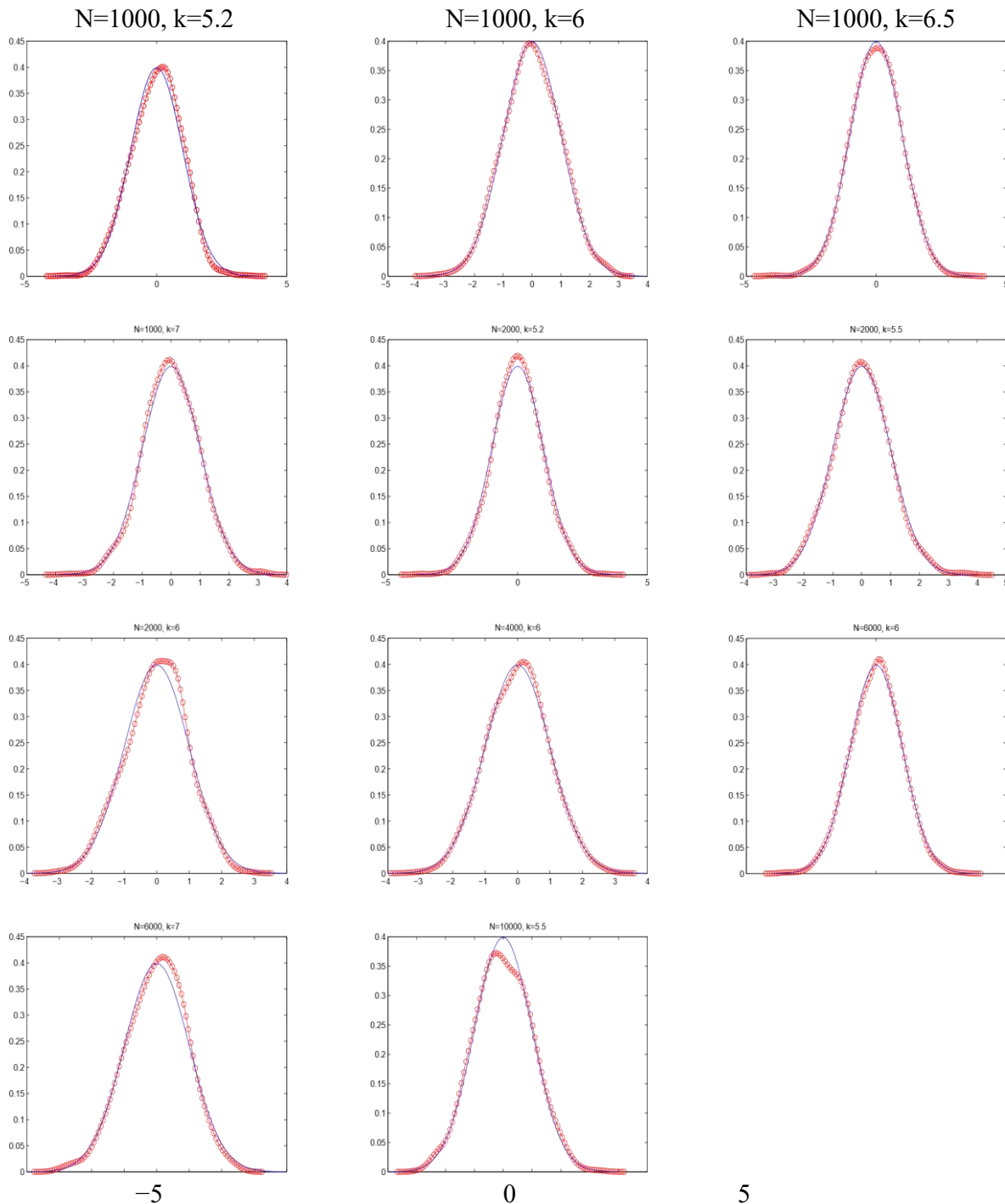


Figure 6: Comparison of distribution of order parameter and normal distribution

the strength the oscillators are coupled together. Our main purpose here is to further predict the numerical distribution around Kuramoto's theoretical prediction. To have a comprehensive understanding on the synchronization of all coupled oscillators, we investigated the density function for synchronized and unsynchronized oscillators individually. We found that when the number of oscillators is very large, in a rotating frame, the sin function of oscillators made no contribution to the order parameter. So we just need to consider cos function for these oscillators. We also found that the mechanism of the order parameters generated from these synchronized oscillators have their own distribution pattern. Basically, the distribution of numerical result of order parameter will satisfy a Gaussian distribution around Kuramoto's analytical prediction. When we make a comparison of the numerical result with the Gaussian distribution, Fig 6. shows that the numerical result basically coincide with a Gaussian distribution.

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# **On Cultivation Of Intercultural Communication Awareness In English Vocabulary Teaching**

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## **Abstract**

*Language And Culture Keep A Very Close Relationship And Are Inseparable. English Language Teaching Is Not Only To Cultivate English Language Learners' Linguistic Competence, But Also To Promote Their Intercultural Communication Competence. In Fact, English Vocabulary Teaching Is One Part Of Vital Integration In English Language Teaching. Meantime, English Vocabulary Teaching Plays An Important Role In The Cultivation Of English Language Learners' Intercultural Communication Awareness. Therefore, The Author Attempts To Expound The Significance Of Cultural Elements In English Vocabulary Teaching, Discusses About The Relationship Between Language And Culture, Stresses On The Cultural Connotations Of English Vocabulary Through The Formation Of English Language, Especially In Some Specific Words And Focuses On Some Typical Cases And Analyzes The Functions Of English Vocabulary Teaching For English Language Learners' Intercultural Communication Awareness Finally, The Author Puts Forward Some Useful Suggestions To Cultivate The English Language Learners' Intercultural Communication Awareness Through English Vocabulary Teaching.*

Key Words: Intercultural Communication, Intercultural Communication Awareness,  
English Language Teaching, Culture, English Vocabulary Teaching

## **1. Introduction**

English Vocabulary Is Fundamental Of English Language Formation. English Vocabulary Teaching Is An Important Component Part Of English Language Teaching. As For English Language Learners, English Vocabulary Acquisition Is A Central Task In Second Language Acquisition. Meanwhile, It Is Vital For The English Language Learners To Learn Different Cultural Connotations From A Large Number Of English Vocabularies. And Then English Language Learners Will Be Cultivated Into Successful Language Learners With Intercultural Communication Awareness.

Since Language Is So Important To Successful Communication, Whenever Possible, Both Parties Involved In Intercultural Communication Should Seek Common Language And Attempt To Understand Cultural Differences In Using The Language. And Intercultural Communication Is Simply Defined As Interpersonal Communication Between Members Of Different Cultures. To Be Successful In Intercultural Communication, It Is Essential That English Language Learners Should Know Not Only Their Own Culture's Rules But Also The Cultural Rules Of The Person With Whom They Are Interacting. To Some Extent, Intercultural Communication Awareness Indicates "That The Cognitive Aspect Of Intercultural Communication Competence That Refers To The Understanding Of Cultural Conventions That Affect How We Think And Behave." (Cheng, 2010:35) Therefore, The Author Attempts To Expound The Significance Of Cultural Elements In English Vocabulary Teaching, Discusses About The Relationship Between Language And Culture, Stresses On The Cultural Connotations Of English Vocabulary Through The Formation Of English Language, Especially In Some Specific Words And Focuses On Some Typical Cases And Analyzes The Function Of Cultivation For English Language Learners' Intercultural Communication Awareness By English Vocabulary Teaching.

## **2. The Relationship Between Language And Culture**

Vocabulary Is Made Of Different Words. Language Is Consisted Of Different Vocabularies. To Some Extent, Words Are Essential Of Language Formation. However, With The Formation And Development Of Language, Language Keeps A Close Relationship With Culture And Is A Part Of Culture. No Doubt, Vocabularies Are Symbols Of A Specific Language And The Primary Means By Which A Culture Transmits Its Beliefs, Values And Norms. In One Word, There Is No Language Without Vocabularies, Otherwise, There Is No Culture Without Language. We May Know More Things About The Relationship Between Language And Culture.

On The One Hand, “Language Is Influenced And Shaped By Culture;(Deng And Liu, 1989:3) It Reflects Culture. At The Same Time, Language Is Used In Contexts Of Communication, It Is Bound Up With Culture In Multiple And Complex Way. To Put It In Specific Terms, “Language Embodies Cultural Reality; Language Symbolizes Cultural Reality” (Clarire Kramsch, 2000:37)

At Watkins (1992:318) Said: “Language Is Linked To Culture In A Complex Fashion.” Language Is A Part Of Culture And The Expression Of Culture. Thus, Language Is Symbolic Representation Of A People, And It Comprises Their Historial, Social, And Cultural Backgrounds As Well As Their Approach To Life And Their Ways Of Living And Thinking. And Each Language Is Deeply Rooted In Its Culture. So, Cultural Instruction Should Bean Unavoidable Part Of Language Teaching And Vocabulary Teaching.

On The Other Hand, Culture Is An Integral Part Of A Language, And That The Understanding Of English Language Requires The Understanding Of Its Culture. The Teacher Should Introduce Cultural Background Before Learning A New Word, Especially A New Noun Word, And Tell The Language Learners How To Interpret The Word Meaning In The Light Of Cultural Background In Order To Discover And Distinguish Multiple Layers Of Meanings In A Specific Text.

In Sum, Language And Culture Are Interdependently And Inseparably Related. They Constitute An Integral Whole. Though They Are By No Means The Same, Neither Of Them Could Survive Without The Other. Metaphors Can Be Employed To Vividly Describe The Relationship Between Them. Some People Say That Language Is The Mirror Of Culture, Which Means That People See A Culture Through Its Language. Others Consider That Language Culture Together Form The Iceberg. The Visible Part Is The Language, With A Small Part Of Culture Standing Out Above The Sea Surface While The Greater Part, Lying Hidden Beneath The Surface Of The Sea, Is The Invisible Aspect Of Culture. Still Others Say That Language And Culture Make A Living Organism, By Which They Mean That Language Is Flesh And Culture Is Blood. Without Culture, Language Would Be Dead And Without Language, Culture Would Have No Shape (Jiang,2000). In One Word, Language And Culture, Different As They Are, Form A Whole.

## **3. Cultural Connotation Of English Vocabulary**

People Know That English Language Just Like Other Languages Possesses Three Main Elements: Phonetic Element, Lexical Element And Grammatical Structure, Of Which Lexis Is The Fundamental Pillar That Supports The Huge System Of English Language And Plays An Indispensable Role In Conveying Information. Cultural Distinctions Of English Language Are Most Prominent And Widespread At The Lexical Level. Thus, Cultural Features, Especially Cultural Connotation In English Vocabulary, Will Help English Language Learners To Know And Understand Effectively The Relationship Between Language And Culture, Better Understand The Cultural Connotations Of English Vocabulary, In This Way, And Really Grasp Successfully Conveying Cultural Information That English Language Bears As Far As Possible. That Is To Say, English Language Learners Not Only Remember The Meanings Of English Vocabulary, But Also The Deep Connotations Of English Vocabulary. Needless To Say, It Is A Special Significance For English Language Learner To Learn The Cultural Connotations Of English Vocabulary.

In The Broadest Sense, Vocabulary Is A Symbolic Representation Of One Language, And It Comprises The

Historical, Social, And Cultural Backgrounds That The Language Has Its Own As Well As The Approach To Life And Their Ways Of Living And Thinking That The English Spoken People Have. And Each Language Is Deeply Rooted In Its Culture. Accordingly, Vocabulary Reflects Cultural Connotations In One Language.

3.1 Learning The Cultural Connotations Of English Vocabulary Can Help English Language Learners To Cultivate Their Intercultural Communication Awareness. For A Long Time, Learning An English Language Well Means More Than Merely Mastering Its Pronunciation, Grammar Rules, Literal Meaning Of Words. It Also Means Learning To See The Connotative Meaning Of Words Within The Cultural Context And Learning The Ways In Which English Language Reflects The Ideas, Customs And Behavior Of Their Society.

However, Cultural Connotation Of English Vocabulary Is An Integral Part Of English Language, And Learners' Understanding Of English Language Requires The Understanding Of Its Culture. The Teachers Of English Language Should Introduce Cultural Background Before Learning A New Word Or A Text And Tell The Students How To Interpret The Word Or The Text In The Light Of Cultural Differences In Order To Discover And Distinguish Multiple Layers Of Meanings In Word Or A Text.

To Some Extent, Successful English Vocabulary Teaching Should Combine The Use Of Context With A Focus On Lexical Patterns And Groupings. Context Is Crucial For The Learner To Infer The Meaning Of A New Word That Learner Encounters. By Context, It Is Understanding That It "Involves The Learner In Seeking Clues To Meaning By Following A Number Of Defined Steps Which Lead From The Form Of The Word Itself, To Its Immediate Context, And Then To Its Operation In The Surrounding Context"(Carter, 1992).

Also, Honeyfield (1977) Stresses The Importance Of Context In The Teaching Of Vocabulary. He Points Out That Ever With A Functional Vocabulary Of The Three Thousand Most Frequently Occurring Items In English, Learners Will Still Not Know Around 20 Per Cent Of The Items They Will Encounter In An Unsimplified Text. The Problem Confronting Both Teachers And Learners Is That No Course Can Provide Learners With Anything Like The Vocabulary They Will Need To Comprehend Authentic Texts. It Is Therefore Important To Provide Learners With Strategies For Inferring The Meaning Of Unknown Vocabulary From The Context In Which It Occurs Or The Different Meanings Of Known Vocabulary From Their Particular Contexts.

Hence, English Language Learners Should Unavoidably Learn Different Cultural Connotations From A Word So That They Will Be Aware That Them Not Only To Master Words' Pronunciation, Grammar Rules, Literal Meaning But Also To Learn Words' Cultural Connotative Meaning, So As To Effectively Promote Linguistic Competence And Communicative Competence. Also, The English Language Learners Will Be Gradually Cultivated To Have Their Own Intercultural Communication Awareness.

3.2 Learning The Cultural Connotation Of English Vocabulary Can Help English Language Learner To Better Understand The Cultural Characteristics Of English Language, So As To Enhance Their Intercultural Communication Competence.

English Language Learner Clearly Knows That They Should Have A Lot Of English Reading And Special Courses Of English Culture Study And Then They May Master Cultural Connotation Of English Vocabulary Because Most Of The English Vocabulary Listed In Textbooks And Dictionaries Is Not Flanked By Explanations Of Cultural Meaning. In China, Some English Language Teachers Are Influenced A Lot By The Grammar-Translation Method And Have Some Wrong Thoughts About That If The Learner Had Have Good Fundamental Of The Pronunciation And Grammar Of English Vocabulary And Remembered A Lot Of Words By Their Hearts, The Learner Would Certainly Master English Language Quite Well.

At The Same Time, English Language Teacher Have Very Heavy Teaching Workloads And Have Limited Time In The Big Size Class, Most Of The English Language Teacher Usually Have Attached Little Attention

To Interpreting The Specific Cultural Connotation Of English Vocabulary. As For Learners, When They Meet An English New Word, They Generally Depend On English Language Teacher And All Sorts Of English Dictionaries To Give Them The English For A Chinese Word, Or The Chinese For An English Word, Without Learning Very Carefully The Individual Connotation Of The Word, The Learners Therefore Can Not Catch The Exact Meaning Of Some Specific English Words Or Can Not Choose The Proper Words To Express Themselves About Some Things Or Some Accidents. We Take One English Word “Individualism” As An Example. The Chinese Learners Always Think This English Word Means “Selfish”, “Thinking More About The Needs, Happiness, Etc, Of Their Own Than About Other People”. But, This Word Originally Means “The Belief That Individual People In Society Should Have The Right To Make Their Own Decisions, Etc, Rather Than Be Controlled By The Government,” “ The Quality Of Being Different From Other People And Doing Things In Your Own Way”.(Wehmeier,2004:899) Needless To Say, One Word Represents Only One Or Two Meanings Of Their Own, But Also Reflects The Beliefs And Values From Another Culture.

#### **4. Measures Of English Vocabulary**

In English Vocabulary Teaching, The English Language Teachers Should Know How To Improve The Learners’ Understanding Cultural Connotations Of English Vocabulary. The Author Put Forward Some Useful Suggestions On Pedagogical Approaches For Efficient English Vocabulary Teaching And Improving The Learners’ Intercultural Communication Awareness. Therefore, The English Language Teachers Should Pay More Attention On Their Teaching Methods, So As To Improve Their Linguistic Competence And Communicative Competence.

- 4.1 English Language Learners Should Be Broadened About The Depth And Breadth Of English Vocabulary Knowledge Through Their English Reading And Listening. Especially, English Reading And Listening Materials May Cover A Wide Range Of Subjects – Humanities, Politics, Military Affairs, Science, History, Economy, Etc. More Attention, Especially In Class, Should Be Paid To The Depth And Breadth Of English Vocabulary, Specially Including The Cultural Connotation Of English Vocabulary, Which Is Of Great Significance As Well. Just As Hulstijn(2001:266)Says That “Most Vocabulary Items Are Acquired ‘Incidentally’, That Is , As A By-Product Of The Learner Being Engaged In A Listening, Reading, Speaking Or Writing Activity”. Incidental Vocabulary Learning Occurs As “Learners Are Focused On Something Other Than Word Learning Itself” (Paribakht & Wesche, 1999:196). In This Way, The More Relevant Cultural Information The English Language Learners Have, The Easier The English Language Learners’ Understanding English Culture Will Be.
- 4.2 English Language Learners Should Be Developed In Intercultural Awareness Through Learning Cultural Connotation Of English Vocabulary Because English Culture Is An Integral Part Of English Language And Rooted In English Language. Also, Effectively Mastering English Language Requires English Language Learners To Better Understand Its Culture. The English Language Learners Would Obtain The Cultural Knowledge From Given New Words And Would Respect, Tolerant And Accept Different Cultures, And Have Real Intercultural Awareness To Communicate With People From English Cultural Background. Hence, The English Teachers Should Introduce Cultural Background And Connotation Of Given New English Words And Tell The English Language Learners How To Interpret The English Text Or Materials In Class Due To Cultural Differences In Order To Discover And Distinguish Multiple Layers Of Meanings In A Text.
- 4.3 English Language Learners Should Be Encouraged To Use Different Basic Methods For Learning New English Words. For Example, The English Language Teachers Should Ask The Learners Or The Students To Exploit Available Information To Guess Passage Ideas And Predict Outcomes, And Then Should Let The

Learners Know Understanding Involves More Than Mere Linguistic Decoding And Tell The Learners How To Identify The Meaning According To The Situation. Finally, The English Language Teachers Should Proceed From A Familiar Framework By Using Familiar Instances To Exemplify Unfamiliar Ones, And Fill In Missing Information To Bridge The Gap Between The Material Context And The Learners' Existing Knowledge Of English Culture. The English Language Learners Should Associate The Known With The Unknown While Learning Some New English Words. Especially, The English Language Teachers Should Require The Learners To Attach Much Attention To The Cultural Connotation Of New English Words.

## **5 Conclusion**

As For English Language Teachers, English Vocabulary Teaching Is One Of Main English Language Teaching Tasks. Especially, English Vocabulary Is Important Component Part Of English Language. Meanwhile, The English Language Teachers Should Clearly Know The Relationship Between Language And Culture, Understand The Cultural Connotations Of English Vocabulary In Order To Enhance English Learners' Intercultural Communication Awareness. Because The English Learners' Intercultural Communication Awareness Has Occupy The Vital Position In Cultivating English Learners' Intercultural Communication Competence, The English Language Teachers Should Attach Great Attention To English Vocabulary Teaching And Take Some Practical Measures To Teach English Language Learners To Master The Cultural Connotations Of English Vocabulary Such As Broadening About The Depth And Breadth Of English Vocabulary Knowledge Through English Reading And Listening Materials Including Different Subject Of English Society, Introducing Cultural Background And Connotation Of Given New English Words And Using Different Basic Methods For Learning New English Words, Etc. Only In This Way, The English Language Learners Can Be Really Encouraged To Learn New English Words From An Intercultural Perspective And Really Understand The Cultural Connotations Of English Vocabulary, So As To Improve Their Intercultural Communication Awareness, And Finally Enhance Their Intercultural Communication Competence.

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## **Pre-service Teachers' Perceptions towards Multicultural Education and Teaching of Culturally and Linguistically Diverse Learners**

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### **Abstract**

*In this study the authors investigated 80 pre-service teachers about their perception towards multicultural education and teaching of culturally and linguistically underrepresented diverse students. Participants completed a modified version of the Diversity Orientations Survey. First, results show that the majority of pre-service teachers largely agreed for the need for the inclusion of multicultural education to teacher education program with regards to teaching linguistically culturally diverse students. Second, participants indicate lack of awareness with regards to understanding of multicultural education in terms of cultural awareness in the teaching of special needs students. This paper conceptualizes pre-service teacher's perceptions towards multicultural education in general and discusses the teaching of culturally, linguistically and underrepresented diverse learners in K-12 schools. The authors propose reforms in the curriculum of teacher education preparation programs in colleges of education of inclusion of comprehensive multicultural education course at each level of education.*

**Keywords:** Multicultural education, culturally and linguistically diverse learners, pre-service teachers, diversity

### **Introduction**

The trend of increasing diversity in United States classrooms continues to grow especially in urban schools where there is an increasing population of immigrants and other minority students in those K-12 schools. According to the U. S. Census Bureau, by the year 2040, White non-Hispanics will make up less than half of the school-aged population. In 2010, the Hispanic population was projected to account for 43% of United States population growth. A recent National Center for Education Statistics (2010) report reveals that students of color, described as Latina/o, African American, and Asian, are now the majority of students in K-12 public schools in the United States (Maxwell, 2014). It is evident that K-12 schools in the U.S. are becoming increasingly diverse including culturally, linguistically and underrepresented diverse learners. The issue of diversity in U.S. K-12 schools requires significant training and experiences for preservice teachers to recognize the importance of students' socio-cultural, religious values, and the influence their cultural background have in their quest to succeed in the educational endeavors.

The southeastern United States is no exception, as this region has several communities that can be described as the New Latino Diaspora [NLD] (Durand, Massey, & Capoferro, 2005). An NLD is defined as a geographical area of the United States where Latinas/os have traditionally not settled (Murillo & Villenas, 1997). The city of Dalton and Whitfield County, Georgia are powerful examples of an NLD area.

Trevizo (2010) noted that “[T]wenty years ago, public schools in Whitfield County, Georgia had just three non-English-speaking students. Currently, there are more than 1,700, or about 1 in every 6 students” (para. 1). Moreover, there are 16,604 Latina/o students in Whitfield County. Between 1990 and 2000, Whitfield County, Georgia experienced a 694% increase in its Latina/o population and an 81% increase between 2000 and 2011. Whitfield County currently has a Latina/o population of 33,387, which is 32% of the county’s population. This county’s percentage far surpasses Georgia’s overall Latina/o population percentage of 9% (US Census Bureau, 2011).

The National Center for Education Statistics (NCES) reports that, between 1979 and 2008, the number of school-aged children (children ages 5-17) who spoke a language other than English at home increased from 3.8 to 10.9 million (NCES, 2009). NCES (2010) reports that during 2007-2008, about 58% of public school teachers of grades 9 through 12 were females with 83.5 % defined as belonging to the “White” race/ethnicity category, while the categories of Hispanic constituted 6.6 % and Black 6.9% of the teacher population. The implications of the difference between the number of students with diverse backgrounds and the number of diverse teachers available to meet the needs of these students demands new calls for research to explore the attitude, knowledge, and perceptions of pre-service teachers about culturally, linguistically, and underrepresented minority students. Rhoads (1995) contends that the ever-increasing diversity that students bring to classrooms produces mass confusion about how to teach, what to teach, and best instructional strategies to adopt to teach.

The city of Dalton, Georgia is a prime example of the changing demographics in schools. Currently, Latinas/os are 48% of this city’s population or 15,891 of its 33,128 residents (US Census Bureau, 2011). Moreover, 69% of Dalton public school students are Latina/o (personal communication, Caroline Woodason). However, most teachers in Dalton’s public schools are White with a mono-cultural background and less experience in teaching culturally, linguistically and underrepresented diverse learners.

According to Wortham, Mortimer, and Allard (2009), NLD towns in the northeastern United States longtime residents “often described Mexicans as unsuccessful in school and as unlikely to improve themselves through education” (p. 3), while recognizing them as model minorities in other realms, such as civic-mindedness and work ethic. Limited research has been conducted about pre-service teachers’ attitudes and perceptions towards teaching of culturally, linguistically, and underrepresented minority students especially regarding pre-service teachers from mono-cultural backgrounds. This study provides significant information to teacher educators, policy makers, curriculum and development planners, and future teachers about the need to reform teacher training and multicultural education to make it an integral part of teaching and learning at all levels of education. Hopefully, reforms will create an awareness and special attention to culture as well as the realization that every student grows up in a specific culture. This study also provides teachers, pre-service teachers, and researchers in the field of education information about preparing pre-service teachers and other post-secondary students the issue of culture and how it can influence student’s background information, which influences their response to learning in what can be referred to as *surviving the school experience*.

Multicultural understandings are fundamental to the education of all children, not only children from minority backgrounds but also those from white middle-class families, too. An assumption we hold is that multicultural education is basic. It’s an integral part of the curriculum not separate. In our own university classrooms, we have found that when conversations surrounding the rights and treatment of minorities in schools today enter our course discussions that many of our pre-service teachers’ emotions and deep-seated beliefs cause them to question themselves. We hope that as we open the doors to multicultural thinking, we are creating new roles for ourselves in the classroom. Our goal is to step down from the podium to engage ourselves with our students in hopes to empower them to think and construct their own meaning from the world around them.

Consistent with the above, there is still a dearth of knowledge with regards to pre-service teachers’ perceptions towards multicultural education in the teaching of culturally and linguistically diverse learners. The

purpose of the study was to examine pre-service teachers' perceptions towards multicultural education and teaching of culturally and linguistically diverse learners in a NLD area in northwestern Georgia value diversity and/or difference using the Diversity Orientations Survey instrument.

### **Review of Relevant Literature**

Gay (2000) and Ladson-Billings (2000) defined multicultural education as adopting a culturally responsive pedagogy with trained instructors facilitating it. In a similar way, Nieto (1996) contends that multicultural education as "antiracist education" which is "a process important for all students" (p. 307). The National Association for Multicultural Education (NAME) described multicultural education as a "philosophical concept built on the ideals of freedom, justice, equality, equity, and human dignity as acknowledged in various documents, such as the U.S. Declaration of Independence, constitutions of South Africa and the United States, and the Universal Declaration of Human Rights adopted by the United Nations" (National Association of Multicultural Education, 2011). Banks (2005) outlined five core dimensions of multicultural education; namely: (1) content integration, that is, infusing the curriculum with material from diverse groups, (e.g., new authors, new historical material); (2) knowledge construction, comprising of an awareness of and focus on the way that cultural frames shape the identification and interpretation of educational content (e.g., understanding that the "westward migration" was only "west" for one social group); (3) prejudice reduction to mean the extent to which the teachers and administrators in a school actively work to reduce prejudice and stereotyping by students in the school, such as through the inclusion of an explicitly antiracist curriculum; (4) equity pedagogy that is reference to pedagogies designed specifically to increase the academic achievement of lower performing students and to create greater equity between students; and (5) empowering school culture to mean, altering school structures and processes to be more empowering for all students, with particular attention to eliminating institutionalized racism in school practices.

The National Council for Accreditation of Teacher Education (NCATE) in the past four decades have set up standards that require teacher education programs to incorporate multicultural perspectives and cultural diversity (NCATE, 2008). To meet these standards, as well as standards set for teacher certification, each state, including Washington DC, showcases a diversity-related requirement in some manner (Akiba, Cockrell, Simmons, Han, & Agarwal, 2010). However, Akiba, et al. (2010) further state that only three states required a specific course in multicultural education and cultural diversity for reaching teacher accreditation. Many challenges exist for creating and designing appropriate multicultural understanding and teaching of students in K-12 schools. It is evident there is lack of multicultural preparation, awareness, along with the isolation of teachers among their own ethnic groups, and the possession of a professional preparation that excludes direct meaningful interaction with different cultures in the U.S. (Cannella & Reiff, 1994).

Several colleges of education in the U.S. are utilizing different methods to promote multicultural education as well as to develop culturally competent teachers (Akiba, et al., 2010) with a stand-alone course serving as one solution. Sleeter (2001) states that a single course of multiculturalism and cultural sensitivity objectives will not solve the problem for promoting multicultural education among pre-service teachers. However, other research studies confirm that a single course of multicultural education for preservice teachers can accomplish the objectives, positive awareness, and increased teachings concerning the quality of instruction and positive relationships between the teacher educator and the pre-service teachers (Chizhik & Chizhik, 2005).

According to Blanchett (2006), most teachers continue to enter public school classrooms unprepared "to effectively teach African American and other students of color" (p. 27); they begin teaching with limited knowledge of who they are as racial beings outside of their own and lack the skills to identify, implement, or assess culturally responsive learning strategies (Bell, 2002; Cochran-Smith, Davis, & Fries, 2004; Cross, 2005; Juárez, Smith, & Hayes, 2008). Public-school classroom teachers are increasingly from backgrounds identified as culturally, linguistically, ethnically, religiously, economically, and otherwise socially diverse (Douglas

Horsford; 2011; Juarez & Hayes, 2010; Ladson-Billings, 2006; O'Connor, 2006). However, the teaching force in the United States remains predominantly White, female, and monolingual (English) (National Summit on Diversity in the Teaching Force, 2002; Sleeter, 2001). This disparity has far-reaching implications and presents yet another unprecedented challenge for today's public schools.

The diversity of student populations served by public education systems is already having an adverse effect on overall student achievement and is forcing more and more educators to question their own beliefs and prejudices. The need for all teachers to be prepared to effectively teach all students can hardly be understated; it is now a demographic imperative (Banks, 2002). To successfully teach all students, not just those who most closely reflect U.S. society's previously White mainstream, teachers must have the knowledge, disposition, and skills to effectively implement and assess a culturally responsive pedagogy (Gay, 2000; Ladson-Billings, 1999). Despite increasing ethnic diversity in the United States, many educators do not seem to understand that multicultural education is the broader understanding, involvement, and appreciation of more than two cultures. This study will help fill the gap of knowledge regarding preservice teachers' knowledge and attitude towards multicultural education and teaching of linguistically and cultural diverse students.

## **Study Purpose**

As teacher educators in a teacher education preparation program where the majority of the preservice teachers are White and who teach a predominately non-White student body in segregated schooling structures, we felt that this disparity warranted our considered exploration. In order to take culturally responsive teaching seriously in our specific situation, we needed to seriously examine the demographic landscape of attitudes and beliefs of our teacher candidates in our education program, particularly since this racial composition is unlikely to change in the near future. We experienced, as teacher evaluators of preservice teachers, the discord between student teachers and K-12 students primarily due to cultural and linguistic differences that emanates from lack of cultural awareness or knowledge on the part of preservice teachers. It was surprising to experience and, to a greater extent, acknowledge their lack of cultural understandings because most of them had prior experience in multicultural education courses. The purpose of the study was to evaluate the degree to which elementary and secondary pre-service teachers enrolled in a postsecondary institution located in a New Latina/o Diaspora area in northwestern Georgia understand, appreciate, and /or embrace diversity-related issues, such as race/ethnicity, class, gender, sexual orientation, second language learning, and immigration status, especially related to their Latina/o students.

Blue Ridge College (BRC) is an undergraduate degree institution where 65% of students are the first in their families to attend college. Additionally, BRC is an emerging Hispanic Serving Institution (HSI) with a 21% Latina/o student population. According to 2010 Census Bureau data, the city in which BRC is located is 50% Latina/o of which a majority are of Mexican-origin. Furthermore, 69.3 of this city's public schools are Latina/o with a majority being Mexican-origin.

## **Methods**

### **Participants**

The purpose of the study was to examine preservice teachers' perceptions towards multicultural education and teaching of culturally and linguistically diverse learners. Participants in the study were education majors in early childhood and secondary education with an age range of 18 to 36. Participants included n=23 (29%) male and n=57 (71%) females. Additionally, 85% of the participants self-reported as White followed by 13% Hispanics, and 3% as other race (see Tables 1 and 2 for demographic information). All participants were full-time college students who had completed at least one semester of teacher education courses in the school of education at BRC.

## Data Collection

All education major students were invited to participate in this study through verbal and email invitations. The first email was sent to pre-service teachers enrolled in Area F (major-related courses required before admission to the School of Education) and Blocks I-IV in the Early Childhood Education and Secondary Education programs. Three reminder messages were sent via email to all prospective participants inviting them to complete the survey. The survey was open from October 1 through October 15, 2014. Of the 100 potential participants, 80 completed the survey, which was a modified version of the Diversity Orientations Survey (please refer to Appendix I). This survey's responses were based on a Likert scale of 1 to 5, with 1 indicating strongly disagree to 5 indicating strongly agree.

## Analysis

Data was analyzed using SPSS 22.0 and EXCEL software to identify participants' age group, level of education, program of study, and knowledge and awareness about multicultural education as teacher educators

## Findings and Discussions

The purpose of the study was to examine preservice teachers' perceptions towards multicultural education and teaching of culturally and linguistically diverse learners in a NLD area in northwestern Georgia value diversity and/or difference using the Diversity Orientations Survey instrument. Table 1 displays gender of students. As seen in Table 1, there were more female students (71%) than male students (29%).

Table 1. Gender of Participants

Gender	<i>n</i>	Percentage (%)
Male	23	29%
Female	57	71%

*N*=80

Table 2 presents race/ethnicity of students enrolled in the BRC teacher education preparation, which describes that there were more White students (85%), followed by Hispanics (13%), and other (3%). The above data will help to authenticate the value of multicultural education perspectives among preservice teachers, because most of the student population is White.

Table 3. Race/Ethnicity of Students

Race/Ethnicity	<i>n</i>	Percentage (%)
White	68	85%
Hispanic	10	13%
Other	2	3%

*N*=80

According to Lee and Dallman (2008), teachers at all levels enter their profession with preconceived notions about diversity issues such as race, gender, disability, sexual orientation, language, and socioeconomic status. Several research studies indicate that many of the perceptions held by preservice teachers on student success are often influenced by preservice teachers' lack of cultural knowledge and by their own ethnic heritage (Middleton, 2002). Classrooms are filled with different cultures and perspectives making it a necessity for teachers to be trained and acknowledge the essence of diversity in the classroom. For example, according to the National Center for Education Statistics (2007), 64% of public school students are White, 17% are African American, 14% are Hispanic, 4% are Asian/Pacific Islander, and 1% are Indian Alaskan native.

As Sleeter (2001) points out, "Education in many communities of color as well as poor-White

communities is in a state of crisis” (p. 94). By the year 2020, one third of the student population will be non-White, and almost one-fourth will live in economic poverty (Carnignan, Sanders, & Pourdarrod, 2005). It is imperative to acknowledge the relevance of preservice teachers to recognize the diversity of K-12 classrooms. Ladson-Billings (2000) suggested there is an imminent need to prepare teachers for a culturally-relevant pedagogy in order to teach culturally diverse student populations (Ambe, 2006; Gay, 2002; Nieto, 2000). This assertion is supported by Ambe (2006), who stated, “Culturally relevant pedagogy is founded on the premise that rather than being considered deficits, students’ cultural backgrounds can be used to serve and enhance their learning” (p. 692). Teacher education programs continue to face challenges of establishing effective multicultural education curricula that addresses educational, social, and economic equity for preservice teachers (Banks, 2004).

As seen in Table 3, a large percent of BRC preservice teachers (44%) agreed it was important to explore cultures other than their own. Based on these data, we could speculate these students are interested in other cultures because of their previously acquired knowledge from a multicultural education course. We contend this is a surprising finding because data published by the United States Department of Education (2007) reports that 86% of all elementary and secondary teachers are White. The majority of these teachers will enter classrooms with student populations with whom they share limited cultural knowledge or intercultural experiences. This discontinuity between the cultures of the teachers and the students will continue to be a critical issue for teacher certification programs.

The data also indicate a significant number of students (49%) had no perceived problem working with people of different cultures. The data show that students are aware of the need as teachers to recognize and tolerate other cultures, especially as teachers at the K-12 schools. It could be deduced from the data that students are on the path to be culturally-competent teachers, as they do not object to core principles of multicultural education and diversity in school even though the percentage of students agreeing to it was quite low..

Table 3 reveals that some of the students strongly agreed that they understand the challenges and frustrations that immigrant or minority students in K-12 schools experience because of their cultural, ethnic, and language backgrounds. This finding confirms that student teachers acknowledge the challenges of minority students in schools such as linguistic, financial, parent support, lack of resources, and other challenges that they go through in order to be achieve equitable academic success.

It is interesting to note that on the issue of language and diversity in the classroom, the percentages were largely evenly distributed. We expected students to be aware of the significance of bilingualism in students who speak other languages other than English at school. However, the results from the data reveal inconsistent perceptions. For example, the data indicate that 32% disagree that speaking other languages does not bother them, followed by 22% as strongly disagree, while 20% agree, followed by 20% been neutral, 4% strongly agree, and 3% as other. As stated beforehand, many teacher education programs do not prepare students for the diversity that they experience once they join the ranks of full-time teachers.

Consequently, when students do not learn in the way we teach, we assume that the problem is with the child. According to Delpit (2006), educators assume that, when children do not respond to this one-model-fits-all approach, they cannot learn (p. 223).

It is expected that most teacher-education students will recognize there is the need for additional resources for K-12 teachers to teach, expand and or meet the needs of students in exceptional education programs (special needs). However, findings from the data reveal an even percentage of responses from preservice teachers. For example only 10% of the students strongly agreed that additional resources were needed followed by 32% as agree; 34% neutral and 16% strongly disagree. Many questions remain why pre-service teachers will not concede to the importance of the need for additional resources in teaching special needs students in K-12 schools. This finding supports Gay’s (2002) assertion that teacher education programs are obligated to address the needs of children typically marginalized by a dominant Euro-centric society (Gay, 2002). She further (2002) contends that teachers’ beliefs and values influence their theory and practice and have a direct impact on their

overall expectations for student learning and student achievement. This could be due to the fact that they might not have taken any course in special education in their program or have taken a limited number of courses or have less knowledge regarding the need to recognize the education of students with special needs.

Ambe (2006) reiterates that “one of the reasons why schools have not successfully met the literacy needs of students of diverse cultural backgrounds is due to a mismatch between the home, culture of students and that of the school “(p. 691). This mismatch is often referred to as cultural discontinuity. In a related result, a significant number of students (47% strongly agreed, 38% agree) reported that additional resources must be provided to help in the educational development and adjustments of English language learners or students in K-12 schools. Findings from data indicate that most of the students agreed to fund additional resources to schools because they became aware of the need to help English language learners via courses they have taken in English As a Second Language Learners (ESOL). This is referenced by the fact that several researchers have reported that preservice teachers’ cultural awareness has been changed by a course and/or seminar in multicultural education (Brown, 2004; Milner, Flowers, & Moore, 2003). It was not surprising from the data that students holistically agreed (47% strongly agreed, and 37% agreed as against 1% and 0% for disagree) on the inclusion of multicultural education in the school curriculum. This is a great accomplishment because for pre-service teachers in a predominantly majority institution with less exposure to diversity to acknowledge the importance of multicultural education in the school. It could be that they become aware of the importance of multicultural education from their culture and education class or ESOL classes or instructors or the college has been doing a good job of disseminate information about multicultural education inclusion for schools.

Table 3.

	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)	Other (%)
Interested in exploring cultures different from my own	29	44	13	5	4	5
Have enough experience with cultures different from my own	0	14	39	41	5	1
Believe that some cultures and ethnic groups are better than others	1	11	15	28	42	3
Comfortable around people whose cultural background is different from mine.	27	49	16	6	0	1
Bothers me when I hear people talking in a language I cannot understand	4	20	20	32	22	3
Members of all racial and ethnic groups make valuable contributions to society.	53	27	14	3	1	3
Important for people to examine possible personal prejudices.	43	44	8	4	1	0
In the United States, given equal intelligence and ability, every individual has equal access to success	18	22	15	32	11	3
With appropriate resources, people with intellectual disabilities can be as successful as people without disabilities	33	44	11	10	1	0
It is acceptable to tell racial or ethnic jokes	1	5	25	27	41	1

In the United States, members of racial and ethnic groups have equal opportunities to be successful	14	29	16	32	9	0
In the United States, women have equal opportunities to be as successful as men	11	27	20	33	9	0
It is important to be sensitive to issues related to sexual orientation	30	44	18	5	3	0
A teacher's role should be limited to promoting only middle class values and mainstream culture	1	6	9	35	48	0
I consider particular attitudes or behaviors of children to be a direct consequence of cultural or ethnic differences	5	39	20	30	4	1
I feel I can understand the point of view of a child who comes from a culture different than my own	9	51	29	9	1	1
Additional school resources are appropriately expended in meeting the needs of students with special needs	10	32	34	16	5	3
Values and attitudes learned in minority cultures keep children from making progress in school	6	19	27	34	11	3
Multicultural education should be an important part of a school curriculum	47	37	13	3	0	1
Teaching about various world religions should be a part of the public school curriculum	32	30	16	10	10	1
Students from economically disadvantaged families should be expected to achieve as well as those from more advantaged families	28	39	24	8	1	0
I am comfortable teaching in culturally diverse classrooms with students who share different value systems	33	48	15	4	0	0
Students without documentation should be excluded from receiving public education	4	10	20	20	44	1
Additional resources should be provided to help meet the needs of English Language learners.	47	38	10	1	3	1

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N=80

## Implications for Teacher Education

Future teachers must be able to create equitable learning environments for diverse student populations (Bennet, 1995). Unfortunately, teacher education often fails to encourage candidates to expand their vision of culturally responsive pedagogy beyond academic material. If the future vision of public education includes insuring that all students experience instruction from a culturally responsive teacher, then the responsibility for accomplishing that goal lies squarely on the shoulders of teacher education that produce the teachers of the

future. It must be a clear and important goal for Teacher Education that their programs produce *culturally competent* teachers. According to Singh (1996), a culturally competent person is one who has knowledge and skills that enable him or her to appreciate, value, and celebrate similarities and differences within, between, and among culturally diverse groups of people. Teacher Educators must facilitate the process of achieving cultural competent preservice teachers.

If the ethical responsibility of Teacher Education is to prepare preservice teachers who can work effectively with students from diverse backgrounds, then multicultural education must be broadened to include cultural understandings of all persons. For example, Martins (2008) argues that “the awareness of one’s own assumptions, prejudices and stereotypes is a first step to be able to positively interact and learn from others. In this process lies the essence of intercultural learning” (p. 203). In addition, there must be the need to go beyond the lack of multicultural ingredients in the curriculum, policy and structure issues within schools and how school personnel, specifically teachers, interact with students and with each other (see also Banks & Banks, 2000; Lee, 1995; Nieto, 2000). It is important to note that the attempt to change mono-cultural institutions into multicultural democratic communities is treating cultural diversity as a subject matter and not attempting to reform the ways of thinking and doing in the society (Rhodes, 1995). The purpose of multicultural education based on the objective of the study is to identify factors from pre-service teachers and how to transform educational institutions and organizational structures to reflect diverse cultures and perspectives.

Diversity does not mean divisiveness. We believe that we can avoid the segregation that strengthens group identity to the exclusion of others as we work to break down the stereotyped thinking that comes from fear and leads to prejudice. Such understanding begins with awareness of self and leads to recognizing the needs of others.

## Conclusions

The purpose of the study was to examine preservice teachers’ perceptions towards multicultural education and teaching of culturally and linguistically diverse learners in a NLD area in northwestern Georgia value diversity and/or difference using the Diversity Orientations Survey instrument. According to Nieto (2004), the increase in ethnic diversity has caused many educators to recognize the need to expand their knowledge of multicultural education in the public schools. The success or failure of multicultural education depends upon the effective preparation of teachers and administrators. These teachers must be competent in the courses they teach if their students are to be academically successful (Ogbu, 1992). The study shows that preservice teachers are keenly aware of the challenges immigrant and other minority students especially linguistically and culturally diverse students face in K-12 schools. Results indicate that preservice teachers have the willingness to study and to be aware of multicultural awareness for them to operate and teach with less difficulty in the teaching learning process. Overall, preservice teachers showed significant understanding about the need to incorporate multicultural education and benefits to be gained from the concepts of multicultural perspectives as future teacher educators considering the increasing growth of diversity in the U.S. Preservice teachers’ knowledge and awareness of multicultural education varies depending on the background as well as cultural ties they have had before entering college.

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## Secondary School Teachers' Attitude Towards Information And Communication Technology In Ondo State, Nigeria

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### Abstract

*This study was carried out to examine secondary school teachers' attitude toward information and communication technology. The study covered twenty selected secondary schools in Ondo South senatorial district of Ondo state. Four hundred teachers were selected from 20 selected secondary schools out of 300 secondary schools in Ondo State using systematic random sampling technique. Five research questions and 5 hypotheses were formulated for the study. A descriptive survey method was adopted for the study. Data were collected and subjected to inferential statistics like frequency and percentage and chi-square. A questionnaire tagged "Teachers' Attitude and Access to Information and Communication Technology" (TAAICT) adopted from Yusuf (2003) which has 20 items and divided into 3 sections was used to collect data. The validity and reliability of the instrument was ascertained, the instrument was valid and reliable. The findings showed that there was significant difference in the overall attitude of secondary schools' teachers towards information and communication technology using teacher age, subject discipline, gender and years of experience and as variables. Based on the above findings, recommendations were made such as, government should encourage the use of modern technology in form of computer services; provide funds to schools through the Ministry of Education, purchase computer machine, and make them available to all public schools as operating in some private schools; government should also employ computer teachers who will not only teach the students but need to be computer literate.*

**Key Words:** *Teachers' Attitude, Information and Communication Technology*

### Introduction

Information and communication technology incorporates two main technologies or domains of study namely, computers and telecommunications. It is the technology of gathering, analyzing, manipulating, storing and communicating data. Today, the world data encompasses voice, text, numbers, fax, graphics, pictures, video and multimedia (Woherem, 2000). The word is used to refer to data or sets of data that have been processed and/or manipulated to produce meaningful and useful information (Woherem, 2000). Computer systems are made of two major component for them to carry out their data or information processing functions. The two parts are hardware and software. Computer hardware refers to the physical component of the computer that is, those aspects of the computer that can be physically manipulated. While software refers to the sets instructions that are fed into the main machine that enables the computer to process data/information (Woherem, 2000).

Information technology is the acquisition, processing, storage and discrimination of vocal, pictorial, textual and numerical information micro-electronics – base combination of computing and telecommunications. It involved acquiring, storing, processing and distributing information by electronic means (including radio,

television, telephone and computer) (Russel & Bradley, 1998). It is the convergence of computing and telecommunications technologies. Other part is telecommunication, which radically alters the balance of power between institutions, governments and people by broadly disseminating important information (Woherem, 2000). Whilst people have been communicating from time immemorial with word, their hands, stone tablets and smoke signs telecommunication, it is the technology that is used to bring about the communication of voice and data signals over great geographical distance.

The terms, information and communication technology in teaching learning activities is seen as one used tools to achieve improved teaching and learning outcomes. Learning technologies are referred to as enhance student learning. Therefore, teachers must help students to be relevant and be active participants in modern information and communication technology. Yusuf (1998) emphasized that attitude is important in view of the fact that it is the controller of actual behavior of individual, consciously and unconsciously.

Secondary schools in Nigeria are institutions of learning where education is given after primary school, and today it is divided into junior and senior secondary school. It includes those private institutions offering correspondence subjects. Secondary school could be used to develop innate genius in the youth and enhance their capacity to stand by themselves (Yuen, 2002). Thus, secondary school could be used as investment that could yield rich productive dividends in a very near future, which could have far reaching effects on information and communication technology (Murphy & Greenwood, 1998).

Teachers' attitude refers to the cognition, beliefs and factual knowledge of the human and non-human which eventually positively influence his/her behavior toward the issues or things (Meyer, 2000). Therefore, the uptake of ICT by teachers is very essential in secondary school in the sense that it helps develop their skills to meet the challenges of the future through the use of information and communication technology. The attitude of secondary school teacher toward the use of information and communication technology to attain a high level acquisition of knowledge by student is worthy of being examined critically.

Communication, according to Mayer (2002) is a study of the manner in which individual exchange messages the purpose of such message transactions and factors that will enable a message to achieve its objectives. One word, which runs across the above definition is "message" then message according to a pattern. Communication involves the transmission of information from one person to another. It is only effective when it is interactive and it involves feedback, it is done for the purpose of entertaining, persuading, informing and instructing. It is a process: it is dynamic, on-going ever changing and continuous. It includes all methods of conveying and kind of through, feeling and attitude between person(s). It can be man to machine, animal to animal, machine to machine and animals to machine. In education, communication is the result of planned human and non-human interaction (Richardson, 2000).

In education, Cuban (1999) stated that the method and the process have to be matched to the objectives to effective communication. Any breakdown in communication may lead to conflict, failure, war, misunderstanding and other chaotic situations. Information and communication technology is very important in everybody interaction. Carnoy (2004) in relation to education stated that attitude could be divided three types the belief, the inclination. To act and how it affects an individual's motivation. She then made it as distinctions as follows:

- i. The cognitive attitude, which refers to what, a person believes about education.
- ii. The affective attitude which refers to how the students is incline to act toward education and
- iii. The behaviours attitude which is referred to as the determination, which affects motivation and substations, one's interest in the task being done in spite of the entire above, attitude is not a concrete term. This is because it can only be inferred from the way a person behaves towards certain objects, situations or ideas so it is easy to determine whether an attitude has been truly formed.

## **Statement of the Problem**

Attitude is a function of many things. However human experiences go a long way in influencing his attitude towards things events or situation. Unfortunately, Nigeria is just emerging as an information and communication technological nation and this has been responsible for the low level of attitude of teachers toward ICT. This is because the concept of ICT is new to them and majorities of them have not had the opportunity of experiencing the concept. With the rate at which societies are developing, there is very likely to be a time when majority of school instruction would be via information and communication technology. Even, currently, the National Open University of Nigeria (NOUN) has been the bulk of its instruction in ICT and with the need to develop themselves through further education, it become necessary that teacher in secondary school should be exposed to ICT this is because students of this level of education in themselves are seriously embracing ICT and it would not be good for teacher who are suppose to teach them to be naïve in the concept. Also examination bodies have embraced ICT with result and registration on the internet.

With the above stated reason, should teachers be ignorant of ICT? The answer to this is no. For it is the teacher that is responsible for teaching and they should be there in illuminating the lives of the youths. It is based on these that a study on secondary schools teachers attitude toward the use of information and communication technology, needs to be carried out.

### **Purpose of the Study**

The main purpose of this study is to investigate into secondary school teacher's attitude towards information and communication technology. Specifically, the study was designed to:

- a) Find out the attitudes of graduate and NCE teachers to ICT?
- b) Find out the attitude of teachers to ICT based on age?
- c) Find out the attitude of teachers to ICT based on subject discipline?
- d) Find out the attitude of teachers to ICT based on gender?
- e) Find out the attitude of teachers to ICT based on years of experience?

### **Research Hypotheses**

1. There is no significant difference in the attitudes of graduate and NCE teachers to ICT.
2. There is no significant difference in the attitude of teachers to ICT based on age groups.
3. There is no significant difference in the attitude of teachers to ICT based on subject discipline.
4. There is no significant difference in the attitude of teachers to ICT based on gender.
5. There is no significant difference in the attitude of teachers to ICT based on years of experience.

### **Scope of the Study**

This study is designed to find out secondary school teachers' attitude towards Information and Communication Technology in Ondo State. The study covered 20 secondary schools and 400 teachers from the total 300 secondary schools using simple random and systematic random techniques. Frequency and simple percentages and chi-square was used to analyse the data collected.

### **Methodology**

#### **Research Design**

The research design adopted for this study is the descriptive survey method. Oniye (1999) described the descriptive survey method as the research design that deals with systematic description of an event in a way that is factual and accurate. In a descriptive survey method, the researcher collects information from a representative sample upon which inferences are drawn about the perception of the target population. The descriptive research type of the survey method was employed for the investigation so as to obtain necessary

information from teachers of the sample secondary school. More so, the personal experience and observations as observed during teaching learning situation were also considered.

### **Population, Sample and Sampling Technique**

The target population for this study was all the secondary school teachers within the 300 secondary schools in Ondo State. However, the sample for this study includes four hundred (400) teachers from twenty (20) of the selected schools from Ondo South Senatorial District of Ondo State. To achieve this figure, simple random sampling technique was used to select the sampled schools, the names of all the secondary schools in Ondo South were written on pieces of paper and numbered on tallies and the tallies was placed in a box. After this, an uninformed person was asked to pick twenty of the tallies. To select the sampled teachers, the researcher visited each of the randomly selected schools. Systematic random sampling technique was used to select the sampled teachers. The researcher took permission from the school authority to carry out the distribution of the questionnaires, the instrument was distributed to all selected teachers and were immediately collected for collation and scoring.

### **Instrumentation**

The main instrument that was used in collecting data for this research is a questionnaire tagged “Teachers’ Attitude and Access to Information and Communication Technology” (TAAICT). This instrument was adopted from Yusuf (2003) and used by the researcher. The questionnaire was designed into 3 sections, section ‘A’ was designed to request for demographic data on each of the respondents, these data included, name of school, subject discipline and qualification, age and sex of respondent and years of teaching experiences. These are indices used as the predictive variable for hypothesis that was tested. Section ‘B’ was developed to know the respondents level of exposure to ICT these covered six operational concept in information and communication technology and respondents were requested to tick the levels. Section C, however was developed to probe into the attitude of teachers towards information and communication technology. This section was designed with a 4 Likert type response scale. The options ranged from Strongly Agree to Strongly Disagree.

### **Psychometric properties**

**Validity:** Validity means how accurately the test results represent or predict the particular characteristics intended (Abiri, 2006). In order words, a test is said to be valid when it measures what it purports to measures. To establish the validity of the instrument, the questionnaire was given to five experts in the Faculty of Education, University for vetting, after which corrections were made and the instrument was adjudged suitable for usage.

**Reliability:** According to Stagnor (2004), the reliability of a measuring instrument is the extent to which the instrument is free from random error, thus measuring consistently over time the variable of interest. The reliability of the instrument used for this research study was established using the test-retest method within an interval of four weeks. Pearson Product Moment Correlation co-efficient was used in computing the correlation co-efficient of the instrument. A reliability co-efficient of 0.82 was obtained, hence, the instrument was statistically adjudged to be reliable and considered suitable for research use.

### **Procedure for Data Collection**

The researcher personally administered the questionnaire among the teachers of the sampled schools. The respondents were expected to indicate their responses by ticking strongly agree, agree, disagree, or strongly disagree based on the polar question asked. In analyzing the data, care was taken in identifying the socio-economic factors of respondents as these served as the predictor variable on the criterion variable (teachers’

attitude towards information and communication technology). This is to measure the reliability of the instrument.

### Data Analysis Techniques

The researcher employed both descriptive and inferential statistics for the data analysis. The data obtained were analyzed with the aid of the simple percentage and chi-square statistical tools.

### Results

For the purpose of this study a total of four hundred teachers were used as the study samples. These consist of 126 Graduate teachers and 274 NCE holders from four subject disciplines, arts (130), science (86), social science (107), and vocational (77) the break down is presented in table 1.

**Table 1: Distribution of Samples by Qualification**

Qualification	Frequency	Percentage
Degree	126	31.5
NCE	274	68.5
Total	400	100

From table 1, it would be seen that majority, 274 (68.5%) of the respondents were holders of the Nigeria Certificate of Education.

**Table 2: Distribution of Sample by Subject Discipline**

Subject	Frequency	Percentage
Arts	130	32.5
Science	86	21.5
Social Science	107	26.7
Vocational	77	19.3
Total	400	100

The above table shows that 130 (32.5%) of the respondents were Arts subject teachers, 86 (21.5%) were Science teachers, 107 (26.7%) were Social Sciences teachers while 77 (19.3%) were teachers of vocational subject.

**Table 3: Distribution of Responses ICT**

Qualification	Agree	Percentage (%)	Disagree	Percentage (%)
Degree = 126	94	74.6	32	25.4
NCE = 274	86	31.4	188	68.6
Total = 400	180	45.00	220	55.0

Table 3 shows that 74.6% of the Graduate teacher accepted that they have had access to ICT while only 31.4% of the NCE holders had access to ICT on the exposure of teachers to ICT, size, level of exposure was indicated in the instruction. Teachers were requested to tick from the followings:

Table 3 show that 74% of the Graduate teachers accepted that they have had access to ICT, while only 31.4% of the NCE holders had access to ICT on the exposure of teachers to ICT, six levels of exposure were indicated in the instrument. Teachers were requested to tick from the following:

- i. Data processing
- ii. E-mail processing
- iii. Internet browsing
- iv. Graphic software
- v. Spread sheet
- vi. Data base software

Teacher's response are given below in table 4.

**Table 4: Level of Exposure**

Level	Frequency	Percentage
None	36	9.0
I	250	62.5
II	40	10.0
III	38	9.5
IV	22	5.5
V	12	3.0
VI	2	0.5
Total	400	100

Table 4 show that 62% of the respondents were familiar with the operation of all ICT gadgets. However, it could be seen that out of the total number of respondent 30(9%) had no exposure to ICT at all.

### Hypothesis Testing

**Hypothesis 1** stated that there is no significant difference in the attitude toward ICT between graduate and NCE holders of secondary schools teachers in Ondo State.

**Hypothesis II-V** stated that there is no significant difference in the attitude towards ICT by teacher of:

- a. Difference by age groups.
- b. Difference based subject disciplines.
- c. Difference based on genders
- d. Difference based on years of experience.

To be able to establish these, data sourced from the questionnaire were analyzed with the aid of chi-square ( $X^2$ ) and the outcome is presented in table 5.

**Table 5: Analysis of Secondary School Teachers' Attitude to ICT**

S/N	Variables	Agree	Disagree	Total	df	Cal $X^2$	Table $X^2$	Decision
1	<b>Qualification</b>							
	Degree	94(74.4%)	32(25.4%)	126				
	NCE	86(31.4%)	188(68.6%)	274	1	66.89	1.84	Rejected
	Total	180(45%)	220(55%)	400				
2.	<b>Age level</b>							
	20 – 24 Yrs	114(45%)	186(62%)	300				
	14Yrs	66(66%)	34(34%)	100	1	22.64	3.84	Rejected
	Total	180(45%)	220(55%)	400				

3	<b>Subject Discipline</b>							
	Arts	40(26.92%)	82(34%)	122				
	Science	62(72.19%)	24(27.9%)	86				
	Social science	45(42%)	62(67.5%)	107	3	34.2	7.815	Rejected
	Vocational	25(32.5%)	52(67.5%)	77				
	Total	180(45%)	220(55%)	400				
4	<b>Gender</b>							
	Female	46(29.9%)	108(70.1%)	154				
	Male	134(54.5%)	112(45.5%)	246	1	22.18	3.82	Rejected
	Total	180(45%)	220(55%)	400				
5	<b>Year of experience</b>							
	0 – 10yrs	91(50.6%)	88(40%)	179				
	11-20yrs	51(28.3%)	78(35.5%)	129	2	24.13	5.991	Rejected
	21 – 30yrs	38(21.1%)	54(24.5%)	92				
	Total	180(45%)	220(55%)	400				

This table establishes the significant difference between secondary school teachers' attitude to ICT by respondent in respective of qualification, age levels, subject disciplines, gender and years of teaching experience. Moreover, the strength of relationship between the variable and attitude to ICT by the various groups are generally weak as indicated by Pearson's contingency co-efficient, two main hypotheses were formulated for the study, after analysis of all data collected for the study, it was revealed that 94 (74.4%) Graduate teachers showed positive attitude towards ICT while 86 (31.4%) of NCE teachers showed positive attitude towards ICT.

The study also discovered that age difference could significantly influence teacher's attitude towards ICT. This is because it was found that 14 of the 300 (38%) teachers of ages (20-40) years showed positive attitude. While 66% of those of 41 years and above had positive attitude toward the influence of subject discipline it was revealed that 62 (72.1%) of science teachers showed positive attitude towards ICT with (26.9%). However, there is an inverse relationship between years of teaching experience toward ICT by these teachers. This could be seen as those with fewer years fostered higher positive attitude while lower years fostered higher attitude towards ICT, from these findings, it could be seen that most teachers have not been exposed to ICT and there in the need for teachers to be involved in ICT.

### Summary of findings

The following are the major summaries of findings

1. There is no significant difference in the attitudes of graduate and NCE teachers to ICT.
2. There is no significant difference in the attitude of teachers to ICT based on age groups.
3. There is no significant difference in the attitude of teachers to ICT based on subject discipline.
4. There is no significant difference in the attitude of teachers to ICT based on gender.
5. There is no significant difference in the attitude of teachers to ICT based on years of experience.

### Discussions

The discussion of this study was derived from the findings of the study. Firstly, the study revealed that teachers' qualification has a significant influence on teachers attitude towards information and communication technology, this is because the result revealed that teachers with higher qualifications fosters higher attitude this

could be related to the views of Becta (2002) who recognize exposure and literacy as determinant of attitude toward ICT.

Secondly, the study discovered that age has a significant influence on teacher's attitude toward ICT in the outcome. It was shown that there is an inverse relationship between age and attitude towards ICT. Those whose ages are between 41-60 had higher number (60%) showing positive attitudes, only (38%) of those within ages (20–60) showed positive attitudes towards ICT, the reasons this could be related to experience who (71%) were positively inclined towards ICT. Again, gender was shown to have a significant influence on the attitude of teachers towards ICT. This finding corroborate with those of Bradley and Russell (1997), the report of the European community (2003) and Vitehez (2002). However, of significant is the influence of subject specialization. In this area, science teacher were seen to have shown the highest positive attitude towards information and communication technology. This ought not to surprise anybody as ICT is related to science disciplines and knowledge in science would be beneficial to understanding the concepts in ICT, thus influencing a positive attitude towards the concepts.

With the above, it would be seen that the demographic indices such as qualification, age level, subject specialization, gender and years of experience among the teacher respondents were tested and the outcome was that all these indices could significantly influence attitude towards information and communication technology.

## Conclusion

The study therefore generated these conclusions that there is no significant difference in the attitudes of graduate and NCE teachers to ICT; there is no significant difference in the attitude of teachers to ICT based on age groups; there is no significant difference in the attitude of teachers to ICT based on subject discipline; there is no significant difference in the attitude of teachers to ICT based on gender and there is no significant difference in the attitude of teachers to ICT based on years of experience.

## Recommendations

In view of the finding of the study, the following recommendations were made:

- i. Government should encourage the use of modern technology in form of computer services providing funds to schools or through the ministry of education purchase computer machine, and make them available to all public schools as operating in some private schools.
- ii. Government should also employ computer teachers who will not only teach the students but need to be computer literate
- iii. There is the need for a maintenance culture and thorough supervision with these concepts, information and communication technology ought to be given priority among teachers and students.
- iv. Parents, old students association and other stake holders in our educational system could also contribute to the application and orientation of information and communication technology services; they can do this by donating ICT hardware and software to schools. This will help in motivating the teachers and encourage the school authority.

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## **The production of documentary as teaching material for basic education**

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### **Abstract**

*Nowadays it is unquestionable that audiovisual has become a widely used tool for the development of knowledge in the classroom. Based on this assumption, the research that I have developed aims to produce documentaries as helping diffuser product and content for students of Basic Education and also as a form of training, put graduate students to deepen the practices developed in the classroom. The audiovisual aid that will be developed is the documentary which will be the matrix for the development of teaching material that fits the process of cognition between teachers and students. This will be achieved through the interaction between University and Basic Education Institutions and will include the involvement of teachers and students. The activity is of extension and social order and aims to promote integration between the University and the Basic Education Institutions for the development of teaching materials.*

**Keywords:** Documentary; audiovisual; educational materials; interaction.

### **1. Introduction**

Based on experiments in the area of Social Communication as a university professor in disciplines involving the audiovisual discourse as news and informative elements, I realized that activities in the classroom could expand and move to a heading of educational content composition that could be used as support for the enrichment of education. This concern arose when a group of students produced a documentary on the theme "Bonete, a lost paradise" that addressed customs and habits of a community located on the coast of São Paulo. It is an ethnographic view that focused on awareness of the importance of preserving the culture of this fishing community. The documentary showed a profile of the routine of a group of people that fight for survival through fishing. This documentary material, made me consider that the University could expand their extension activities for schools of basic education, as a provider of content through audiovisual products in a didactic line, that is, to develop products that would help as a tool in the process of education.

However, this extension process would also have the integration between university and basic education institutions, leading teachers and students to carry out an integrated project involving both institutions. In this sense, graduate students of Journalism and Liberal Arts courses would participate as content producers covering the areas of History, Science, Citizenship, Sociology, Anthropology, Arts and Health.

The audiovisual product revealed with this experiment is the documentary that will be the form of knowledge production related to issues that are relevant to the main themes of each subject. Thus, as Paulo Freire said, the documentary is a way for the study. "Consider, for example, the extraordinary advantage that today's historians – who rely on documentary films of historical facts – have on yesterday's historians. [...] Today this form of documentation offers the historian an extraordinary instrument to understand his studies. "[1]

The documentary is a filming genre that allows, through projects of creative and experimental actions, the composition of educational contents with appropriate language to the cognitive needs of students who attend Basic Education.

Thus, all the documentary composition process, as teaching material, would be interconnected with the participation of teachers and students from University and Basic Education. Therefore, the construction of content goes through a process of interaction at both levels of education that would provide the performance of activities and practical exercises, for college students, and theoretical material for students of Basic Education.

## 2. Development

The documentary is a filming genre that has been presented in classrooms at all levels of education as a helping tool for cognitive development of the student body. However, the use of a particular documentary must be completely articulated to the reality of the particular subject program content and, therefore, a whole process of preparing and structuring must be linked interactively with the institutions concerned with the production of this teaching material. Thus, the preparation of the documentary must be directed to a broad learning process that would involve a team consisting of teachers, professionals in the audiovisual area and students interested in putting this activity into practice. Despite being a didactic material the production of the documentary would not be linked to any subject of Journalism and Language and Literature courses not to be contaminated by methods and concepts that act as evaluative elements to the student. It would indeed be an autonomous form of evaluation related to a particular group of University extension that works with social activities.

For the viability of the process it would be necessary to have the implantation of an adequate infrastructure to carry out all activities for the realization of this production task. Besides physical space and the composition of people involved, the University would provide audiovisual equipment for holding all the documentary production process. Regarding the people who will participate in all the development of the audiovisual piece, one should think of an asset with members that have a commitment to the success of the project so that it can be accomplished well. Some members would be effective for the management of the entire process, and others would participate as advisers invited to perform a certain documentary. Thus, the effective staff would count on the participation of two teachers from the Journalism area, two from Languages and Literature and six students from University. The invited members would be Basic Education teachers who accompany the entire making of the documentary as advisers. Some students of Basic Education also follow the production as a way of learning. An important point to consider is that the audiovisual product is performed by a collective work process, that is, each member does his part and moves to the next to make progress in the process. This way all operational methodology has to be well planned, which means that each member has to know exactly what he has to develop for the success of the project. The team would receive a compositional constitution formed by coordinators, advisers, producers and technical team. The functional organization chart would look like this:

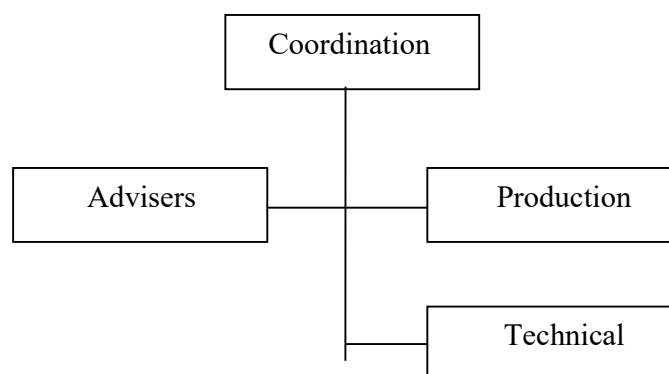


Figure 01: Activity chart

The ones responsible for coordination must have a deep knowledge in audiovisual language as they will have the task of managing the planning stages, pre-production, production and post-production. In that case, a professor of journalism course would be responsible. Also included in the coordination, to perform the script process, construction of narrative and discourse analysis, a professor connected directly to the area of Languages. The team of advisers would be composed of basic education teachers who would help in the planning process, which includes the preparation of the script, and providing advice on the content that will constitute the documentary narrative. Other important contributors would be college students who would put all the planning and production into practice. Along with the college students, students of Basic Education would participate in the process as apprentices.

This way the whole process for developing the documentary as teaching material would involve a wide learning process for all this large number of people involved. As for the teachers, updating about the topic and methodology, which would apply to every situation in the development of the product, would involve them in the production of research for the content. As for the students, besides participating in the research, they would be putting elements learned in their courses into practice, in addition to developing new techniques through practice. All this experiment would be successful within educational contexts that would put teachers and students in research, reflection and interpretation positions.

### **3. The Documentary as a content source**

In Brazil, former President Getúlio Vargas created in 1936 the National Institute of Educational Cinema (INCE) to produce educational films to be distributed in schools around the country. The INCE acted for thirty years and was a landmark by setting up a new perspective on teaching in the classroom. The traditional way of teaching, taught by teacher's explanation, books and photographs, received the support of film language as a way of spreading content. INCE conducted more than 400 educational films and documentaries mostly in short-feature movie. Thus, the documentary is a tool for research and materials for teaching to be respected as a representative documentation of historical and scientific facts originated through investigative and experimental work.

The documentary is a film genre and had as its starting point the film *Nanook of the North* of the American filmmaker Robert Flaherty. According to Barbosa and Cunha, "*Nanook of the North* was the first film to which we applied the term documentary, coined by John Grierson, British filmmaker in the 1930s who defended the creation of a specific film genre, concerned about the representation of reality. Flaherty was an amateur filmmaker and traveler, exactly the kind of job profile from which modern scientific anthropology wanted to keep distance from in this period of consolidation of new paradigms in the subject." [2]

The documentary shows a representation of Nanook's (an Eskimo) and his family's way of life, in the Bay of Hudson. The documentary was launched in 1922 and presented to the public this family's hard fight to survive in a Canadian region surrounded by the Arctic Circle. However, Flaherty's documentary is known to have been scripted and performed so that he could portray a representation of the reality experienced by Nanook's ancestors. By the time it was shot, Nanook's people already used equipment for hunting brought by white merchants. It was obvious that the white man's culture had changed the traditions of the Eskimos and this is emphasized at the beginning of the documentary. Barter was a form of trading goods, white merchant exchanged weapons and tools for skins of foxes and bears that later were sold in Europe. With these facts, Flaherty would not portray the primitive essence of survival of these Eskimos. So he decided to script the documentary creating situations experienced by Nannok ancestors. Thus, they used fictional movie elements such as direction of scenes, scenarios (igloo) and the use of native characters to build a family to Nannok since he was single.

Despite the fictional elements, *Nannok of the North* is considered the first documentary in film history. Its originality as a documentary is linked directly to the reconstitution process, often used in documentaries that portray historical facts. So, according to Ramos, "as it proposes to establish assertions about the historical world,

the documentary will be dealing directly with the reconstruction and interpretation of a fact that in the past, had the intensity of the present." [3] This form of documentary does not lose credibility because it is based on research in most diverse areas. Thus, if the documentary deals with the reconstruction and interpretation of a certain fact, its characteristic is the prevailing fact for the production of educational materials for schools. On the issue of the documentary *Nanook of the North*, reconstitution was the tool that was found by Flaherty for the construction of a narrative composed of values and parameters for understanding how the ancestors of the Eskimos lived without the cultural influence of the white man.

Another question about the documentary is related to the feeling of veracity that this genre has built, through its own history. What is being shown has realistic origin due to register through image and sound. According to Nichols, "the documentary tradition is deeply rooted in its ability to transmit an authenticity impression. This is a strong impression. It began with the rough film image and the appearance of movement: despite the poverty of the image and the difference compared to the photographed thing, the appearance of movement remained indistinguishable from the real movement. " [4] However, the documentary is not only an evaluative image product but also, similarly, highlights sound elements in its aesthetic and discursive composition. Due to this, the documentary consists of a language that reaches the viewer through auditory and visual sensory perceptions that are intertwined by means of codes to transmit a certain message.

#### 4. Planning of didactic documentary

The production of a documentary for educational purposes demands planning for the whole implementation process to achieve its expectations and goals with excellence and quality. The organization of the entire pre-production, production and post-production, must be planned and organized to avoid obstacles that may hinder any stage of the process. However, before any planning, the University should have some links, or partnership, with some Basic Education institution that is interested in participating in the realization of educational material in the documentary format.

After the partnership a team should be established as working group to assess the needs that the development of the documentary will require. In a first meeting the teachers of the University, responsible for coordination, should develop a process of working with teachers of Basic Education, advisers, to determine the content of the documentary and how it should be approached. With this information, the working group will determine a research process that will identify elements for the composition of the documentary approach. At that stage, the participation of advisers is the most important, because, within that group, there should be the presence of teachers, specialists on the topic discussed. So with the content of results of the research, the working group will have the necessary basis for the elaboration of a first draft of the script.

Although most documentaries do not have a finished script, the didactic documentaries allow the elaboration of a script for being a product that hardly find factual actions that may interfere with the process. According to Puccini, "Historical, biographical, or file documentary that deals with past events, can be very well written before filming begins." [5] Therefore, it is essential that, at that stage, the coordinator from the Language Course and advisers meet the producers to write the first draft of the script and then the final product.

After approval of the script, coordinators, advisers and producers will conduct a thorough technical reading, that is, page by page, and scene by scene, to survey all the necessities for the accomplishment of the project. Everything must be reported in a pre-production map, including the distribution of tasks for the ones who are responsible. In fact, this map shows the needs and measures that will be taken before the production steps. Thus, all kinds of necessary documentation, such as statements, contracts, permits for filming in certain locations must be reported to be provided in the pre-production process. The use of outdoor and studio should also be on the list of measures together with the transport and equipment needs. The list is fundamental and its content is related to the dimension of the final product.

## 5. The production of the documentary

After the planning phase, we begin the pre-production phase which is the first step in the production of the documentary. The production team will receive a list of tasks properly connected to a schedule to be followed rigidly so that the goals are met in the pre-set deadline. According to Marques, "pre-production is roughly the period in which everything must be prepared, negotiated, studied for the camera to start and the film is carried out with a minimum margin of unexpected events". [6] In this phase, the team will contact all people who will participate as sources of information and set dates for the interviews. Another measure is related to external locations and studios in documentation issues and scheduling.

However, it is in this pre-production phase that the students, the technical team, will have workshops on audiovisual language. These workshops should provide instructions on frameworks, movements and camera positioning that are to be used in generating the documentary. The students of Basic Education will also have the same learning, however, to work on the realization of a *making-of* to record the entire process.

After all the arrangements were made, the technical team will start work. They will hold all the pictures and sound capture process. It is the stage where the documentary will be made and will test all the planning and pre-production. In this sense, the team of producers will also participate in this phase to ensure the smooth progress of production. Producers will now assist at the time of the recordings as *plateau* producers to be responsible for equipment, moving of technical staff, rent, food, reception of the characters, etc. They will provide everything for the technical team to perform the recordings safely and accurately. All members of the technical staff should have a clear idea of what will be done and work together with the *plateau* producers during the recording.

Finally, there is the phase of post-production in which all the captured material will be analyzed and cut to be delivered to the technical team that will perform the editing and finalization of the documentary. Here, the production team has already provided the extra material that will be part of the documentary, as archive of images, photography, animations, sound effects, music, etc. However, after completion of the documentary, it must be shown to a limited audience who will have the task of evaluating all contents.

## 6. Final Considerations

In view of the arguments presented, it is clear that the audiovisual, in the documentary genre, is a tool that can be used as a learning process in different educational levels simultaneously. Being a universal product, i.e., it covers any area of knowledge, the documentary can be a tool for diffusion of activities, theoretical and practical, for students of Basic Education and the University.

Integration is the matrix that will expose the University in a socio-educational activity regarding the production of content that may be used as a teaching supplement in the educational institutions of our country. Thus, the interaction appears as an inter-institutional path that will promote actions that will value the cognitive processes related to the contents and production of the documentary. The entire production process is based on the plurality of knowledge from each teacher training and through the experiences developed by college students. However, Basic Education teachers actively participate with knowledge of their respective areas.

The whole process is motivational to stimulate and encourage teachers and students to diversify the production of contents and the teaching/learning process.

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# Impact of Real-time, Electronic, Formative Feedback: Using InkSurvey as a Collegiate Learning Tool In Engineering Statistics

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## Abstract

*This paper describes the impact of InkSurvey in a college classroom, as a tool to formatively shape instruction. Tablet personal computers (PCs) were distributed and the InkSurvey software was used for the instruction of a Probability and Statistics Course for Engineers. Using InkSurvey, instructors are able to view student responses and use this information to alter instruction in real-time, immediately addressing students' learning needs. Data was collected from volunteers using the following methods: a pre and post concept inventory on statistics, a pre and post attitude survey, and an anonymous, end of the course, student assessment survey. The results of this study support that students' concept knowledge, as measured by the Statistics Concept Inventory, and the students' attitudes, as measured by the Attitudes Survey, both validated instruments, became more positive with respect to statistics over the course of a semester.*

## 1. Introduction.

Today's college students are accustomed to and comfortable with technology being integrated into all facets of their lives. Entering college students have interacted with technology since they were children, both through formal education and out of school experiences. College faculty who grew up during a different period may neglect technology as a resource, preferring traditional teaching methods, such as overheads and white boards. Yet, technology can provide advantages over these traditional methods, including the documentation of classroom instruction for later student review and the conversion of a passive classroom to an active one. Colleges and instructors are including technology in classrooms as a means of improving instruction, retention, and attitudes. Research is underway in an effort to identify the most effective pedagogical approaches (Probst, 2014). This article examines the impact of a method of embedding technology, viz. InkSurvey and Blackboard, on a daily basis, into the college level course for engineers in probability and statistics.

The sections that follow include an overview of how current students are likely to experience technology in the classroom before they enter college, and of college efforts to embed technology into instruction. This is followed by a review of the assumptions that inform college instruction and learning and how these assumptions can be supported through the use of the InkSurvey software and Blackboard. Next, the research methods used here and the results of these efforts are discussed. This article concludes with a description of the potential impact of this work for college level instruction.

### 1.1 College Students' Prior Experiences: Technology in Precollege Education

Ontario schools provide an example of the experiences that some students have with technology before entering college. Seventy nine percent of the kindergarten classrooms in Ontario reported the introduction and use of computer technology as part of the learning process (People for Education, 2014). In the U.S., as of 2003, 80% of kindergarten students reported using some type of computer and 32% reported the use of the internet; amongst high school students, 97% reported using the computer and 80% reported using the internet (National Center for Educational Statistics, 2005). In 2009, 97% of public schools in the U.S. reported the availability and use

of the computers in the classroom (Gray, Thomas & Lewis, 2010). Many of the students included in the kindergarten sample in 2003 are now ready to enter college. Their then older peers, first through twelfth graders, may already be in college or have completed college. Pre-college students also report the use of hand-held and tablet PCs with pen-based entry to support the completion of comprehensive digital notes (Frolik, 2004; People for Education, 2014).

The details of how these machines are used during instruction are not clear. In Baltimore County Public Schools, through the support of HP, 120,000 PCs were distributed for teacher and student use in the fall of 2014 (Christensen, 2014). As more elementary and secondary schools embrace the use of technology as a natural component of instruction, more college students will expect technology to be integrated into the university experience. The use of traditional overheads and white boards, and the necessity of maintaining scrupulous notes, are likely to be confusing to students who have experienced a technology rich precollege education. As precollege instruction increases the use of technology in the classroom, colleges will be expected to respond in a similar manner.

## **1.2 Technology at the University**

Many universities have responded to the anticipation of the arrival of technology savvy college students. Georgia Institute of Technology developed Classroom 2000 in the mid 1990s as an electronic resource to capture college level, classroom lectures (Abowd, 1998). This project continues today with a revised and period-appropriate name, eClass (Brotherton, 2001; Georgia Institute of Technology, 2014). eClass captures lectures by storing the instructor's audio and visual notes online for later review by the students. This approach makes it easier for students who attend class to maintain pace with the lecture while limiting the demand for note taking; students who miss class also have an online resource to assist them in making up the material. Various platforms are available to organize and post instructors' notes and videos, including purchased programs, such as Blackboard (Blackboard Learn, 2015), and free access versions, such as Moodle (2015). Often these platforms are coupled with other modes, such as YouTube, Smart Boards, etc., to provide students with more complete resources and information.

eTeach at the University of Wisconsin supports a different approach for transferring information from instructor to student, referred to as the "flipped classroom." The term "flipped classroom" has come to represent Moses and Litzkow's approach to instruction (2000; Anderson & Litzkow, 2008) in which students view online videotapes of a lecture before class. In class, the students participate in active problem solving. The classroom is called "flipped" because instruction occurs at home and homework is completed in class with the instructor available for questions. This flipped classroom approach to learning has been criticized by Bogost (2013) for being a "condensed" classroom or a classroom in which lectures are streamlined into morsels, and delivered in a manner that is similar to textbooks. Whether lecture is delivered in the classroom or via video at home, the learning process during the lecture is most likely passive. Students passively listen to an instructor either during class or while watching a video. The approach that is discussed in this article is different in that the students are actively engaged in lecture by responding to questions that the instructor posts on InkSurvey.

## **1.3 Assumptions of University Instruction**

Reflecting on traditional instruction, online instruction, and the flipped classroom, several conclusions can be drawn as to the premises that underlie college learning environments regardless of whether technology is included:

- Lectures in some form continue to be necessary, whether they are delivered in person or by video. Lectures provide a method of introducing new material to students in an efficient manner.

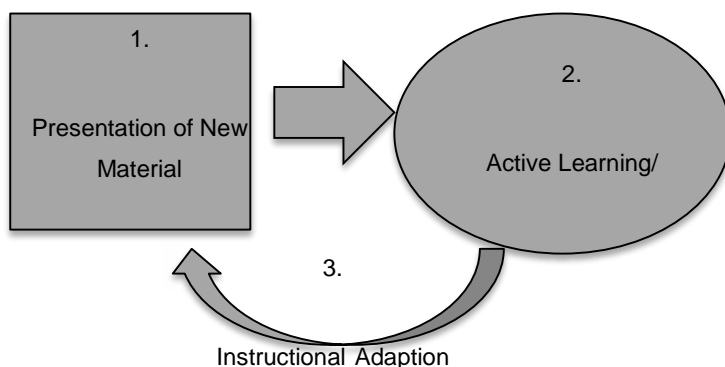
- Students require active learning experiences, either in class or at home, in which they practice the process of applying their knowledge to problem solving situations.
- Active learning, or learning that engages students' interests and attention, is more effective for improving students' knowledge than is passive learning, or listening to instruction while taking notes.

The current article supports the addition of the following:

- Faculty are better able to support their students' learning needs when they have formative information concerning their students' knowledge base which can be used to dynamically adjust instruction to the learners' needs.

This final assumption separates the efforts described here from the previously described work. Most videos do not evaluate and adjust to the knowledge of the students who view them. When formative assessment information is available, faculty may change their instructional approach based on students' needs, creating a more efficient and effective learning environment.

These assumptions of learning lead to the model of instruction adapted to learning that appears in Figure 1. The first step in the process is student exposure to new material. This typically occurs through a lecture, which is viewed by students during class or before class via video. During the next phase, students participate in active learning, which usually includes problem-solving activities. Based on the student responses during active learning, the instructor can adjust and adapt instruction to match the students' learning needs. The cycle repeats throughout the learning process as new material is introduced. A shorter cycle is likely to result in a more efficient learning process, especially when the instructor has the information that is necessary to dynamically adapt to and address students' learning needs.



**Figure 1.** Model of instruction adapted to learning

#### 1.4 InkSurvey Software

InkSurvey was developed at <Blind> under a HP Technology for Teaching grant with the purpose of supporting the formative assessment of students' understanding of lecture material while lecture was being delivered (Kowalski, Kowalski & Hoover, 2007). InkSurvey is web-based and permits the instructor to post questions to which students respond during lecture. Students can respond by typing or pen-based entry, as is more likely in probability and statistics. Other software, such as Classroom Presenter (Anderson et al., 2007), is available to support similar classroom purposes. InkSurvey was selected for use in this investigation rather than comparable software for the following reasons: i) InkSurvey was developed at <Blind>, providing local support for the software, and ii) InkSurvey is available via the internet without the requirement that additional software be downloaded to individual computers. Through InkSurvey, the students' classroom problem solving approaches are transformed into information that may be used immediately by the teacher to inform the direction of

instruction. The cycle described in the previous section is reduced to a minimum length, allowing the teacher to acquire formative information from students multiple times during a single classroom event. Blackboard was used in this investigation to post an outline of the class notes, reducing note taking to a minimum.

### **1.5 Research Questions**

The research questions that were investigated here are as follows:

1. As measured by the Statistics Concept Inventory, do students' concept understanding change from the beginning to end of a course that utilizes InkSurvey and Blackboard in the instruction of probability and statistics for engineers?
2. As measured by an attitudes survey, do students' attitudes with respect to probability and statistics improve following a course that utilizes InkSurvey and Blackboard in instruction?

## **3. Material and Methods**

This section provides an overview of the course, instructor and its' students. Next, a description of the instructional and the assessment approach is provided.

### **3.1 Course, Instructor and Students**

The data presented here was collected in the Spring of 2013 as part of the Probability and Statistics for engineers course at <Blind>. Probability and Statistics for engineers is a junior level course that is required for most engineering majors. The course textbook was "Statistics for Engineers and Scientists" (Navidi, 2010). The course instructor had 18 years of experience and had previously taught this course on seven occasions. On two prior occasions, this instructor had used InkSurvey and Blackboard jointly to support instructional learning. Additionally, this instructor had oversight of the initial implementation of InkSurvey in this course in 2011 (Blind). At the time of this investigation, she was already familiar and comfortable with the capabilities and use of the software in the classroom.

There were 38 students registered for this course. All students were majoring in science or engineering undergraduate degree programs at <Blind>. The students were not expected to have their own computers; rather, tablet computers were distributed to students who requested them at the start of the semester. Some students brought and used their own machines, including iPads and other hand held devices. All students had a machine that supported pen-based entry.

### **3.2 Instructional Approach**

The primary approach to instruction used in this investigation was lecture. Lecture occurred twice per week, for one hour and fifteen minutes. An outline of each day's notes was created by the instructor in Word and posted in a PDF file on Blackboard for student access; registered students had the opportunity to download, print or review these notes before each class or during class. The online PDF notes are available upon request from the first author. The solutions to practice problems were omitted from the posted course notes. The students, using the InkSurvey software, completed these problems in class and submitted solutions anonymously to the instructor. The complete file of submitted responses appeared on the instructor's computer screen immediately following submission, and was reviewed by the instructor in real time by scrolling through responses.

The students were permitted to work individually or in pairs when completing in class problems, but were asked to submit individual responses. The instructor projected the online responses to a screen during class and discussed both correct and incorrect solutions. When necessary, the instructor used the student errors to identify

material which needed to be discussed in greater depth. The instructor added follow-up problems when necessary or reduced the number of problems based on the students' submitted solutions. In other words, the use of the InkSurvey software resulted in the adaption of instruction in a dynamic manner based on student learning needs.

On average, the students completed a problem and submitted a solution through InkSurvey three times within a 90 minute instructional session. Approximately half of the attending class typically submitted a solution. Students had the option of writing anonymous questions to the instructor in place of a response if they were confused or required further information to complete a given problem. The instructor became proficient at quickly reviewing student responses and identifying correct and incorrect approaches.

### **2.3 Assessment Instruments**

All students were invited to complete the online pre and post concept inventory and attitude survey during the first and last two weeks of class, respectively. Participation was voluntary and the instructor was not aware as to which students selected to participate. Both the concept inventory and the attitude survey were administered using the CiHub. Prior research supports each instruments' validity and reliability for use in the college classroom (Stone, Allen, Rhoads, Murphy, Shehab, & Shaha, 2003; Allen, 2006; Wise, 1985). The concept inventory contained 38 questions which directly addressed the material that was covered during the course, including probability, inference, and graphical representation of data (Allen, Reed-Rhodes, Terry, Murphy, & Stone, 2008). The survey was scored based on the number of correct answers.

The attitude survey was comprised of 29 statements about statistics, using both positive and negative phrasing (Wise, 2008). The survey was scored using a four-point Likert scale, ranging from 'Strongly Agree' to 'Strongly Disagree.' No neutral option was available, forcing students to determine whether they agreed or disagreed.

Student feedback concerning the use of the InkSurvey software was also collected as part of the end of the semester course evaluation. All feedback was anonymous. The course evaluation consisted of eleven statements addressing the effectiveness of the course and the instructor. Response categories ranged from "Strongly Agree" to "Strongly Disagree" and included a "Not Applicable" option. The survey further included three open-ended questions, in response to which students could provide unstructured comments concerning the course.

## **4. Results**

### **4.1 Concept Inventory**

Sixteen of the 38 registered students completed both the pre and post Probability and Statistics Concept Inventory. As Table 1 indicates, the majority of students' performances improved from pre to post-test with an average difference from pre to post of 12.2%. Only two students, student 3 and student 9, displayed either a decrease in performance or no change. Students average performance on the pretest was 47.7% and on the posttest 59.9%. The average posttest performance with student 3 and student 9 removed is 63.5%. Given that concept inventory was not created by the instructor, this level of performance on an externally developed assessment is acceptable (especially given the witnessed increase from the pretest as is described in the next paragraph).

Given the data is paired and the sample size is small, a probability plot was created across all students of the paired differences and trend line was fitted. This resulted in an  $r^2 = 0.89$ . Based on this, an assumption of normality is likely to be appropriate and a paired t-test was selected for analysis purposes. A one-tailed, paired t-test was completed and resulted in a statistically significant result, with  $p = .001$ . It can be concluded that students' average posttest scores were statically greater than their average pretest scores on the concept

inventory. Students' average performances, as measured by the concept inventory, improved over the course of the semester at a statistically significant level.

**Table 1. Summary of student knowledge of statistics course material.**

	Pre-Test		Post-Test		Percent Difference
	Percent	Rank	Percent	Rank	
Student 1	47.4	Moderate	65.8	Moderate	18.4
Student 2	55.3	Moderate-high	71.1	High	15.8
Student 3	50	Low-moderate	23.7	Low	-26.3
Student 4	55.3	Moderate	60.5	Moderate-high	5.2
Student 5	65.8	Moderate	81.6	Moderate-high	15.8
Student 6	39.5	Low-moderate	63.2	Moderate	23.7
Student 7	34.2	Low	52.6	Low	18.4
Student 8	36.8	Low-moderate	44.7	Low-moderate	7.90
Student 9	65.8	Moderate	65.8	Moderate	0.0
Student 10	44.7	Low-moderate	73.7	Moderate-high	29.0
Student 11	36.8	Low-moderate	42.1	Moderate	5.3
Student 12	52.6	Moderate	65.8	Moderate-high	13.2
Student 13	34.2	Low	50.0	Moderate	15.8
Student 14	31.6	Low	34.2	Low	2.6
Student 15	57.9	Moderate-high	89.5	High	31.6
Student 16	55.3	Low-moderate	73.7	Moderate	18.4

## 4.2 Attitudes Survey

Sixteen of the 38 registered students also selected to complete the Attitudes Survey. Students' average responses for each statement that appeared on the attitudes survey are displayed in Table 2 and Table 3. Table 2 contains all of the positively phrased statements and Table 3 contains all the negatively phrased statements. As indicated in Table 2, on average, the students' responses were more positive with respect to their own need to learn statistics as a professional after the course than before the course. For the majority of the positively phrased statements, the average response across students increased. Only one statement out of fifteen displayed a decrease from pre to post assessment and one statement displayed, on average, a half-point gain from pre to post assessment.

**Table 2. Summary of student attitudes toward statistics on positively phrased statements.**

Positive Statements	Pre-Test Score	Post-Test Score
I feel that statistics will be useful to me in my profession.	3.2	3.2
A good researcher must have training in statistics.	3.2	3.5
Most people would benefit from taking a statistics course.	2.9	3.0
I would like to continue my statistical training in an advanced course.	2.2	2.3
Statistics will be useful to me in comparing the relative merits of different objects, methods, programs, etc.	3.1	3.1
Statistical training is relevant to my performance in my field of study.	2.9	3.0
Statistics is a worthwhile part of my professional training.	3.0	3.1
Statistics is an inseparable aspect of scientific research.	3.3	3.4
I am excited at the prospect of actually using statistics in my job.	2.6	2.7
My statistical training will help me better understand the research being done in my field of study.	3.0	3.1
One becomes a more effective consumer of research findings if one has some training in statistics.	3.3	3.3
Training in statistics makes for a more well-rounded professional experience.	3.2	3.3
*Statistical thinking can play a useful role in everyday life.	2.9	3.4
I feel that statistics should be required early in one's professional training.	2.9	3.1
#Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.	2.3	2.1

# Marks statements in which students' attitudes declined from pre to post assessment.

\*Marks statements in which students' attitudes increased more than 0.5 on average from pre to post assessment.

The students' responses to the negatively phrased statements were reverse coded, so that a higher average indicated a positive attitude. This allows the reader to look across the table for increasing values from pre to post assessment in order to identify improved attitudes. Out of the fifteen statements, only two displayed a

decrease in the students' attitudes toward statistics. Three of the statements, on average, displayed at least a half a point increase from pre to post assessment. These are marked.

**Table 3. Summary of student attitudes toward statistics on negatively phrased statements.**

Negative Statements	Pre-Test Score	Post-Test Score
*The thought of being enrolled in a statistics course makes me nervous.	2.0	2.5
#Statistics seems very mysterious to me.	2.5	2.4
I have difficulty seeing how statistics relates to my field of study.	2.0	2.2
*I see being enrolled in a statistics course as a very unpleasant experience.	2.1	2.7
Statistics is not really very useful because it tells us what we already know anyway.	1.8	2.1
*I wish that I could have avoided taking my statistics course.	2.2	2.7
Statistics is too math oriented to be of much use to me in the future.	1.8	1.9
I get upset at the thought of enrolling in another statistics course.	2.2	2.6
I feel intimidated when I have to deal with mathematical formulas.	1.7	1.8
Studying statistics is a waste of time.	1.8	2.0
Dealing with numbers makes me uneasy.	1.6	1.7
#Statistics is too complicated for me to use effectively.	2.0	1.8
Statistical training is not really useful for most professionals.	1.9	2.2
Statistics is not really very useful because it tells us what we already know anyway.	1.8	2.1
Statistical analysis is best left to the experts and should not be part of a lay professional's job.	2.0	2.1

Note: Categories were reverse coded, resulting in a higher number indicating a more positive attitude.

# Marks statements in which students' attitudes declined from pre to post assessment.

\*Marks statements in which students' attitudes increased more than 0.5 on average from pre to post assessment.

### 3.3 Course Evaluation

Eighteen students completed the end of the year course evaluation. The student responses to the selected response portion of the instrument are displayed in Table 4. As indicated by this table, the students' evaluations of this course were positive. None of the students indicated disagreement with any of the statements.

**Table 4. Summary of student evaluations of probability and statistics course.**

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Not Applicable
The teaching methods used in this course are effective for promoting student learning.	8	7	3	0	0	0
The instructor explains the material clearly.	7	9	2	0	0	0
The instructor is available during office hours.	7	9	2	0	0	1
The instructor creates an environment that fosters student involvement in the learning process.	10	7	1	0	0	0
The instructor demonstrates a positive attitude toward helping students.	9	8	1	0	0	0
The instructor facilitates student learning.	9	8	1	0	0	0
Graded work reflects the content of the course.	8	9	1	0	0	0
The stated grading policies for this course are fair.	8	9	1	0	0	0
The course goals are clearly stated.	5	12	1	0	0	0
The course goals are being met.	6	10	2	0	0	0
Overall, this instructor is effective.	6	10	1	0	0	0

The course evaluation also included three open-ended questions:

1. What aspects of instruction in this course do you find are effective for promoting your learning?
2. What recommendations would you make that would improve the instruction that you are receiving in this course?
3. If you have any additional comments, please write them in the space below.

Open-ended responses were coded for emergent themes. Some of the student responses to these open-ended questions pertained to the use of tablets and InkSurvey software during the class. These themes and the responses that fell within each are summarized below. Only one student expressed dislike for InkSurvey. Several students indicated that they liked InkSurvey and others indicated that they enjoyed the interactive examples provided in class. Negative comments included requests for more detailed explanations of the problems discussed in class; it is unclear as to whether these request were related or reflective of the use of the software in class.

**Table 5. Student comments about the technology in the course.**

Positive		Negative	
Comment	Number of Times Recorded	Comment	Number of Times Recorded
General liking of InkSurvey.	3	General dislike of InkSurvey.	1
Liked use of interactive example problems during lecture.	2	Requested more explanation of the solution to example problems.	3
Liked increased class involvement.	2	Found example problems too difficult to be helpful.	1
Liked lecture notes posted online.	1		

#### 4. Discussion

The results of this investigation support the assertion that InkSurvey combined with Blackboard can be effectively used to support instruction in a college level engineering course on probability and statistics. The students' concept knowledge, as measured by the Concept Inventory, and the students' attitudes, as measured by the Attitudes Survey, became more positive with respect to statistics over the course of a semester. Although the first of these results would be anticipated (that students would learn the course material), prior research with respect to this same course, taught at the same university, and including the same instructor challenge this assertion.

In the spring 2011, a study was completed using InkSurvey across all Probability and Statistics courses offered at <Blind>. Out of five sections, four displayed no change or a decline in student performances as measured by the concept inventory from pre to post assessment. Only one instructor's students displayed a modest increase in students' performances and that was not the instructor who participated in the current investigation. The current instructor's students displayed no change in knowledge and a decrease in attitudes from pre to post assessment in 2011 investigation. Yet, the pedagogical approach used in 2011 by this instructor was similar, in fact almost identical, to that which was used in 2013. All course notes were posted on Blackboard and the students responded to approximately three questions per class through InkSurvey. In the 2011, implementation, however, Tablet PCs were distributed at the beginning of class and collected at the end of class. The cost of these machines prohibited the students from checking them out for the semester. By 2013, tablets with pen-based stylus and touch screens replaced the tablet PCs and were available at an affordable cost (~\$150). These machines were loaned to the students for the semester.

In the article that was written concerning the 2011 implementation (2012), the researchers speculated that the implementation of pedagogical change, any pedagogical change, requires time for both the instructors and the students to adjust. The participating instructor has implemented this approach in three separate offerings of the course, with the current investigation being the third. As was reported here, the anticipated increase in performance was statistically captured in the respective instructor's course. Other factors that may impact the results of this investigation include a changing student population, with each year bringing students with greater technological experience, as well as changes in the technology that is used, such as movement from Tablet PCs to Touch Screen Tablets with Pen-based entry. Any or all of these factors could explain the differences that were witnessed here between the 2011 and 2013 findings.

This raises an important concern as technology is introduced and tested in the classroom. Technological pedagogical approaches that failed in the past may, due to changing students' skill bases and improvements in interface design, succeed in the future. As was argued by Probst (2012), students who have been raised with

computers are likely to have different learning preferences from those who were raised without computers. These preferences are just beginning to display themselves at the college level. Additionally, as students receive more opportunities to use computers in the precollege classroom, they may demand the opportunity to use technology in the college classrooms. This next generation, or possibly the one that follows, may enter college not knowing how to take detailed hand-written notes. What was once a valuable skill may become outdated and replaced by online notes and video discussions. College professors need to prepare.

Some college instructors are responding to the learning needs and expectations of this generation of students by making better use of technology in the classroom. One trendy example is the implementation of the flipped classroom where faculty prepare a lecture online, the students watch this video at home, and during class the students complete reinforcement problems with the instructor's support. This method requires the creation and posting of videotapes online. Faculty may not know how to create and post a video, and some may be resistant to archiving their image online. InkSurvey combined with Blackboard offers a different to enriching the classroom through the use of technology. Instruction is documented through the availability of online notes and active learning and formative instruction are supported through InkSurvey.

#### 4. Conclusion

In most college classrooms, traditional lectures continue to thrive. This article and the approaches describe here do not challenge the traditional methods; rather, this research supports the enhancement of traditional approaches through technology. Most faculty members know how to lecture and evaluate student responses. InkSurvey supports faculty members in using these skills in real time to improve student learning by shortening the instruction adapted to learning cycle. The feedback to the students is almost immediate as is the instructor's adaption of instruction to match student needs. As with any instructional change, there does appear to be a learning period of at least a semester in which the course instructor practices and learns the new methodology. As is discussed here, measurable change was detected in student performances and student attitudes during the third implementation of this approach.

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