International Journal of Education Humanities and Social Science

ISSN: 2582-0745
Vol. 3, No. 03; 2020

# STATISTICS CONFIDENCE INTERVAL CONCEPT MOTIVATION: A CONTEXTUAL LINK PROBLEM APPRAISAL FOR ADULT LEARNERS AND EDUCATORS

**Emmanuel Chinamasa**
Chinhoyi University of Technology School of Natural Sciences and Mathematics

## ABSTRACT

The purpose of this paper is to present a contextualised problem story which can be used by teachers to motivate adult learners during the introduction of the concept of statistics Confidence Interval for the mean. This is an important contribution to adult statistics educators' methodology repertory showing how adult learners can be motivated to learn statistics in a social context. The study was guided by Action research principals. Data were collected through desk research for methods of motivating adult learners in statistics. A purposive sample of seventeen mathematics educators 'in three focus group discussions appraised and evaluated the introduction problem story. Seventy-eight students' lecturer evaluation reports were important for singling out the Confidence Interval problem as an effective introduction. The study found that: a problem story in which adult students were required to explain how a scanner approximates a child's date of birth linked statistics application in a social real life context to statistics formula in the classroom. Facilitator and students found themselves using statistics as a tool for objectively justifying a judgment for the child's paternity in a village court. The problem story concretised the abstract concept of Confidence Interval as a direct social application of statistics. Students ranked the Confidence Interval problem as memorable and effective. It probed them to participate by contributing explanations which were used to concretise the statistics Confidence Interval formula. Female students were emotionally immersed in the discussion. Facilitator was able to use problem analogy to represent the mean and standard error components of the formula for statistics Confidence Interval for the mean in symbolic form. There was learning from concrete to abstract by linking statistics to a social real life context. The answerhad meaning for students and was used to solve a problem. The study encourages lecturers to formulate similar real life problemapplications for the introduction of statistics concepts for adult learners.

**KEY WORDS:** Statistics, Confidence Interval, Adult learners, Motivation, Contextualisation

## 1. INTRODUCTION

One of the universities in Zimbabwe offers statistics education at undergraduate and masters' levels. At undergraduate level, the course is code named Introduction to Statistics and at masters level it is called Quantitative Techniques. Although the word Confidence Interval for the mean is found in both courses, its presentations and content for a particular group of students must be different because adult learners are not big children. Teaching undergraduate learners require pedagogics in which the teacher is the source of statistics knowledge to be transferred into

ISSN: 2582-0745
Vol. 3, No. 03; 2020

learners' heads through their notebooks. Buck and Bartley (2002) hinted that, pedagogy frustrates adult learners when their knowledge and experiences which adds value to the lecture is ignored.

At masters' level, the facilitator is expected to apply andragogy which emphasise the application of statistics concepts in the context of students' social lives. Under such circumstances, the facilitator and students learn from each other's experiences.Finch and Rahim (2017) emphasised that, adult students grasp and retain information more effectively and efficiently when taught with methods that match their preferred learning styles.Such emphasis calls for statistics lecture content to include real world reference points. In fact, the word 'techniques' that is in the course narration for masters' students stress the application more than content reciting. In addition andragogy demands an understanding of mathematics and statistics as an applied science, adult learners as a special group of students, and application of exceptional teaching learning methods.

**Statistics as an applied Science**

Statistics is a proper subset of mathematics. I actually consider it to be an applied mathematical science. Moursund (2001) has three perceptions of mathematics. First as a human endeavour, mathematics is the process of quantifying variables such as time in years, seasons and distance in kilometres. The quantification process, calls for data collection, analysis, presentation and interpretation, which is statistics. Second is the view of mathematics as one of the school disciplines such as Physics or History. This perspective is suitable for pedagogy. Adult learners focus on application. Third consideration is that of mathematics as an interdisciplinary language and communication tool. The latter suggests that, mathematics can be taught within any other subjectas a language of communicating quantitative issues using symbols. The emphasis is on quantitative communications, which funnels to statistics applications.

According to Kyle and Kahn (2009), mathematics is a system of logical ideas applied in the modelling of real world. Modelling stresses the application not memorisation of mathematical facts and formula. From Hibberd (2002) we perceive mathematics as the science of logical deduction and reasoning, a severe taskmaster for both learner and teacher. Being a taskmaster focuses on mathematics' utility value. This view hints on mathematics as a logical system of thoughts not a collection of facts to be memorised and applied. Its teaching then, calls for logical explanations. Javier and Civil (2010) consider mathematics as a human activity involving creativity and imagination. Not a collection of rules, procedures, theorems, definitions and formulae to be memorised and applied.The main implication of these conceptions of mathematics is that, its' concepts must be introduced within the cultural, social and economic context understood by students.

Wegner (1999:2) views statistics as an important tool for transforming masses of raw data into meaningful, usable information for decision making. Hence businesses regard statistics as a decision support tool. Consequentlyits' teaching should be aimed at helping students develop skills to apply statistics as a tool. Kahn (2001) observes that, the mathematics that adult learners can do such as counting is considered by them as common sense rather than mathematics. Wegner (1999: 3) buttressed this point by saying, "managers have been applying statistical

ISSN: 2582-0745
Vol. 3, No. 03; 2020

principals unknowingly and calling it common sense." It is important then for teachers to help students establish the link between statistics as a discipline and that real life common sense.

For Freund (1992: 1) statistics now encompass the science of basing inferences on observed data and the entire problem of making decisions in the face of uncertainties. Human activities such as tossing a coin, dietician experiments with food additives, actuary determines life insurance premiums, quality controller rejects or accepts manufactured products, newspaper predicts outcomes of election results or teachers compares student abilities are based on statistics. These examples illustrate that there is an abundant world of real life examplesfrom which adult learner facilitators can select from to enhance their andragogy collections.

**Andragogy implications for statistics teaching-learning interactions**

Adult learners approach their statistics learning from different backgrounds, experiences and attitudes to mathematics in general and statistics in particular. Unlike undergraduates, masters' students learn what they want when they want to. These variations place adult learners at different levels of preparednessand kurtosis of content reception which demand a clear understanding of the application of andragogy. Kemp, Morrison and Rose (1998) presented andragogy as a model of adult learner instruction heavily focused on presenting any subject content using instructional methods which facilitate adult learners' acquisition and retention of new knowledge and skills. As such, andragogy requires the learner to be in charge of what gets learned for the most part of the interaction. The key objective of andragogy stressed in this paper is the promotion of the adult learners' experiences and statistics content schema formation by linking all statistics content to real life situations. It is a cognitive endeavour.

Knowles' (1970) principals of andragogy accept that adults understand what they learn from the same teacher in different ways. The principals suggest assumptions whose mathematics teaching implications are proposed:

a) Adult learners have a need to know why they need to learn something before undertaking to learn it. Kelly (2006) proposed that, they (adult learners) learn to equip themselves for changes that they experience and to be professionally competitive. This need can be satisfied by providing students with the statistics course outlineshowing course objectives and possible areas of application.What is critical is harmonising the learner and facilitator's rationale for the course and content needs.

   During lesson interactions, Teachers can pose problems within students' levels and real life context but requiring statistical skills as a basis for the solution.Such is a tactical knowledge gap revelation which motivates the student's need to learn. The problem must be structured such that it creates a need for statistics as a tool for the solution. To that end, Buck and Bartley (2002) underlined that adults need to understand the applicability and practicability of why they need to learn any statistical concept. One of the purposes of this action research report is to show how a problem story based on an inadequate understanding of the scannerrevealsa direct application of Confidence Interval as a tool for a social life paternity verdict in a village court.

ISSN: 2582-0745
Vol. 3, No. 03; 2020

b) Adult learnersbring to university a high self-concept. They are expected to be responsible for their own decisions and to be treated as capable of self-directed learning.To that end, facilitatorscan be flexible in theassignment due dates for their statistics tasks.In fact students and teacher can agree on due dates during planning. Learner's self-concept calls for immediate successful experiences through reinforcing strategies rather than technical knowledge. In this paper, learners attached meaning to the formula rather than being given the formulae for numerical manipulation to get an answer.Their numerical answer was fitted back into the social problem for application.

c) Adult learners bring a wide variety of life experiences which represent the richest resource for learning. Subsequently facilitators are encouraged to capitalise on these experiences by accepting that students have something to contribute to their learning. In addition, facilitators can make efforts to couple students'experiences by allowing them to contribute to the discussions.In This paper's task, students were probed to explain how the scanner works. Those students from the health sector, particularly midwives and radiographers, took the opportunity to show off their expertise. It is one way of exploiting adult learners' ability and need to learn from each other and in groups. Sergei et al (2019) concluded that, real-life mathematics application motivates learners. I resolved that students require both cognitive and practical experiences throughout their mathematics and statistics education.

d) Adults come to school because they need to learn. The magnitude of the need is shown by their time and financial investment. They are expected to be ready to learn those things they need to know in order to be able to cope effectively with life situations. Kelly (2006) advises teachers of adult learners to be flexible and adapt learning materials to real life examples that adult learners can relate to. The facilitator's task is to satisfy this need by helping them see the real life situations in which each of the concepts applies.During the orientation days, students can be allotted time to introduce themselves to the class. Learners can also be tasked to suggest other areas of statistics application which the facilitator can record for his/her future teaching methods.Learners' need to know and direct the choice of statistics contents towards the mathematics needed for their day-to-day functional purposes.

e) Adults are motivated to learn to the extent that they perceive learning as a tool to help them perform tasks they deal with in their life situations. Their orientation to learn requests the learning environment to be grounded in appropriate life situations. Taken as a statistics instructional reference point for adult learners' motivation to learnfocused action research methodology on participative interaction rather than lecturemethods. Lesson content (explanations of how the scanner works)was contributed by students' and the facilitator brought in the Confidence Interval for the mean formula in its symbolic form. When designing the learning activities I took care to include all possible life experiences that could be charged with a statistical significance. For example, students' suggested the following cases where statistics Confidence Intervals for the mean are

ISSN: 2582-0745
Vol. 3, No. 03; 2020

applied: weight of a 2kg park of sugar, a 50kg bag of cement, time taken to travel from one city to another and duration of a lesson.

This section presented adult learners' unique characteristics which can be summarised as: curious, self- motivated, rich in life experiences, inclination for group work, able to articulate and apply their perspectives and experiences to course content. They connect their learning experiences based on their learning styles. Wynn (2006: 57) observes that, these attributes vary from student to student.The attributes and their variations make teaching adults both challenging and unique. As a result effective adult teaching-learning should be especially rewarding and motivating if the interaction is built on students' life experiences. Such a learning interaction must be structured to accommodate learners' learning differences. Andragogy then as a teaching-learning model can be considered as a strong spring-board for motivating adults learning mathematics in general and statistics in particular.

**Adult learner Motivation**

Humans inherently have a high affinity for full knowledge of everything. Such a genetic configuration provides curiosity which is the genesis of motivation to learn. Vilder (1977) suggests that, curiosity and motivation are closely linked psychological traits in humans. Students' motivation can be perceptual, ego or social related.

The indicator for a child's perceptual curiosity is the child's increased attention to objects in the environment,their form and movement. Hence, a child's natural motivation can be traced from childhood curiosity at primary school level to intellectual curiosity at tertiary level. While children explore physically their physical environment to satisfy their curiosity, adults' perceptual curiosity or motivation can be raised by shared experiences of the world around them. Sharing interpretations of the fabric of the world requires peer education and studies based on action research. Lecturer's facilitation in applying mathematical analogies such as the need for the sample mean and standard error in the computation of the statistics Confidence Interval for the meancan be understood when discussion includes peer knowledge and experiences. This paper shows how peer experiences are included.

Adult learner motivation can be intrinsic or extrinsic. In statistics, intrinsic motivation is the enterprise to study statistics that the student feels from within. It compels students to do their homework tasks quickly and read the subject comprehensively.Intrinsic motivation is shown by students' desire to understand statistical concept and their application. Application is also a task related motive. According to Vilder (1977: 67) achievement motivation is shown by a pattern of actions connected with striving for some internalised standard of excellence. It is a proper subset of intrinsic motivation. Fry, Ketteridge and Marshall (2009) concluded that, the most important motivators for adults are intrinsic they are less interested in teacher rewards. One can conclude that, external motivators like stars and class position are not used at university because the students are not interested in them.

Internal motivation is groomed by assigning students graded tasks whose level of difficulty is incremental. For example, start by calculating the sample mean and standard error before

ISSN: 2582-0745
Vol. 3, No. 03; 2020

bringing the two facets together when calculating the Confidence Interval for the mean. Teachers are encouraged to review the computation of the mean and standard error as assumed knowledge for the Confidence Interval for the mean.Vilder (1977) hinted that, adult learners are interested in excellence for its own sake rather than the rewards that it brings. One can conclude that, in statistics intrinsic motivation is associated with understanding concept linkages and intellectual pleasure for problem solving.

Extrinsic motivation is the drive to succeed in solving statistics problems which comes from outside the student. Posamentier (2017) approves praise from teachers, peer acceptance for good performance in statisticsor avoidance of punishment and ridicule as extrinsic motivators.Facilitators' marking comments orally and in written form are effective instruments for students' extrinsic motivation.

Sitting on the intersection of intrinsic and extrinsic motivation are those students who show the desire to outperform others (ego-related) and impress on others (social-related) motivation. Adult learners' virtue of learning in groups and from their peers places their mode in this intersection. Facilitators can exploit this characteristic by using group discussions to enable students to receive recognition and appraisals from their peers. Billett (2014) proposed that to raise motivation, teachers can integrate rich statistics ideas with familiar physical objects for any concept motivation.

**Concept motivation**

Concept motivation is different from student motivation. Vilder (1977: 2) defined concept motivation as a teaching strategy pivoted on students' curiosity for the introduction of a new concept. It is the injection of pleasure in the understanding of an academic concept. Concept motivation is justified for its' applications to solving real life problems. It is a subset of a teaching process based on the need to solve real life problems. It impresses on statistics concept applications rather than computations.

In statistics concept motivation as an applied mathematics domain is based on the assumption that, the goal of learning mathematics is to concretise abstract or applied notions. Hence, concreteness is an instrument for any mathematics concept motivation. Subsequently Brown and Uhde (2001) declared that, students' interest is stimulated by teaching statistics concepts using examples from students' locus of experiences. Sergei, et al (2019) added that, a statistics concept not interesting to the student gains interest (motivation) when it is associated or presented in a context in which the student's interest already exist.In this study, midwives and radiographers who had limited interest in statistics derived it from its application in introducing statistics confidence interval for the mean.

While the need for relevant examples is loud and clear, in Zimbabwe currently, statistics teaching is based on text-book examples which present a foreign economic, cultural and social context. Teachers were not trained to author text-books in-cooperating Zimbabwe's social, economic and cultural context. A centralised examination system blinkers teachers to statistics contexts which both the teacher and student do not understand. The end-result is that, teachers

ISSN: 2582-0745
Vol. 3, No. 03; 2020

and their students do statistics computations to get answers required by the examinations not to apply statistics in their day-to-day activities. The Confidence Interval problem story presented in this paper shows a break from the text-book to teacher structured problem examples for use by teachers.

**Statement of the Research problem**

There are limited documented teaching methods with a social context for adult learners' instruction for statistics in general and Confidence Interval for the mean in particular. In Zimbabwe Teachers' colleges focus and limit teacher education curriculum to pedagogy, the teaching of children. Adult learners are overlooked in the learning system of many developing countries. The majority of teachers who lecture in universities have degrees in their content areas such as BSc Honours in Statistics but no teaching qualification. Some have teaching qualifications focused on children not adult learners. Most of them have not authored modules for use in their teaching of statistics. They blinker themselves to text-book problems structured by foreigners and lacking Zimbabwe's social and economic contexts. The foreign contexts and teachers' limited innovation results in low level understanding of statistics concepts by both the teacher and student. The role of this action research is to advocate for a teacher break from the text-book confinement instruction. The presented problem story within a social Zimbabwean context demonstrates thatit is possible for teachers to structure their own statistics concepts problem contexts. It is presented in this paper for discussion, adoption and adaption by statistics teachers for the introduction of the concept of statistics Confidence interval for the mean.

**Research Questions**

This action research sought answers to these pertinent questions:

1. How can a teacher introduce the concept of statistics Confidence Interval for the mean to enhance both motivation and understanding by adult learnerswho are not majoring in statistics?
2. What are students' reactions to a locally contextualised problem story to introduce Confidence Interval for the mean?
3. What are the strengths of a contextualised problem story for introducing Confidence Interval for the mean?

**Purpose of Study**

This study's purpose was double barrelled. First it sought a teaching method which can be used to motivate adult learners during the introduction of statistics Confidence Interval for the mean. This was motivated by the observation that, adult students expressed limited understanding of the concept of confidence interval for the mean. Questions such as: "where is all this used in real life? Why are we adding and subtracting the standard error?" were common during lecture. The second purpose of the study was to explore the effect of applying problem story and drama as a teaching method for adult learners for statistics. Particularly for non-mathematics majoring students, who study statistics mainly for its utility value and as their masters' degree program

ISSN: 2582-0745
Vol. 3, No. 03; 2020

qualification's requirements. Exploring the effect of the problem story was also the study's inbuilt self-evaluation mechanism for quality.

**Significance of Study**

This action research contributes a problem story which can be used to introduce the statistics concept of Confidence Interval for the mean. This is an important contribution for teachers who are serious about teaching statistics to adult learners who are learning statistics for utility value. The problem story is a good original initiative to break away from being blinkered on text-book examples to structuring of own examples. It improves students' understanding and conceptualisation of statistics confidence interval for the mean. The problem story is a teaching resource from mathematics and statistics teachers by teachers for teachers. Last but critical, is the fact that, the problem story contributes literature on the application of drama and story-telling as a teaching method in mathematics in general and statistics specifically.

## 2. LITERATURE REVIEW

**Model class environment**

For adults, learning includes learning in everyday life situations (Javier and Civil, 2010). From this angle, context is the key element for adults to make sense of formal mathematics. Finch and Rahim (2017) require adults' mathematics education to be a situated practice produced as a consequence of interactions among learners in an egalitarian class environment. Such is an appeal for adult educators to respect their students and consider them as colleagues. To facilitate contributions by most class members, group work becomes ideal. When the class has freedom of participation, mathematics learning involves contextualisation, transferring, sense making and application in real life.

Adult learners build on their memories and experiences to make sense of mathematical problems, symbols and formula hence need for a social cultural context. Kahn (2001) declares that, contextualising mathematics by relating it to learners' life experiences is one of the methods of meaning-making. It makes the invisible, visible to learners.These sentiments expressing the ideal but lack real examples presented in this paper.

**Model lesson hints**

Brown and Uhde (2001: 88) proposed that the following conditions for a conducive mathematics lesson for adult learners: since adults have a desire to be accepted, respected and supported, their class must have a spirit of mutuality between teachers and their students. They must consider themselves as joint inquirers with freedom of expression without fear of punishment or ridicule. The teacher must apply a variety of content presentation techniques to appeal to the different expectations of each learner's cognitive and affective domains. More important is that, learning becomes a way of assisting students to make connections between their past experiences, and their future through their present day learning in their search for meaning from the statistics that they learn. These class environment requirements were summed up by Fry, Ketteridge and

ISSN: 2582-0745
Vol. 3, No. 03; 2020

Marshall (2009: 65) who said, “an active, challenging, collaborative, critically reflective and transformative atmosphere should be nurtured.”

According to Posamentier (2017) class nurturing anticipates that teachers regulate students’ motives for learning by identifying mathematics knowledge voids in students to capitalise their desire to learn more. The more dramatic a teacher reveals the gap in understanding, the more effective the will be the motivation.This was an important pillar for the presentation of this paper’s problem story which was laced with dramatic humour. Knowles (1970) associated a positive correlation between the knowledge gap realisation and motivation.

For the concepts to be understood, teachers can present a logical sequence of content difficulty. Billett (2014) advised teachers to introduce genuine practical applications with statistics as the solution tools for the problem. One can start with simple exercises involving situations that are familiar to students. Familiarity stimulates a stable cognitive schema in the student’s mind. Then students can be moved to exercises involving unfamiliar and more challenging problems. In each case, teachers are encouraged to help students discover patterns. Hibberd (2002) obliges students to interpret the mathematical solution in a real-world context as a way of enhancing understanding.

According to Palmer (1998) in Kahn (2001: 65) every problem or issue can be an opportunity to illustrate the internal logic of a discipline. Kahn (2001) encourages teacher generation of own examples and visualisations connecting ideas or unpacking symbolic representation. These are calls for a move away from focusing on content to the process of building up understanding and meaning of the formula content. To that end Fry, Ketteridge and Marshall, (2009) concluded that, relevant examples develop both subject-specific and transferable skills in students.

From a teaching point, Hibberd (2002) observes that, statistics can be taught to adult learners more effectively when: there exist individual and small group activities for students to support each other. Feedback is provided for each of the stages in the process. Solutions are validated by comparing with reality and predictions. Its numeric computations are reduced by use of calculators and computers. These sentiments provided supportive anchorage for the problem story lesson. More support was provided by Fry, Ketteridge and Marshall (2009) who reiterated that, adults become ready to learn when they experience a need to know something (gap creation). They are less subject-centred than children. They are increasingly problem-centred.

## 3. RESEARCH METHODOLOGY

### Research Philosophy

The purposeof this Action research is to find a solution that works for the problem under those circumstances hence it is guided by thepragmatism philosophy inclined to qualitative methodologies. White (2005) suggests that, truthfulness for pragmatists is found in what-ever solution works. According to Johnson (2012), action research is incomplete when the solution has not been subjected to a practical test. Hence it becomes critical for the study to test the effectiveness of the problem story in a real class. The truthfulness of generated knowledge is found in the practical results of implementation. In this study, pragmatism facilitated the

ISSN: 2582-0745
Vol. 3, No. 03; 2020

application of both qualitative and quantitative methods. Method triangulation captures the multiple realities of interpreting the world.

**Research Design**

Generally, action research takes place in a sequential spiral of activities starting from the individual, to a group, then globally for sharing through publications. The question; "what method can I use to improve students' understanding of confidence interval for the mean?" required extensive reading of statistics teaching methods sources. This study applied a serialized research design involving; problem identification and sharing, literature review for data collection framework, lecturers' focus group discussions for solution, model lesson design, model lesson delivery and evaluation, focus group evaluation and improvement, lesson delivery and evaluation for effectiveness.

**Population and Sampling**

The population of this study is composed of human and none-human materials. None-human materials were mainly statistics teaching methods materials. The human population was composed of mathematics lecturers and students. Purposive sampling was applied to select participants. The inclusion criterion was mainly having knowledge of teaching statistics confidence interval for the mean, being available, willing to participate. Adult students were ideal for the population because they have the experiences required for contextualised concept motivation.

**Data Collection**

Data was collected over three years. The problem was identified from students' end of course lecturer evaluation forms in 2016. Students indicated that they did not understand what the symbols in the formula for Confidence Interval for the mean could be standing for. In addition, they indicated that, they did not see where Confidence interval can be applied in real life. Lectures concurred that it was a teaching methods problem.

I started by reading to understand the adult learner. This was followed by reading resources on mathematics and statistics for the content knowledge. The third variables from literature were teaching methods (andragogy) which provided the teaching framework. A model lesson introducing confidence interval for the mean based on presenting the formula one aspect at a time was formulated. This was discussed by lecturers' focus group discussions and an improvement for story telling was introduced. I carried out another literature review to understand how stories can be included in mathematics lessons.

I presented a lecture observed and evaluated by other lecturers who focused on contextualisation of the concept of confidence interval for the mean. Students' evaluations of the lesson provided insights of the strengths and weaknesses of the lecture. These were in cooperated during lecturers' focus group discussions.During each focus group discussion session, my teaching journal in which I recorded every significant comment and insight was just ideal for identifying weaknesses that required improvement.

ISSN: 2582-0745
Vol. 3, No. 03; 2020

The last cycle of the study involved the presentation of a problem story to introduce confidence interval for the mean. It was evaluated by students for concept understanding, lesson effectiveness and strengths. Lecturers' evaluation was guided by Coghlan and Brannick (2005: 23) who required them to check if the original diagnosis and action taken were correct. Then find if the action was taken in the appropriate manner and key issues feeding in the next (publication) action.

## 4. FINDINGS AND DISCUSSION

The problem story narrated below was arrived at the forth cycle of the action research refinement. It is narrated together with the reflective purposes for each action to help teachers understand it.

| **Lesson interactions** | **Reflective purpose** |
|---|---|
| 1.I entered the classroom about five (5min) late (*unusual*).<br>2.Ladies and Gentleman, I am sorry for being late.<br>3.I am the son of a Village Headman *(Class burst into a fit of laughter*).<br>My father is grooming me for succession (*classsilence and attention*). He does the grooming by referring to me cases that his jury find difficult to judge. I was delayed by his phone call. He presented this case, which I would like you to help me understand and possibly present the appropriate verdict. | 1. curious attention<br>2.Respect for students<br>3.Context building |
| 4.A young couple started staying together as husband and wife in March 2017. The wife 19 years old and husband 27. The wife was visibly pregnant in July 2018. They went for a SCAN. They were told to expect the child on 04 January 2019. The child was delivered on 24 December 2018. (*write the dates: delivery 24/12/2018. Expected 04/01/2019*) | 4.Problem story context |
| 5.*Problem*: The supposed father of the child is objecting paternity of the child on the basis of these dates. The village court failed to understand what a SCAN is and what it does. This is why they could not decide and instead, referred the case to me for advice. I do not understand a SCAN, can those who know educate us? | 5.Call for students' contributions from their experiences |
| 6.SCAN explanations: A scan gives the Average date of delivery *(write: average/mean and the symbol* $\bar{x}$*)*.The calculations are based on the *approximate* date of conception, lengths of the limps of the foetus and head size. Since the date of delivery is an approximation, SCAN allows a ±14 days.(*Write: ± 14 days*) | 6.Midwives, nurses and radiographers provide good answers |
| 7.Ask: Why should there be a plus or minus 14 days? (Answers such as, no woman or man knows exactly when conception took place, there may be errors in approximating limp lengths are given) | 7. Whole class participation |
| 8. Use these to introduce the word: Standard Error for the mean and symbol ($\frac{s}{\sqrt{n}}$). | 8.from word to symbolic |
| 9. Lead the class to deduce the verdict by checking on the calendar | 9. Direct application |

ISSN: 2582-0745
Vol. 3, No. 03; 2020

| | |
|---|---|
| dates:04/01/2019 minus 14days brings us to 23/12/2019 then 04/01/2019 plus 14days take us to 18/01/2020. Then represent the answers in the form: (23/12/2019 to 18/01/2020)<br>10. Summarise the Verdict as: The father must accept paternity of this child with confidence because the child was born within the Confidence Interval (23/12/2019 to 18/01/2020).<br>11. Define Confidence Interval is a range within which an approximated parameter is expected to fall with confidence.<br>C.I. for μ, is a range within which μ is expected to be found. So the symbolic formula components:<br>C.I for μ = mean ± standard Error<br>$C.I. for\ \mu = \bar{x} \pm t_{\frac{\propto}{2(n-1)}} \frac{S_n}{\sqrt{n}}$ | 10. linking reality to abstract symbolic statistics |

**Evaluations**

Students evaluated the lesson introduction as an effective one. After the class, some students would pass comments such as, "The child is his because he is in the Confidence Interval!"

Other would say, "A mathematics judgement is the best." Other students followed up those who had explained the scan for more understanding. Each of the formula components had some representative meaning attached to it from real life.

Students showed extended application of the Confidence Interval for the mean to;urban vehicle speed limit as ± 60km/h, weight of a bag of cement as ± 50kg, duration of lecture as ± 2h and wages of a maid as ± $ 600. Statistics concepts were taken out of the class to students' day-to-day activities.

**REFERENCES**

Billett, S. (2014).Learning in the circumstances of practice.*International Journal of Lifelong Education.*34(7): 827-843.

Brown, A. H. and Uhde, A.P. (2001). Making mathematics come alive : The effect of implementing recommended teaching strategies in the classroom. *Teacher Development*.5(1):87-100.

Buck, K. and Bartley, S. (2002). Learning style and training delivery mode preference. *Journal of Workplace Learning*. 14(1): 5-9.

Coghlan, D. and Brannick, T. (2005).*Doing Action Research in your own organisation*. London: Sage.

Finch, D.M. and Rahim, D.M. (2017).*Adult learners: Technology-driven learning styles*. London: Nova Science publishers.

ISSN: 2582-0745
Vol. 3, No. 03; 2020

Freund, J.E. (1992). *Mathematical Statistics*. New Jersey: Prentice hall.

Fry, H., Ketteridge,S. and Marshall, S.(2009). *A handbook for Teaching and Learning in Higher Education.*London: Rutledge.

Hibberd, S. (2002).*Mathematical modelling skills*. London: Kogan page.

Javier, D. and Civil, M. (2010). Learning mathematics with Adult learners: Drawing from parents. *International Congress on Mathematics Education*.14(1): 71- 94.

Johnsosn, A.P. (2012). Introduction to Action Research.www.OPDT-Johnson.com. Accessed, 12/06/20.

Kahn, P.E. (2001). *Studying mathematics and its applications*. Basingstoke: Palgrave.

Kelly, M.H. (2006). Teach an old dog new tricks: Training techniques for the Adult learner. *Professional Safety*. 51(8): 44

Kemp, J., Morrison, G. and Ross, S. (1998). *Designing effective Instruction*. Upper Saddle River: Merril.

Kyle, J. and Kahn, P. (2009).*Key aspects of teaching and learning in mathematics and statistics.* New York: Routledge.

Moursund, D. (2001). What is mathematics? [o].uoregon.edu/moursund/maths. 17/04/19

Posamentier, A. et al (2017). Motivating students in Mathematics.*EDUTOPIA*.

Sergei, A. et al (2019). Teaching mathematics through Concept motivation and Action learning.Hindawi Educational Research International.http://doi.org. Accessed 12/04/20.

Vilder, D.C. (1977). *Curiosity and Motivation in Education*. New York: Academic press.

White, C. (2005). *Research Methodology: A practical guide*. Cape Town: Intutuko.

Wegner, T. (1999).*Applied Business Statistics*. Cape Town: Juta

Wynn, S. (2006). *Using standards to design differential learning environments*. Boston: Pearson.