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Didactic Transposition of the Alternative Knowledge of the Brazilian Telenovela "O Clone" to Knowledge Taught

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Abstract: ***The aim of this study was to demonstrate how scientific knowledge found in different themes in an entertainment movie can be transposed into teachable knowledge and used as a didactic edutainment tool for developing inferential thinking skills and competence in learners. The survey involved 45 undergraduate students of the Higher Teachers' Training College of the University of Yaoundé I. It was conducted during the first semester of 2013 – 2014 on the Brazilian telenovela "O Clone" broadcast in English over Cameroon Radio & Television (CRTV) and was considered by many viewers as a favourite entertainment movie. Scientific knowledge on human cloning, artificial procreation and the socio-controversial issues of ethics and drug addiction generally masque by the romantic entertainment elements of the telenovela was transposed and taught. Results demonstrated statistically significant gains in all categories tested. Within limits of the study, it was concluded that the gains in performances observed were influenced by the tools that guided didactic transposition. Inherent perspective for future investigation using edutainment soap operas was raised.***

Keywords: "O Clone", telenovela, didactic transposition, socio-controversial scientific issues, bioethics

1. Introduction

Numerous studies on teaching thinking and creativity have been realised [1, 2, 3, 4, 5; 6]. Others survey the development of critical thinking [7, 8]. In this survey which aims at developing inferential thinking skills, the data is obtained from the telenovela ''O Clone". It raises socio-controversial questions in the school environment that challenges the social practices of internal didactic transposition (in and out of the institution) making recourse to the social representations of scientific knowledge.

Soap operas are TV movie series designed principally for entertainment. Most of them carry important messages which could be scientific, social, economic, religious, ethical, etc, in nature. Soap operas that combine both entertainment and education are referred to as edutainment or telenovelas. Amongst many such movies with complex themes is the Brazilian telenovela "O Clone" with themes conceived to entertain and educate movie lovers. The principal themes in this movie include among others: medically assisted procreation; human cloning and bioethics; love; misdemeanour due to drug consumption and addiction; and religious conflict pitting Islam and Christianity. The different interpretations and understandings given to these scientific and socio-controversial themes constitute our research problem. [9] The plots of the telenovela are Rio de Janeiro in Brazil and Fez in Morocco. The perception of the scientific knowledge embedded in these themes from the point of view of functional relationships derives from the critical mind. Due to the socio-controversial nature and the type of application to which the knowledge in the telenovela can be put, transposition by teachers cannot be limited to a simple straight jacket decontextualisation and recontextualisation as is the case in a strictly formal classroom situation. It requires moving out of the ambits of classroom settings into the society where value systems, practices and the need for effective use of such knowledge in problem-solving come into play, [10, 11; 12, 13, 14]. In this work therefore, the conceptions of science student-teachers in training in Cameroon are analysed as being the outcomes from interactions between knowledge, values and practice (KVP) model, proposed by Pierre Clément [15, 16, 17]. This KVP model appears to be useful in analysing the epistemological features of the taught knowledge so as to try to understand what is related to science or to values in scientific representations, and their interactions with contemporary socio-controversial practices and value systems in the telenovela.

This research was conceived against the background that innovations in the pedagogic policy framework in Cameroon are probably not yielding the desired outcome because the manner of transposing textbook and expert knowledge; defining learning objectives and teaching does not provide learners with sufficient opportunity to dream, become inspired and move away from being passive participants to active contributors, in the process of the construction of their own knowledge [18, 19, 20, 21]. Additionally, there is great paucity in research on the didactic transposition of school textbook and alternative knowledge especially from media sources into teachable knowledge within the context of Cameroon, [14, 22, 23]. Most teachers in the Cameroon school system tend to paraphrase textbooks and dictate to learners without taking into consideration the fact that reading alone constitutes only about 10% of what the learner actually retains [24]. Specifically, alternative scientific knowledge from media sources such as a telenovela is largely unexploited and therefore usually relegated to the background in preference to the entertainment aspect of it. It is our opinion that if properly exploited soap operas and media data accompanied by appropriate didactic transposition, can constitute powerful tools for developing inferential thinking in the learner through combining

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knowledge construction and appropriation with entertainment – that is, creating a sort of didactic edutainment tool.

From the methodological point of view therefore, we transposed the scientific and socio-controversial content of the Brazilian telenovela using Klopfer's taxonomy [25] of educational objectives and Noumi's hypothetico-deductive [19] model of thinking into knowledge to be taught and finally into knowledge taught. The following levels of Klopfer's taxonomic [25] classification and Noumi's hypothetico-deductive thinking model were used:
Klopfer's taxonomic categories:

- training or observation and measurement of objects, organisms, phenomena and events or knowledge of their characteristics, or properties;
- application or appropriation of competence involving the ability of the individual to use these knowledge, skills and know-how to explain or seek solutions to problems in new contexts and to show proof of the appropriation and mastery of these skills and attitudes in varied contexts. The pedagogic approach that leads to the appropriation of this kind of skill is competency-based learning or pedagogy of integration, [26, 27, 28];
- Noumi's hypothetico-deductive model of thinking:
- derived from Klopfer's taxonomic category C which is about seeing a problem and seeking ways of solving it. Rather than problems, the characteristics of organisms or phenomena and events that we see are actually solutions to problems in themselves. Hence in this model the characteristic or property of organisms, objects, phenomena or events are considered as solutions, and from it by brainstorming one can decipher the problem underlying the possession of such characteristic [8, 21]. This constitutes the know-how of application (know-how's knowledge) and meta-cognition (knowledge of know-how's knowledge) [8, 19]. Here the task situation raises controversial questions at the levels of knowledge, their psycho-social and practical implications. In this survey, this process aimed to trigger the thought processes that will lead to the construction and appropriation of creative and inferential thinking skills subtended by the mathematical logic of the set theory.

The methodology that deciphers social facts from the properties and features of an object, organism, phenomenon or event, in order to contribute to enhancing the intellectual capacity of the learner, constitutes education by the social implications of scientific thinking [6].

The goal of this survey therefore is to demonstrate how a didactic edutainment tool such as the soap opera "O Clone" which has as primary objective entertainment, could be used in combination with appropriate didactic transposition and active learning techniques in developing inferential thinking skills in learners.

Hypothesis:

Ho: An audio-visual edutainment soap opera such as "O Clone" whose principal goal is entertainment cannot significantly contribute to the development of inferential thinking skills and the appropriation of competencies among undergraduate students.

2. Methodology

2.1. Sampling

The survey population consisted of second year students of 2013/2014 academic year of the Higher Teachers' Training College of the University of Yaoundé I. Forty five undergraduate students of the biology class constituted the sample. The experimentation was conducted on the Course Edi-208, (Sciences of Education and Didactics of the Life and Earth Sciences) using three tools:

2.1.1. The telenovela "O Clone"

A sequential summary of the movie series screened on Cameroon Radio & Television (CRTV) was realised by students in groups and their findings shared during the course work in plenary.

2.1.2. The Course work

The course works SVT 213 (Human reproduction) and SVT 214 (Genetics) were taught and students were asked in their groups to use the knowledge to identify the characteristics or properties of the scientific and socio-controversial concepts embedded within the episodes of the telenovela. This approach was selected because the students would later be required to reinvest their knowledge of these characteristics to explain the scientific concepts in the movie series, and to propose scientific solutions to the law suit between Deusa da Silva and the very rich Leônidas Ferraz. This constituted a base for judging students' ability to face life situations in different contexts with greater autonomy – that is, the appropriation of competence [28, 8, 21].

2.1.3. Homework

The homework consisted of 7 questions distributed as follows:

- in the observation and measurement category of Klopfer's taxonomy questions 1, 2 & 3 helped us to find out if the students took into account the characteristics of the scientific knowledge content embedded within the episodes of the soap opera which could be explained through the principles of Mendelian genetics;
- in the application and competency domain questions 4 & 5 were concerned with the application of the knowledge of Mendelian genetics to clarify the paternal and maternal law suit between Leônidas and Deusa. This exercise aimed to find out if students could establish the link between their school knowledge and the society thereby demonstrating the raison d'être of schooling. By constructing genealogical trees of inheritance in the telenovela and the subsequent reinvestment of such knowledge students were required to propose scientific explanations to the concepts of cloning, medically assisted procreation, the raging law suit over the parentage of Leo, the associated social practices, value systems and ethical implications behind the geneticist Augusto Albieri's obsession leading to the cloning of Lucas Ferraz.
- The last two questions were based on the hypothetico-deductive thinking model to investigate the development of inferential thinking skills using appropriate scientific

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terminologies and the scientific and socio-controversial issues in the different episodes of the telenovela. While Q6 sought to find out if students appropriated the hypothetico-deductive thinking model, Q7 was designed to test the students' ability to think rationally and scientifically through the use of the mathematical set concept to identify similarities and differences within a set of characteristics. Specifically, they were required to infer the scientific identity of Leo given the raging law suit over his parentage as a way of seeking a lasting solution to the problem.

2.2. Data collection and treatment

The scripts were carefully marked and the marks transcribed onto a mark sheet against the name of each student. Data sorting and coding was manual. The codes and data were keyed into the variable and data spreadsheets respectively. The keyed-in data and codes were verified for errors and corrected accordingly. Descriptive and analytic statistics were generated using SPSS v.20.0. The mean performances, variance and standard deviations were computed and results displayed on frequency and cumulative frequency distribution tables, histograms and line graphs for analysis. The degree of significance between pre- and post-test performances of students was compared by a student t-test at a confidence interval of 95%.

3. Results and Discussions

3.1. Presentation and discussion of descriptive results

On the overall there was marked improvement in performance between the pre- and post-test results. The pre-test results on the one hand revealed that the highest frequency of marks was 5/20 (representing 28.9% scored by 13 respondents) and the cumulative percent column showed that 97.8% or 44 respondents scored ≤9/20. Only one respondent scored 10/20 giving a cumulative percent success rate of 2.2. This performance showed a normal Gaussian distribution as in table1and figure 1. On the other hand, the post-test results revealed that the highest frequency of marks was 11/20 representing 24.4%, scored by 11 respondents. Conversely a cumulative 17.8% representing 8 respondents scored ≤9/20 with 82.2% or 37 respondents scoring ≥10/20. Only one respondent however, scored 10/20. This performance also showed a normal Gaussian distribution as in table 2 and figure 2

Table 1: Overall pre-test performances for the three categories under study

Marks		Frequency	Percent	Cumulative Percent
Valid	2,00	4	8,9	8,9
	3,00	4	8,9	17,8
	4,00	8	17,8	35,6
	5,00	13	28,9	64,4
	6,00	9	20,0	84,4
	7,00	4	8,9	93,3
	8,00	1	2,2	95,6
	9,00	1	2,2	97,8
	10,00	1	2,2	100,0
	Total	45	100,0	

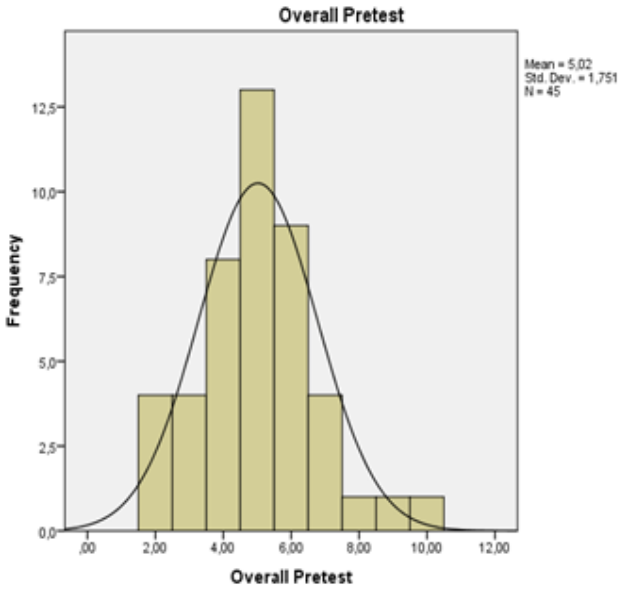


Figure 1: Histogram overall pre-test performances of the three categories combined

Table 2: Overall post-test performances for the three categories under study

		Frequency	Percent	Cumulative Percent
Valid	7,00	2	4,4	4,4
	8,00	2	4,4	8,9
	9,00	4	8,9	17,8
	10,00	2	4,4	22,2
	11,00	11	24,4	46,7
	12,00	10	22,2	68,9
	13,00	4	8,9	77,8
	14,00	5	11,1	88,9
	16,00	3	6,7	95,6
	17,00	2	4,4	100,0
	Total	45	100,0	

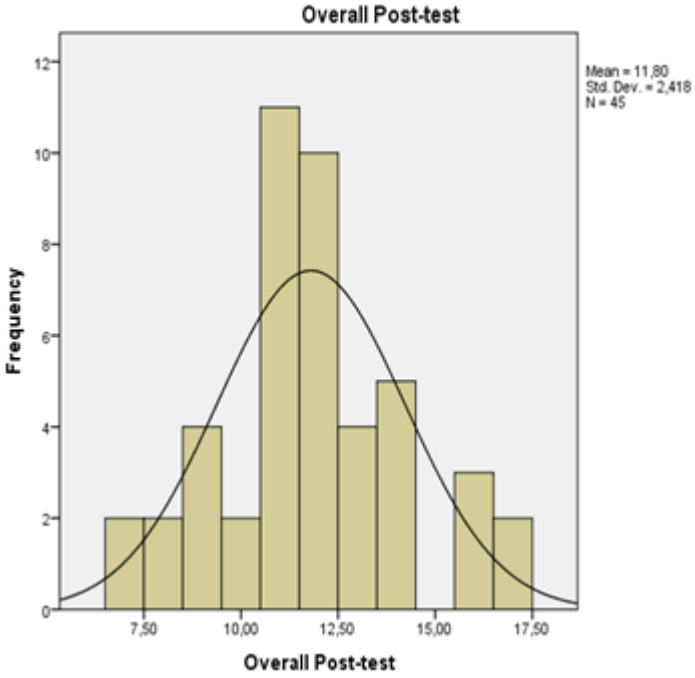


Figure 2: Histogram overall post-test performances of the three categories combined

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3.2. Presentation and discussion of analytical results

The descriptive statistic from the pre- to the post-test revealed marked gains across the board in all the categories investigated after didactic transposition of the alternative knowledge in the telenovela. A pair-wise samples t-test comparison revealed a significant difference in respondent's performances at: $t(44) = -21.37$; $\rho < .001$ in a two-tailed test within the lower and upper bound limits of 95% confidence interval as in table 3. Hence the mean test performance after experimentation was significantly higher. The overall low mean performance observed in the pre-test is a possible indication that most soap opera lovers among the Cameroonian students investigated are more interested in recreation than the scientific knowledge often masque by the romantic aspects built into the episodes.

Table 3: Paired Samples t-test statistic

Comparison		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre-test Observation & Measurement Vs. Post-test Observation & Measurement	-1.97778	.62118	.09260	-2.16440	-1.79116	-21.358	44	.000*
Pair 2	Pre-test Application & Competency Vs. Post-test Application & Competency	-3.35556	1.66727	.24854	-3.85646	-2.85465	-13.501	44	.000*
Pair 3	Pre-test Inferential Thinking Skills Vs. Post-test Inferential Thinking Skills	-1.44444	.89330	.13316	-1.71282	-1.17607	-10.847	44	.000*
Pair 4	Overall Pre-test Vs. Overall Post-test	-6.77778	2.03256	.30300	-7.38843	-6.16713	-22.369	44	.000*

**** = significantly different***

4. Observation and Measurement

The observation and measurement category has significant implications as only effective observation will lead to identification and interpretation of the characteristics of the scientific messages in the cloning experiments of the geneticist Albieri, medically assisted procreation, ethical issues, social practices and value systems in the soap opera. The nuclei and mitochondria of all cells contain nuclear DNA and mitochondrial DNA ($_{mt}$DNA) respectively. Whereas nuclear DNA is transmitted to the progeny by both parents, the $_{mt}$DNA is transmitted by the mother only. Additionally, while the transmission of nuclear hereditary characteristics obey the statistical laws of Mendelian genetics, that of $_{mt}$DNA does not.[29]. Hence the transmission of hereditary characters to Leo, does not obey the statistical laws of Mendel since he is a product of medically assisted procreation. Leo bears striking similarities to Diogo and Lucas. Leônidas calls him "my son", though without being married to or entertaining a sexual reproductive relationship with Deusa – the surrogate mother of Leo. Deusa wanted to have a child and went to geneticist Albieri's clinic for artificial insemination.

From the social perspective, Yvette, a girl friend to Leônidas' and convinced that Leo must be Leônidas' son, presents him as proof of his infidelity to, and lack of love for her. The Lucas and Maysa couple is in discord due to Lucas' infidelity consistent with Maysa's. Their daughter Mel is traumatised and coupled with a feeling of abandonment takes to drugging to the extent of becoming addicted in the hope that she could find a safety valve out of her trauma and stress. She is an accomplice in crime to Nando and Virginia who are also drug addicts and street girls. Due to both the effects of strong peer influence and the nagging environment on Mel she is a victim of circumstances.

Blending scientific knowledge, social practices, value systems and entertainment within the episodes of a soap opera, in itself significantly masques the science in such a mix. The question then is: How can such knowledge be transposed to knowledge to be taught and eventually, knowledge taught [30]? To try to answer this question, we proposed a didactic transposition model which consists in:

- identifying the characteristics of the knowledge, practices and values [16, 17] in the telenovela;
- positioning these as solutions to some underlying problems; and
- brainstorming to decipher the problems [8, 21].

An extrapolation of this type of thinking should then be extended to other areas of the same subject, other sciences and the society. This approach led to the generation of associated and related new ideas, having as common denominator, the identification of a problem and seeking solutions to it. Combining this model of thinking with knowledge of the characteristics of the different segments of the telenovela, the learner should be able to reinvest such to seek solutions to problems in new contexts – a veritable competency-based approach. In "O Clone", the didactic transposition of the knowledge to teach into knowledge taught starts with targeting the diagnostic features of the series which include among others, those related to:

a) procreation consisting of:
   - the delivery of monozygotic twins by the Celina and Leônidas couple;
   - the medically assisted procreation of Deusa; and
   - the delivery of Leo (The Clone in the movie) by Deusa;
b) bioethics linked to the process of procreation (cloning);
c) social life such as:
   - drug addiction and aggravated theft by Mel;
d) religious conflict opposing Islam to Christianity characterised by:

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- daily lifestyle of main actors on horseback in Fès - Morocco and Rio de Janeiro- Brazil.

4.1. Inferential thinking

This approach aimed to stimulate the students' prior knowledge gains from the course works SVT 213 (Human reproduction) and SVT 214 (Genetics), to link their school knowledge to contemporary socio-controversial issue such as those in the movie. In dealing with such issues a unique correct answer is not expected. Rather a series of responses are possible and all depend on the convincing arguments advanced to support each type of answer. Learning to think is a skill that is developed with practice and endurance. It is therefore necessary to rethink the mission of the school and more particularly the reconstruction of the sciences [31, 32], if learners must be rendered autonomous and have the ability to reinvest their school knowledge to live with. In the telenovela, the technique for developing inferential thinking skills consisted among others of:

4.1.1. Characteristic 1

The birth of Leo (White of pure race), with similar features like the monozygotic twin boys of Leônidas (Diogo and Lucas) to a surrogate mother Deusa (Negro of pure race), is a solution to a problem(s). What can the problem(s) be?

Problem(s): When one egg is fertilised it is expected to give rise to a single individual. Organisms can die before maturity due to harsh environmental conditions or accidents. In the movie, Diogo died of a tragic helicopter crash and the news of his death devastated both Lucas and Leônidas. This subsequently ruined Lucas' plans of eloping with Jade. Albieri, who was Diogo's godfather, is also shattered and deeply distressed and despondent coupled with the death of his fiancée from which he had not fully recovered. Deusa living with her boyfriend Edvaldo wants a child, yet is unable to conceive due to Edvaldo's sterility because he has only one testicle. The major problems that were deciphered from this setting therefore consisted of:

- the need to increase survival chances and the perpetuation of the genome [33], imposed by harsh environmental conditions or accidents;
- for Albieri, how to make another Diogo. This imposes the need to change the natural course of events (fighting against death) and living eternally on earth;
- for Deusa, how to have a child, without betraying Edvaldo's fidelity and love for her.

Solutions adopted: With respect to the need to increase survival chances and perpetuate the species genome, one commonly solicited solution is the adoption of the law of large numbers. In this situation, the fertilised egg undergoes an abnormal partition after the first mitotic division and each daughter cell develops into a new individual as is the case of the monozygotic twins Lucas and Diogo. The production of two individuals after the first mitotic division is essentially asexual in character. This mode of reproduction is common in the animal world especially among mammals that do not litter. In lower groups of animals this is also prominent as seen for example when an earthworm (*Lumbricus sp*) is cut into pieces and each piece regenerates a new earthworm [34]. In plant biology, this phenomenon is demonstrated by vegetative multiplication as occurs in many species such as cassava (*Manihot esculentus L.*), banana (*Musa sp) and Hibiscus sp*, etc.

Concerning Albieri's despondence and obsession caused by the devastating death of Diogo coupled with Deusa's desire to have a child, the solution adopted was Albieri's resolve to regenerate another Diogo and the best suited scientific technique for this was cloning. He posited that the school of theology drained out of him the belief in magic and made him come to the conclusion that all possibilities including that of life are purely scientific, or they do not exist at all. His decision to go to the seminary was borne out of his desire to control and dominate nature. He justified this by pointing out that human beings always feel very small before a natural catastrophe, disease, or death. To control this he associated himself to God, because he believed that it was a way to be protected and through this should be able to find the logic behind the very essence of living. Having found out that God is a mere concept existing in his mind and borne out of his desire to control and dominate death he dedicated himself to genetics. Albieri is anthropomorphic and thinks that mankind being the superior creature to all other creations of God has the exclusive right to dominate nature. This in a way justifies his resolve to regenerate another Diogo through cloning – an act shrouded in ethical and social controversies. This is supposed to be the "first human clone". In his clinic, Albieri received Lucas for a consultation concerning a tumour on his back. In removing the tumour Albieri also took some somatic cells without Lucas's knowledge and consent which he cultured. Equally unknown to neither member of his scientific team nor Deusa who also visited the clinic for artificial insemination, Albieri embarked on a Somatic Cell Nuclear Transfer (SCNT) [35] to inseminate Deusa as opposed to embryo splitting (ES) which is similar to the natural process of production of monozygotic twins [36]. The technique involves enucleating Deusa's oocyte by removing its genetic material (DNA) and implanting into it a somatic cell (from Lucas). This is then given an electric shock to trigger the process of fusion, growth and development. This was later unknowingly implanted into Deusa's womb– a surrogate mother by Dr. Simone – a member of Albieri's clinical team. This surprisingly developed without complications and Deusa gave birth to a baby without knowing that it was a clone. Though Léo is surprisingly born without complications as well, Albieri wants to stay close to it in order to observe it grow up and because of this Léo became very fond of and strongly attached to him. Deusa who was very passionate towards the child became uneasy but all the same Léo is a double solution to the problem of Albieri's obsession with the death of Diogo and the desire to regenerate his replacement and Deusa's desire for a child, without betraying Edvaldo's fidelity and love for her.

In other areas of the same field of science and inferring from the solutions adopted to the problems deciphered from the characteristic above the somatic cell from Lucas (scion) is implanted into the enucleated oocyte (stock) of Deusa and stimulated to fuse and grow into a new individual (Leo). Leo is thus a graft and the process of producing the graft (cloning) is grafting. In botany, branches or buds are

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detached and inserted on rootstocks to improve on food yield to circumvent the long sexual reproduction process.

In biotechnology, genetically modified organisms (GMOs) are grafts or clones of some sort. In 1996, Dolly the sheep was cloned from a cultured somatic cell derived from an adult sheep by the SCNT technique [35, 37, 38, 39]. After Dolly, a diverse range of species have been successfully cloned from adult tissues using SCNT including cattle, mice, pigs, cats, rabbits, horses, goats, dogs, rats, and zebra fish [40, 41, 42,]. The telenovela came just a few years after these great advances were made in the sciences, making the series one of the most contemporary issue of the time. In medicine, skin, bone and kidney grafts are frequent. Biblically, God created Adam (a person) and extracted one of his ribs to regenerate Eve (another person).

The major scientific concepts called into play here are, inferential thinking, and vegetative multiplication, artificial insemination, grafting and cloning among others.

Ethical issues: The phenomenon of cloning embarked upon by Albieri poses in itself serious contemporary socio-controversial and ethical problems. By deciding to regenerate Diogo, Albieri is totally anti-ethical and does not care about the dignity of the humankind as a sacred creation of God which should descend through sexual reproduction necessitating two parents. In one of Albieri's lectures he affirmed that "the departure was given. Now, we, the scientists, have as duty to continue developing those researches and should not yield to the simplistic temptation of overstepping the limits imposed by ethics". In his dreams of cloning a human being he himself began to fear his own shadow by imagining what would become of the soul if his own image came out of the mirror and was living with him. In his wildest imagination he wondered if the soul would have its own life or would be split between himself and his clone or it would simply be a miracle of God or an ambush of the human vanity. [43]. Lost in his thoughts he felt that cloning a human being was technically possible, but ethically wrong. In this same line of thought Albieri felt (and this is an opinion shared by many scientists) that whether human cloning was acceptable or not, the ethical resistance against some new issues in science could be changed. He argued by drawing on the Middle Age belief that the body was sacred and opening it was a crime for whatever reason. He continued that if science would be stopped because of ethical issues there would never be any progress. Today surgical operations are not only acceptable, but desired in the treatment of certain diseases. Scared by fear of the unknown of what may happen to him should it be realised that he has carried out human cloning, Albieri decided to keep his experiment secret to all. In this secrecy, Albieri committed one of the most heinous ethical crimes of scientific research – that of cloning a person (Lucas) without his consent. All of these constitute a contradiction in terms.

4.1.2. Characteristic 2

The fact that Mel, lone daughter of the Lucas and Maysa couple is a drug addict and aggravated thief is a solution to a problem. What can this problem possibly be?

Problem: The Lucas and Maysa couple is in discord and fraught with unfaithfulness in their relationship. This creates a traumatising and stressful environment for Mel who feels abandoned and lonely. The problem that can be deciphered from this situation is how to fill the void experienced in her life and find a safety valve out of her stressful and traumatising environment.

Solution adopted: Resort to drugging and alcoholism in the hope of finding solace by drowning her worries and forgetting her problems. The consequence is that in doing so when she has no money to buy drugs she steals. Additionally, this leads her into joining company with Virginia and Nando, who are street girls and this later aggravated her case due to the strong peer influence that these latter exerted on her.

Inferentially, street children abandon their homes because of poor treatment, lack of attention and care from their parents and the feeling of loneliness. Most often, such homes are either broken or are homes where parents are in regular discord caused by alcoholism, unfaithfulness, drugging, etc. In an effort to seek solutions to their worries and stress, such children easily resort to drug and alcohol consumption, mischief and involvement in stealing, pick-pocketing and in extreme cases armed robbery. From the point of view of health, the nervous system and vital organs of the body are destroyed by drugs, be they mild or hard drugs. [44].
It is for this health reason that governments regulate the circulation and consumption of mild drugs such as cigarettes and alcoholic drinks. From the economic point of view, governments divert huge sums of taxpayers' money to fight the consumption of hard drugs such as cocaine, morphine, marijuana, etc that cause immeasurable health problems to whole populations.

4.1.3. Characteristic 3

The religious conflict opposing Islam to Christianity exemplified by the domestic life of principal actors (members of the same family) on horseback between Fès in Morocco and Rio de Janeiro in Brazil is a solution to a problem. What can this problem be?

Problem: How to demonstrate a show of power and the differences in power relationships between religious ideologies by pitting Islam against Christianity.

Solution adopted: To make the same family live sometimes in Fès in Morocco – a typical Moslem country where the knowledge, values and practices are routed in the teachings and prescriptions of the Koran and at other times in Rio de Janeiro in Brazil, where the precepts of knowledge, values and practices are routed in Christianity against the background of Western civilisation. Life on horseback is a portrayal of wealth and ascent to the bourgeois lifestyle which translates into a show of strength and superiority. This is a sort of class society which provides level ground to confront two opposing ideologies – Islam (Moslem civilisation) and Christianity (Western civilisation).

In the soap opera, Jade is a young Moroccan girl brought up in Brazil against the background of the Western culture. When she returns to Morocco, she is obliged to learn all concomitant new traditions and customs, adjust to her new way of life, and face all the punishments she will be exposed to because of her conflicting personality and actions that go

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against her religion. As a result she is unable to build a steady family life with Saïd and her dream is rather to share her feelings with Lucas – a non Moslem. Conscious of the fact that it is haraam (sin) to love Lucas, she decides to forego her religious mandates for the sake of love, which prohibit her from marrying a non-religious person. In desperation, Jade and Lucas resolve to run away to Brazil – a plan that was ruined by the devastating news of Diogo's death by helicopter accident. Parallel to this, Mohammed takes refuge behind his uncle Ali to avoid marrying a second wife that the uncle Abdoul wants him to marry by force, according to the prescriptions of Islam. Mohammed's girl, Samira, refuses to wear the veil and is locked up and confined to her room with prohibition not even go to school.

To accentuate the religious conflict, the script writer Glória Perez forges a new alliance of marriage between Moustapha (Moslem by faith) and Noêmia (Christian by faith). The script writer laces these conflicts with erroneous but interesting interpretations of the Koran, lies, unfaithful exchanges of the feelings of people in mixed marriages pitting Islam and Christianity. The handling of Islamic customs and attitudes mixes traditions from diverse countries, rather than those of Morocco alone. This has been criticised for its inaccurate representation of these traditions [45] including the portrayal of polygamy as commonly accepted in Morocco, women as rarely working outside the home or pursuing an advanced education, and women having only unimportant roles within the family.

Zooming on Islam and Christianity constitutes according to Huntington [46] the ingredient that fuels the ideological conflict. For the Christians, the problem is not about Islam. It is rather about Muslim fundamentalism which is a different ideology with some adherents who are fanatics and convinced of their superiority though inferior in strength. For the Moslems, the problem is about the Western civilisation – an ideology with adherents believing in the universality of their culture and which must be accepted by all because their superior power confers on them the right to spread this culture throughout the world.

4.2. Application and Competency Category

The application and competency category has significant implications in education. In this study this section clarified in a scientific way, the conflict over the parentage of Leo, the concept of cloning and artificial insemination.

From the results of questions 4 and 5 of the homework, respondents produced the pedigrees as in figures 3 and 4 to show the transmission of the nuclear and mitochondrial chromosome materials to Leo:

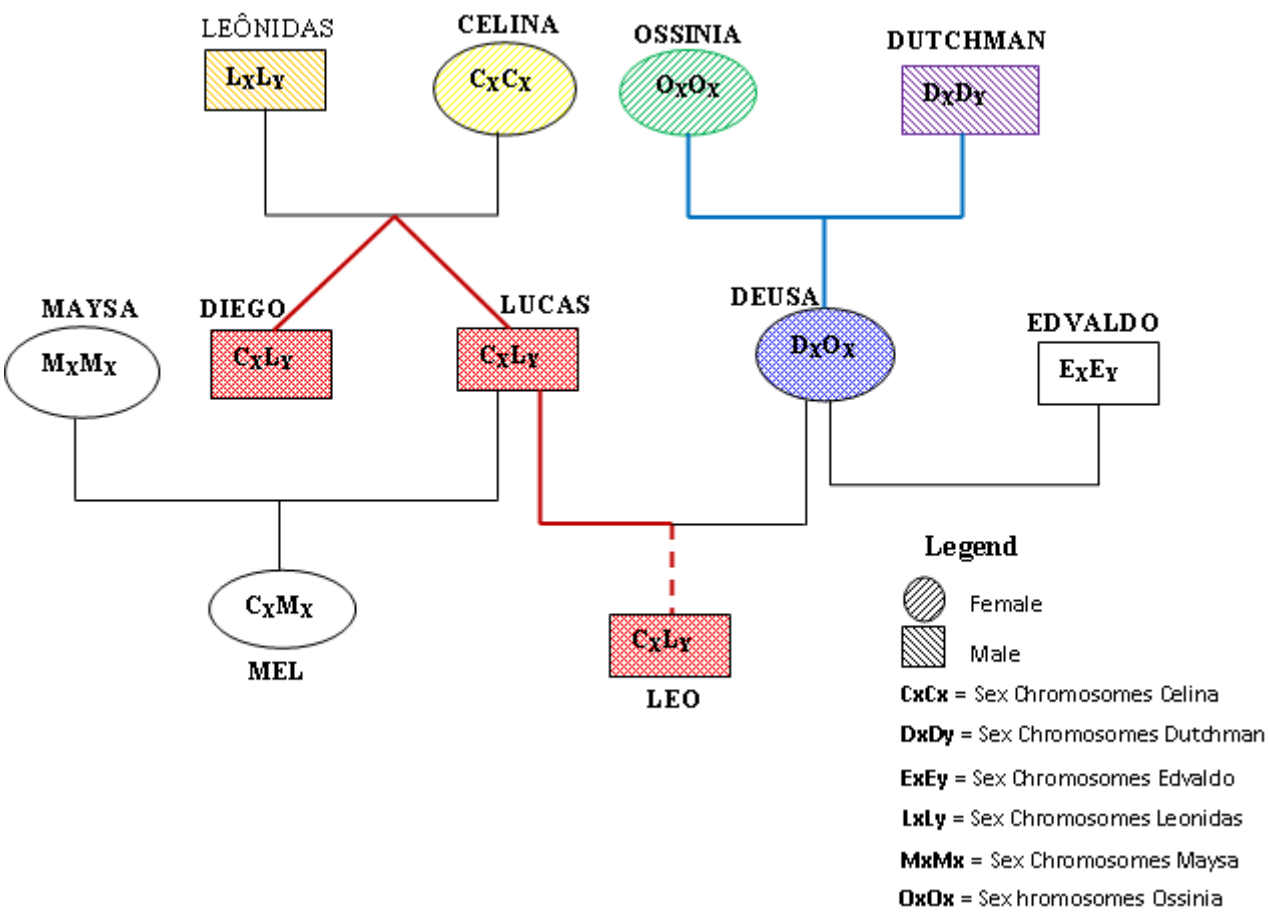


Figure 3: Pedigree of transmission to Leo of nuclear DNA

From this pedigree, the question that immediately comes to mind is: What can explain the fact that a person of pure Negro race (Deusa) –bears a pure White race child (Leo), judging from the declarations of Ossinia the mother of Deusa? According to Ossinia (also pure Negro race), Deusa's father was a Dutchman of pure White race. Deusa

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would then be a mulatto and not of a pure black race which she is by her skin pigmentation. This suggests that since Deusa is of a pure Negro race, then her mother is probably not telling the truth about the genotypic and phenotypic expressions of the Dutchman. On the other hand, if the donor of the insemination semen is a white of pure race, the probability of the cross will be 50% mulatto and 50% white of pure race. This is not the case since Deusa is pure Negro race. Hence if the cross leading to the production of Leo respects Mendelian genetics, he will have a fifty-fifty chance of being a white of pure race. What happened in the creation of Leo did not obey the laws of classical genetic crossing and hence the paradox of a pure Negro race person begetting a child of pure White race. If the donor of the insemination semen is also a mulatto (which is not the case since Lucas is of a pure White race), the hereditary character combinations bound to skin pigmentation will be such that Leo will have a quarter chance of being a white of pure race. In all, the reactions of the others are rather challenging insofar as this type of combination of hereditary characters have never been seen. For them, Leo would be a stolen child, thus reinforcing Leonidas' claim over the parentage of the child. Without contradicting Ossinia, the father of Deusa had to be a mulatto Dutchman so that the different genetic combinations will confer on Deusa a fifty-fifty chance to be a pure Negro race, and consequently the possibility of begetting a pure white race child.

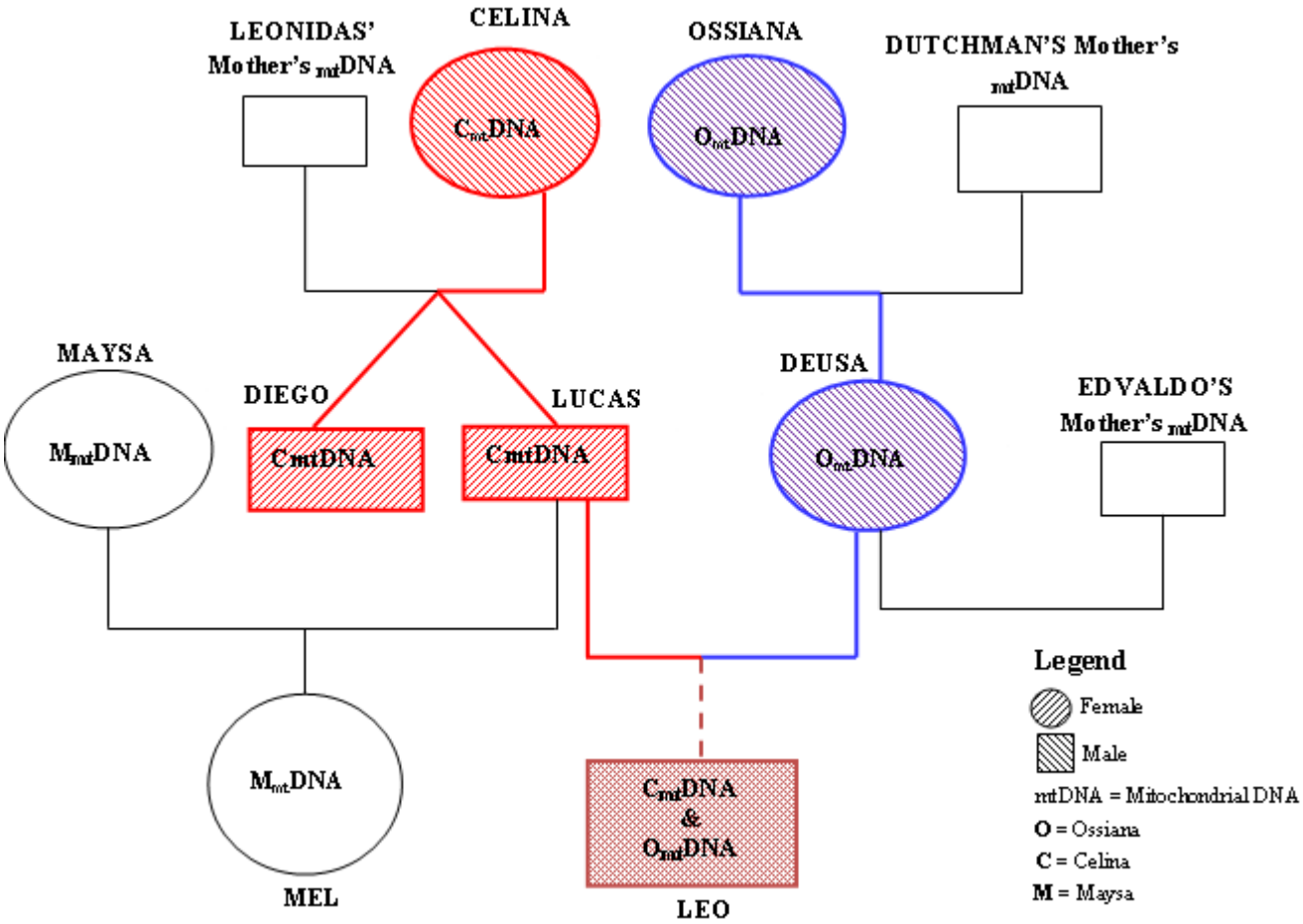


Figure 4: Pedigree of transmission to Leo of the $_{mt}$DNA of his grandmothers

Concerning the transmission of $_{mt}$DNA to Leo, the question this pedigree raises is: Between Deusa and Leonidas, who is the parent of Leo? During fertilisation, the male spermatozoon introduces its nucleus into the oocyte leaving behind its cytoplasm and cytoplasmic organelles. The mitochondria and the $_{mt}$DNA that the resulting embryo contains are contributed by the oocyte. Hence $_{mt}$DNA is transmitted to the progeny by the mother. From this pedigree, Celina's mitochondrial DNA (C_{mt}DNA) is therefore present in the cytoplasm of the somatic and germ cells of her twins: Diogo and Lucas. In the same way the mitochondrial DNA of Ossiana (O_{mt}DNA) is transmitted to Deusa and will be found in the enucleated oocyte of Deusa. When Doctor Albieri enucleates Deusa's, oocyte, the nuclear chromosomes and their DNA are removed. The mitochondrial chromosomes inherited from Ossiana remain in the cytoplasm. Lucas' somatic cell introduced by Albieri into the oocyte of Deusa contains C_{mt}DNA. The fusion of the two cytoplasms places in the same embryo the C_{mt}DNA and O_{mt}DNA. This was implanted in the uterus of Deusa, the surrogate mother and Leo – an exceptional person with two types of mitochondrial DNA is produced.

In this process there was neither mating between Deusa and Lucas nor the transfer of Lucas' spermatozoa, hence Lucas did not provide any gamete in the classical sense of natural procreation and artificial insemination. We are therefore obliged to look for the chromosome descent of Leo from:

- the parents of Lucas – Leônidas and Celina. From this lineage Leo therefore has the following chromosomal architecture:

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- for the sex chromosomes : Cx from Celina and Ly from Leônidas;
- for the mitochondrial chromosomes : C_{mt}DNA from Celina.
- From the Deusa/Ossiana lineage Leo has:
- for the sex chromosomes: nothing
- for the mitochondrial chromosomes: O_{mt}DNA from Ossiana.

The clone obtained from cell transfer therefore is not an exact copy of the donor (Lucas) – He is actually a mosaic consisting of a mixture of the content of the enucleated oocyte from the surrogate mother and the somatic cell of the donor. This implies that the cloning of multicellular organisms using SCNT is not equal to true cell cloning when a one-celled organism such as the amoeba divides and clones itself. In a similar way plants clone themselves when they reproduce by budding, tubers, suckers, for example. Identical or monozygotic twins come from a natural cloning process. In all these examples, there is exact duplication of the whole body cell including the nucleus, cytoplasm, organelles and the membrane. In the case of Leo, there is no exact duplication of the constituents of a single cell. He is a mosaic of the fusion of two cell constituents [52, 53, 54], which is very similar to the process that occurs when a plant shoot is grafted onto a rootstock. It is equally similar to the grafting of a piece of skin on a wound. In both cases the emerging organism is a mosaic of the fusion of cellular materials of the donor and recipient. Leo therefore has a complex chromosomal architecture. Hence Leo is neither 100% Leonidas' child, nor Deusa's. How then can the two protagonists be convinced that Leo neither belongs to one or the other 100%? For both, the presence of the O_{mt}DNA (from Ossiana) and the C_{mt}DNA (from Celina) in Leo is enough to cast doubts in their mines as to the clone's genealogy and therefore parentage. Additionally, it is believed in the anthropology of the Bamiléké, Betis and most grass field communities of the West, Centre and North West Regions of Cameroon that vampirism is the ability for an individual to transform into a bat or owl at night and suck blood from people. The anthropology of these communities holds that this is a heritable characteristic which is transmitted by mothers to their progenies. Hence this characteristic should be sex-linked and transmitted by the x-chromosome. In the telenovela, Celina is a vampire and Deusa is not. The gene for vampirism should therefore have been transmitted to Diogo and Lucas and consequently to Leo. The external demonstrations of vampirism should dissuade Deusa from forcefully laying claims to the matrilineal right of parentage because Leo has another dimension that she ignores.

In transposing the scientific knowledge in the series, we also paid attention to errors and mistakes of facts which could render the teaching/learning process cumbersome and uninteresting. Of particular attention was the use of the genetic information of the mitochondria as proof of Deusa's matrilineal claim over Leo. Although Glória Perez – the script writer used this idea, it was fraught with mistakes illustrated by the submissions of the counsel for Deusa who requested for a test to analyse the DNA in "plasma" (instead of the cytoplasm). He goes on to affirm that in the plasma there is one specific "cell" (the plasma is the liquid part of blood and does not contain cells) called mitochondria (the mitochondria is not a cell). Additionally, some feel that Leo will die precociously as he was produced from a 20 year old somatic cell. By referring to the fact that it was discovered that Dolly the sheep was prematurely aging, Leo had to face the doubt of how long he would remain alive [43]. This is another mistake of interpretation of scientific facts and processes because mature cells in vegetative reproduction undergo dedifferentiation to become totipotent before entering embryogenesis. [55, 56]. In grafting in plants, the scion that is grafted onto the stock has reached structural maturity with secondary wood, yet it develops and produces fruits. In Leo's case, the host (enucleated oocyte of Deusa) receives the scion (somatic cell of Lucas). The somatic cell should undergo a dedifferentiation to acquire a totipotent status before undergoing embryogenesis. Hence Leo will have a normal life cycle like all other people descended from sexual reproduction. Despite this scientific fact that explains that the clone will live a normal life, when Leo found out that he was a clone, he had existential problems because he considered himself only a copy and tried to define his own identity. He equally felt quite uncomfortable with the way people will look at him after knowing he was a clone.

4.3. Mathematical implications

Cantor's definition posits that the set theory is founded essentially on membership or belonging. In "O Clone", the nuclear and mitochondrial chromosomes constitute the elements or members of the set and can be represented on Venn diagrams [47]. Such presentations will facilitate the understanding of the mechanism of cloning that resulted in the creation of Leo. The sets of sex and mitochondrial chromosomes in Lucas, late Diogo and Leo (clone or graft) are presented in set notation as in figures 5 and 6.

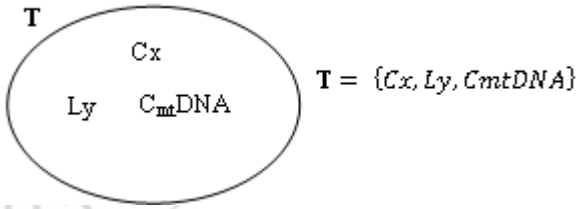


Figure 5: Set of the sex and mitochondrial chromosome elements of the monozygotic twins Lucas and Diogo

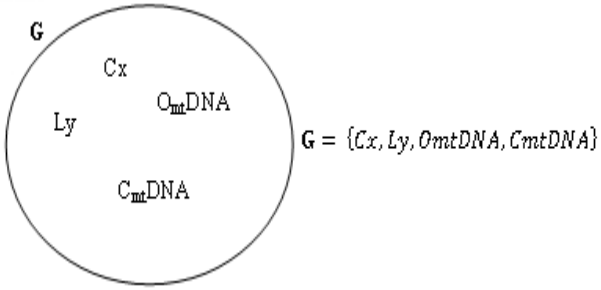


Figure 6: Set of the sex and mitochondrial chromosome elements of the Clone (Graft) Leo

Inclusion set

The set T has elements which are included in set G; said otherwise, T is a part of (or subset of) G (Figure 3).

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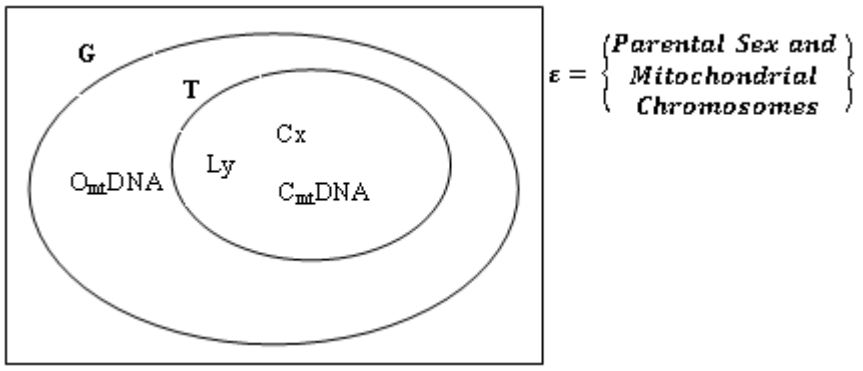


Figure 7: Set of the sex and mitochondrial chromosome elements of the Clone (Graft) Leo

With respect to the movie, the development of Lucas' cell takes place inside Deusa's enucleated oocyte. Stated otherwise, T is bound to G. In this study, Albieri's problem (how to generate another Diogo) is allied or bound to Deusa's (how to bear a child without betraying Edvaldo's fidelity to her by having sex with another man). Leo (the clone) – is the solution to both problems, materialised by figure 7. This solution vilifies the mathematical concepts that:

- *T U T^C = G: where T = set of sex and mitochondrial chromosomes of Lucas; T^C = Complement of T in* **ε***; and* **ε** *= Universal set containing elements of sets T and G in which one of the $_{mt}$DNA is present in set G and absent in set T;* [48];
- *a minus* multiplied by another *minus gives a positive* [49, 50].

The practical application of these concept in the life sciences is demonstrated by the phenomenon of conjugation in bacterial mutant strains in which *one mutant* incapable of synthesising certain amino acids (such as A, B, C) in conjugation *with another strain* incapable of synthesising amino acids (D, E and F) for example gives a *recombinant strain that synthesises all of the amino-acids of both strains.* [51]. This solution to the mutant bacterial protein synthesis is akin to the solution of the problems of Albieri and Deusa in the telenovela.

Difference set

The difference G – T = def $\{x | x \in G \text{ and } x \notin T\}$. Stated otherwise, $x \in (G - T)$ provided $(x \in G) \wedge (x \notin T)$. This is true of the relationship between the $_{mt}$DNA of Leo (the clone) and those of Lucas and Diogo. It is therefore the complement of G in the universal set **ε**. This means that the complement of the intersection between sets G and T constitutes the difference set with single element O_{mt}DNA. Hence, G – T = $(G \cap T)^C$ = O_{mt}DNA is a singleton. This is materialised in figure 7 [48]. The symmetrical difference of the two sets G and T is the set of the elements belonging to one and only one of the sets G and T. It is also the union of the difference of G and T, and the difference of T and G. Hence, $G \Delta T = (G \cup T) - (T \cup G)$
From this relationship therefore, the symmetrical difference is commutative: $G \Delta T = T \Delta G$

With respect to the movie series "O Clone" the symmetrical difference shows the chromosomal contribution of the parental lineage of the clone: the host (Deusa's enucleated oocyte containing O_{mt}DNA) provides the vigour; while the donor (Lucas' somatic cell containing Cx, Ly and C_{mt}DNA) contributes the characters to be preserved. The fusion between the host chromosomal materials and those of the donor poses the contemporary socio-controversial questions of cloning and bioethics which calls for a social practice by teachers that cannot only be limited to the classroom situation but must move outside the school environment into the community where issues of societal practices and value systems are raised [17, 32]. The transposition of such knowledge outside the school environment requires stepping out of the ambits of classical didactics [9]. The difference set concept further explains the fact that Albieri wanted to produce another Diogo, but obtained a Diogo other than his expected Diogo. Additionally, the possession of the O_{mt}DNA by Leo (the solution to Albieri's and Deusa's problems) in a way signifies the common denominator of the entire movie series – unique child families: Leonidas and Celina had twins, and one died leaving only one; the Dutchman and Ossinia had only Deusa; Lucas and Mysa had only Mel; etc. The obvious consequence of the unique child family is that in the event of death, there is no possibility of replacement. Resorting to cloning as Dr. Albieri did in the case of Diogo can only produce a mosaic and in no circumstance can one obtain an exact replica.

5. Conclusion

In this survey the term clones, although enthralling, may seem erroneous. The taught knowledge distinguishes the concept of natural clones (Diogo and Lucas) from a graft (Leo). The basis of the didactics transposition in the soap opera is led down scientific knowledge. The socio-controversial issues are rooted in ethics because of the social stakes involved. The scientific paradox of the soap opera is that Leo has 3 parents: a forster "father" (Lucas) and two donor "mothers" (Celina and Deusa). Diogo and Lucas are identical; Diogo, Lucas and Leo are similar [52]. Klopfer's taxonomy used in combination with Noumi's hypothetico-deductive model of thinking enabled the clarification of the inherent problems in this survey (paternity and maternity suit, drugging, conflicts of civilisations, cloning and bioethics). The use of the Mathematical theory of sets, added more meaning to the application of this model in teaching inferential thinking and therefore the interpretation of inherent scientific knowledge in the telenovela. Within limits of this work, this model appears to benefit both students and teachers and could throw light on didactic

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transposition, the teaching of inferential thinking skills, socio-controversial and bioethical issues.

Work in progress seeks to explore the possibilities of applying this model to initiate primary school pupils in Cameroon into inferential thinking skills and the possibility of reinvesting their constructed knowledge in explaining simple phenomena and events in nature and their environment. It would be interesting to find out whether it would mean the creation of a new variety of humanity if Lucas and Diogo were females and Leo also a female with the potential to grow into an adult and start natural procreation.

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