Mathematical Modelling on the Impact of Educational Factors on the Control of Marital Conflict

Bako, D.[1*] and Yusuf, I.[2]
[1]Department of Mathematics, Federal University of Technology Minna, Nigeria.
[2]Department of Computer Science, Niger State College of Education Minna, Nigeria.
*Corresponding Author Email: deborah.bako@futminna.edu.ng

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ABSTRACT
Family is the bedrock of any society, this is formed as a result of marriage. The study looks at how various education approaches affect marital conflict control. The results of teaching 80% of married men 80% of married women about the risks of marital conflicts are compared with the education of 80% of married men and 20% of married women. The results show that the previous approach is ineffective in bringing the effective contagion rate down to zero, suggesting that conflicts are still spreading among the population. The effective contagion rate in the latter method, on the other hand, initially decreases significantly before beginning to grow again along the trend. In order to attain the best possible control over marital conflicts, a balanced strategy is advised, with 50% of each genders' education coverage. This well-rounded approach seeks to achieve gender parity while guaranteeing that a significant segment of the populace is educated about the risks associated with marital conflicts and divorce.

INTRODUCTION

Marriage is the formal and socially recognized union of two people to become husband and wife.. Family is the vital cell of any society, hence it makes up the society and this is formed as a result of marriage. People get married due to the following reasons; love, childbearing, companionship, legal status, financial security, to create a safe relationship where one can reach the deepest level of intimacy and connection, to provide security for children, to signify a life-long commitment and based on ones' religious belief (Abdulrahman 2021). However, conflicts within marriages are inevitable and can have significant ramifications on the well-being of both spouses and their overall relationship (Nyarks 2023). It is paramount for couples to understand that marriage is not a bed of roses and would not be smooth always enables a marriage to have high hopes of surviving. There is no perfect marriage, every marriage has its problems or challenges peculiar to it. But, there are some factors associated with a successful marriage such as developing communication skills, commitment, forgiveness, accepting each other, appreciation, spending quality time, respect, and trust for each other. This is because everyone desires peace of mind and not a nagging husband or wife (Ghaznavi 2022). Marriage conflicts encompass a wide range of issues, including disagreements over finances, parenting styles, communication breakdowns, infidelity, and differences in values and expectations. Numerous authors have

contributed to our understanding of the causes of marriage conflict. According to Gottman and Silver (2015), conflicts often arise from deep-rooted differences in core values and incompatible personality traits. Additionally, Fincham and Beach (2010) highlight the role of situational factors, such as financial stress or work-related demands, in triggering conflicts within marriages. In their seminal work, Johnson and Greenberg (2013) emphasize the significance of attachment styles and the impact of past experiences on present relationship dynamics. These authors collectively underscore the multifaceted nature of marriage conflict, emphasizing the importance of examining both individual and contextual factors.

It is presumed that conflict was not part of the original plan after getting married. This is because marriage is supposed to be a union for life without any thought that it may one day come to an end (Tessema 2022). But life happens, thing change, love fades, problem arises and excitement begin to wave off. conflicts does not just happen. It is a result of accumulated, unresolved, unspoken errors, unchecked attitudes, and overlooked misunderstandings that sponsor conflicts in the long run. Stable families creates a prosperous nation and a stable world, while poor families breed weak, corrupt and result a country and globe in disarray (Ogwumu, 2020). Marriage conflicts can have far-reaching consequences for the well-being of individuals and the

stability of the relationship. Extensive research by Amato and Previti (2003) demonstrates that unresolved conflicts often contribute to marital dissatisfaction, increased likelihood of separation or divorce, and negative effects on physical and mental health. Conflictual marriages can also adversely affect children's development, as highlighted by Cummings and Davies (2010). Their studies reveal that ongoing marital conflict can lead to increased behavioral problems and emotional distress among children. These findings underscore the urgency of understanding the consequences of marriage conflict and developing effective interventions.

Marital conflict is a universal phenomenon that transcends cultural, socioeconomic, and geographic boundaries. It is an essential area of study, as understanding the nature and dynamics of marital conflicts can shed light on the challenges faced by couples globally. Marital conflict manifests in diverse ways across different cultures (Amato 2000). Research conducted by Hofstede (2001) on cultural dimensions revealed that societies vary in their approaches to conflict resolution, ranging from more collectivist cultures that prioritize harmony and avoiding conflict to individualistic cultures that emphasize open confrontation. For example, in collectivist cultures, such as Japan and Korea, maintaining harmony within the family unit takes precedence over expressing individual needs, potentially leading to suppressed conflicts (Abhinandita 2023).

On the other hand, direct communication may be more typical during marital disputes in individualistic societies like the United States. These cultural differences emphasize how crucial it is to take context and cultural norms into account while researching marital conflict. Globalization's increased interconnectedness has had a significant effect on married couples all around the world (Don 2020). Traditional gender roles and expectations inside marriages change as cultures grow more interconnected. For example, changes in the decision-making processes and power dynamics within relationships have been influenced by the entry of women into the workforce and the breakdown of traditional gender norms. As spouses adjust to their new roles and responsibilities, these changes may cause disputes.

Similar to a social virus, marital conflicts can propagate via social engagement, impacting people and their connections. This viewpoint, which uses the metaphor of infection, contends that bad feelings and actions can spread from one spouse to the other and even to people in their social networks, making marital strife contagious (Abelneh 2021). Seeing marital conflict as a social contagion can help us better understand the mechanics of conflict propagation, its effects, and possible preventative and intervention measures. Just as contagious diseases can spread through a variety of social contact pathways, so too can marital conflicts. According to research conducted by Feinberg (2007) has shown that conflicts between

spouses can spill over into interactions with children, affecting parent-child relationships and potentially spreading conflict to the next generation. Additionally, conflicts within a marriage can influence the behavior and emotional well-being of family members, friends, and acquaintances who witness or are indirectly exposed to the conflict (Lavner, Karney, & Bradbury, 2016). Through verbal and nonverbal communication, emotional contagion, and observational learning, marital conflict can be transmitted and replicated in social networks, perpetuating a cycle of discord (Josia 2022).

The spread of marital conflict has significant consequences for individuals and their social environments. Individuals who are repeatedly exposed to conflict within their social networks may experience heightened stress, emotional distress, and negative affect (Lavner et al., 2016). Witnessing or being involved in ongoing marital conflicts can lead to increased conflict sensitivity and negative relationship expectations, affecting the quality of their own relationships (Rhoades, 2008). Moreover, the social contagion of marital conflict can contribute to the erosion of social support networks, as conflict spreads and affects relationships beyond the marital dyad (Bako 2017).

Understanding marital conflict as a social infection suggests strategies for prevention and intervention. Interventions should target both individuals and their social networks, aiming to equip couples with conflict resolution skills and enhance relationship satisfaction. Authors like Gottman and Gottman (2017) advocate for open communication and mutual respect, while others, such as Markman, Stanley, and Blumberg (2010), propose structured interventions like couples therapy. Additionally, preventive measures like premarital counseling, as suggested by Christensen and Jacobson (2000), can address potential sources of conflict before they escalate, emphasizing the importance of proactive strategies in reducing the prevalence and intensity of marital conflicts.

Mathematical modeling is a versatile tool that can be used to solve a wide range of problems by identifying the problem, developing a mathematical representation of the problem, the validity of the model, and using the model to make predictions and decisions (Azuaba 2022). Mathematical modeling allows us to formulate formal representations of marriage and divorce dynamics, capturing the intricate interactions between individuals, their choices, and external influences (Oluwafemi 2014). By employing social phenomena. This is achieved by the use of quantitative methods to represent human relationships. This interdisciplinary approach can inspire further collaborations between researchers in different fields and foster innovation in both mathematical modeling and social sciences (Bako

2017).

MATERIALS AND METHODS
Assumptions of the model:
- Marital conflict can only occur in a marriage setting
- Every married couple can develop problem.
- The newly married couple that make up the population of married people is constant without considering the death rate, birth rate or migration.
- Every married couple with problem can either go for counselling, separate or divorce.

- Every married couple with problem that go for counselling can separate, divorce or can unite.
- Every marriage couple with problem that are separated, can either unite back or divorced.

Model Formulation
The total population is divided into six sub-populations, which consist of susceptible male (S_m), married male (M_m), divorced male (D_m), susceptible female (S_f), married female (M_f), divorced female (D_f) as shown in the diagram below:
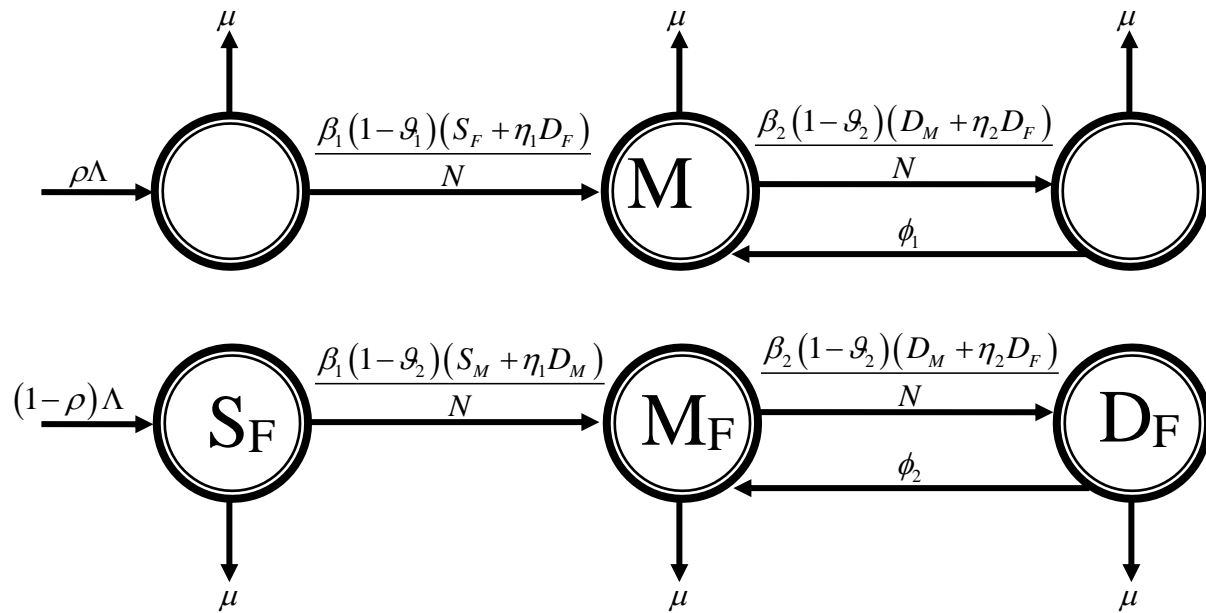
Figure 1: Schematic diagram of the Marital Conflict Model

A full description of the parameters used in the model are given below:

Parameter	Description
Λ	Recruitment number of human
ρ	Birth rate of male
β_1	Contact rate of susceptible and divorced individuals
β_2	Contact rate of divorced individuals
μ	Per capita natural mortality rate
ϑ_1	Control rate for reducing conflict by men
ϑ_2	Control rate for reducing conflict by women
η_1	Modification parameter for the reduction of conflict by men
η_2	Modification parameter for the reduction of conflict by women
ϕ_1	Rate at which divorced men remarry
ϕ_2	Rate at which divorced women remarry
N	Total human population

The corresponding mathematical equations of the schematic diagram can be described by a system of Ordinary Differential Equations (ODEs) given below:

$$\frac{dS_M}{dt} = \rho\Lambda - \frac{\beta_1(1-\vartheta_1)(S_F + \eta_1 D_F)S_M}{N} - \mu S_M \tag{1}$$

$$\frac{dM_M}{dt} = \frac{\beta_1(1-\vartheta_1)(S_F + \eta_1 D_F)S_M}{N} - \frac{\beta_2(1-\vartheta_2)(D_M + \eta_2 D_F)M_M}{N} + \phi_1 D_M - \mu M_M \tag{2}$$

$$\frac{dD_M}{dt} = \frac{\beta_2(1-\vartheta_2)(D_M + \eta_2 D_F)M_M}{N} - (\phi_1 + \mu)D_M \tag{3}$$

$$\frac{dS_F}{dt} = (1-\rho)\Lambda - \frac{\beta_1(1-\vartheta_1)(S_M + \eta_1 D_M)S_F}{N} - \mu S_F \tag{4}$$

$$\frac{dM_F}{dt} = \frac{\beta_1(1-\vartheta_1)(S_M + \eta_1 D_M)S_F}{N} - \frac{\beta_2(1-\vartheta_2)(D_M + \eta_2 D_F)M_M}{N} + \phi_2 D_F - \mu M_F \tag{5}$$

$$\frac{dD_F}{dt} = \frac{\beta_2(1-\vartheta_2)(D_M + \eta_2 D_F)M_F}{N} - (\phi_2 + \mu)D_F \tag{6}$$

ANALYSIS OF THE MODEL:
To verify if the model is biologically meaningful and well posed, we determine the invariant region to break that all solutions of our model equations are positive for all time $t \succ 0$ and that Ω is indeed, bounded.

INVARIANT REGION:
We show that the solution of system (1-6) are feasible for t > 0 and has a solution that is enclosed in the invariant region.

Summing all the six equations of the model gives;

$$N(t) = S_{M(t)} + M_{M(t)} + D_{M(t)} + S_{F(t)} + M_{F(t)} + D_{F(t)}$$

Then, differentiating $N(t)$ *with respect to t*

$$\frac{dN}{dt} = \frac{S_M}{dt} + \frac{M_M}{dt} + \frac{D_M}{dt} + \frac{S_F}{dt} + \frac{M_F}{dt} + \frac{D_F}{dt}$$

Effective Contagion Rate $\left(R_{eff}\right)$

The threshold quantity $\left(R_{eff}\right)$ is the effective contagion rate of the model $(1) - (6)$ for the stability analysis for controlling marital conflict. It measures the average number of new conflict generated by a typical marital conflict in a population comprising of completely susceptible married couples.

Using the next generation operator technique described by (Diekmann & Heesterbeek, 2000), the effective contagion rate $\left(R_{eff}\right)$ of model (1) to (6), which is the spectral radius $\left(\rho\right)$ of the next generation matrix. This is given by:

$$F = \begin{pmatrix} \dfrac{\beta_2(1-\vartheta_1)M_M^{~0}}{N^0} & \dfrac{\beta_2(1-\vartheta_2)\eta_2 M_M^{~0}}{N^0} \\[3mm] \dfrac{\beta_2(1-\vartheta_1)M_F^{~0}}{N^0} & \dfrac{\beta_2(1-\vartheta_2)\eta_2 M_F^{~0}}{N^0} \end{pmatrix}$$

$$V^{-1} = \begin{pmatrix} \dfrac{1}{k_1} & 0 \\[3mm] 0 & \dfrac{1}{k_2} \end{pmatrix}$$

$$R_{eff} = \frac{\beta_2(1-\vartheta_2)\left(k_1\eta_2 M_F^{~0} + k_2 M_M^{~0}\right)}{k_1 k_2 N^0}$$

RESULTS AND DISCUSSIONS

**Table 1: Estimation of Variables and Population-dependent Parameters Values**

S/N	Parameter	Value	Source
1	Λ	3000	Estimated
2	ρ	300	Estimated
3	β_1	0.005	Estimated
4	β_2	0.0027	Estimated
5	μ	0.9	Estimated
6	ϑ_1	0.3	Estimated
7	ϑ_2	0.00005	Estimated
8	η_1	0.01	Estimated
9	η_2	0.6	Estimated

10	ϕ_1	(0,1)	Varied for computational reasons
11	ϕ_2	0.5	Assumed
12	N	5000	Assumed

derived from empirical data.
The assumed values are based on assumptions about the system because real data are not available.
The varied value is used to explain difference model behavior and is varied wuth a range of computational analysis.

The parameter and variables above are defined in Table 1. The estimated values indicate that these parametrt were

Effect of the rate of control strategies on susceptible married couples on the dynamics and control of marital conflicts
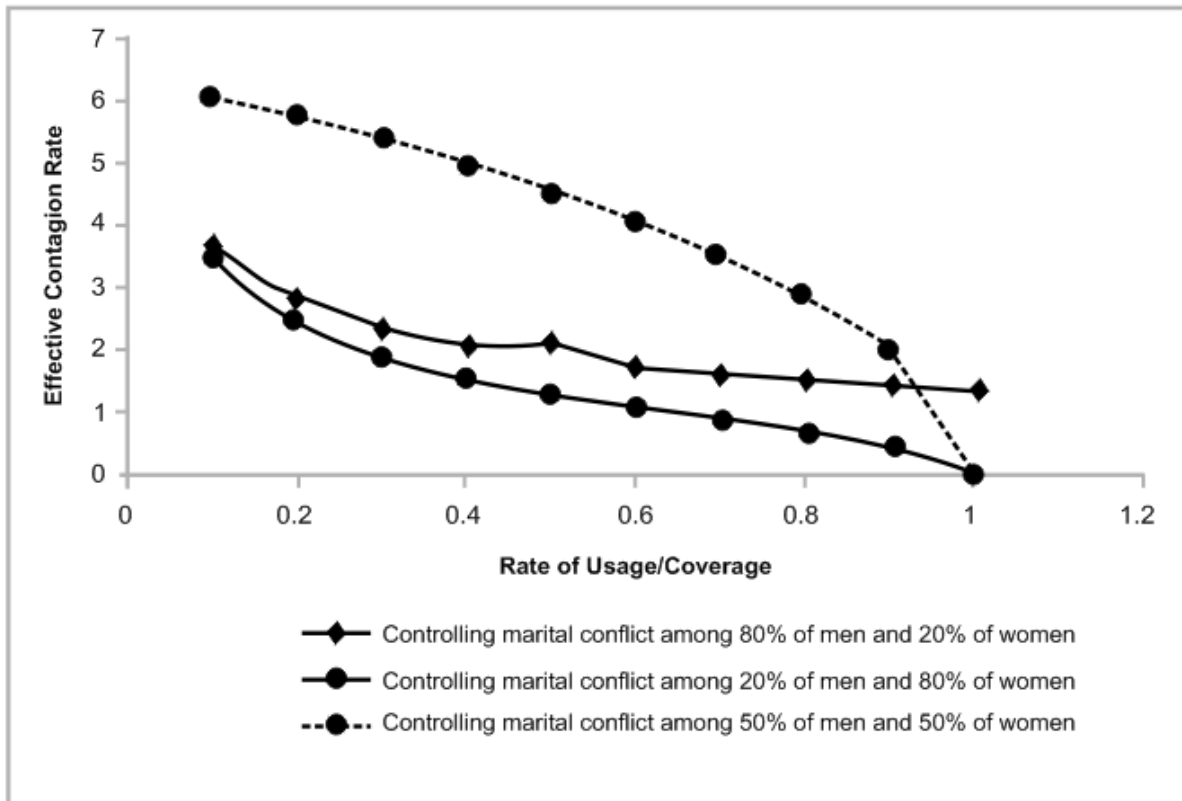
Figure 2: Effect of three different control strategies on the dynamics and control of marital conflict

The analysis of Figure 2 highlights the impact of different education strategies on controlling marriage conflict. Focusing on educating 80% of married men and 20% of married women about the dangers of divorce proves to be ineffective, as the effective contagion rate never reaches zero. This indicates that conflict continues to persist and spread within the population. In contrast, when 20% of married men and 80% of married women receive education on the dangers of divorce, there is a notable reduction in the effective contagion rate. However, it is important to note that even though the effective contagion rate drops to zero initially, it starts to rise again along the trend.

To achieve optimal control of marital conflicts in a society, a balanced approach is recommended. Implementing a 50% coverage rate of education for both married men and women demonstrates promising results in minimizing the spread of marital conflict. This strategy aims to strike a balance between the genders, ensuring that a significant portion of the population receives education on the dangers of divorce. By adopting this approach, it is expected that the effective contagion rate can be effectively managed and kept at a lower level. Overall, the findings suggest that a comprehensive education strategy involving both married men and women is crucial for effective control of marriage conflict. The specific balance of educational coverage can play a vital role in

minimizing the spread of conflict within a society and promoting healthier and more stable marital relationships.

CONCLUSION
This study offers valuable insights into how educational strategies can influence the management of marital conflict. The results clearly indicate that exclusively targeting education toward one gender group does not effectively mitigate conflict transmission within a population. While educating 80% of married men and 20% of married women demonstrates some effectiveness, a more balanced approach, educating 20% of married men and 80% of married women, yields superior results initially in reducing the effective contagion rate. However, it's crucial to note that over time, the effective contagion rate begins to rise again, indicating the need for sustained efforts to maintain control over marital conflict. For optimal control, it's recommended to implement an equitable approach, with a 50% coverage rate of education for both married men and women. This approach recognizes the importance of addressing both genders and ensures that a significant portion of the population receives education on the risks associated with marital discord. By adopting such a comprehensive educational strategy, societies can work toward minimizing the spread of marital conflict and fostering healthier, more enduring marital relationships. Policymakers, educators, and professionals in relationship counseling should understand the importance of providing education to both genders and tailor intervention programs accordingly.

However, it's essential to acknowledge the limitations of this study. The analysis focused solely on the impact of educational strategies on the effective contagion rate, overlooking other potential contributors to marital conflict. Future research should explore additional variables, including cultural and socioeconomic factors, and conduct long-term follow-ups to evaluate the sustainability of the observed effects.

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