

Exploiting Agent-based Modeling and Simulation to Observe the Impact of Parental Attitudes on Behaviors of Schoolchildren

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Abstract – Agent-based modeling is a new technique used to understand social processes facing in the social sciences. The agent-based model is a model in which agents are used to represent the actors of the social world. When simulations of models for social sciences are performed, information about social processes is obtained and future outcomes of those processes are anticipated by using agents. Agent based modeling has also become increasingly popular in the education domain. It is possible to represent students' interactions with each other and their teachers where the teacher and students are programmed as agents in a simulation environment. In the present study, the school environment is represented in a simulation environment and students having undesired behaviors and their interactions with classmates are observed in this environment in order to investigate the relationship between the attitudes of parents and the undesired behaviors of primary school students. If there are students having undesired behaviors in the class environment, it is needed to examine the cause of undesired behaviors. Solving problems in the classroom mostly depends on the families.

Keywords – Agent-based modeling, simulation, education, undesired behaviors, parental attitudes

I. INTRODUCTION

A child first imitates his/her parents since the first interaction of him/her occurs between his/her parents in the ages of 0-6, which is the critical period for the child to develop his/her behaviors. The attitudes of the parents frame the behaviors of the child. Therefore, the unhealthy attitudes of the parents towards the child lays the basis of the adjustment disorders.

Authoritarian parents exert pressure on their child(ren) in order to sculpt their dream human model. The child is always monitored. Each action of the child is considered a mistake. The child's opinion is not cared. The child is only the vassal for the desires of the parents. Some parents may resort to violence as a punishment. Rules are the supreme parameters and absolutely everything that the parents say or do is true, without a question. This type of family is intolerant. There is no flexibility in anything. The child refrains from his/her parents in regards to sharing his/her problems. Families with a low level of education mostly adopt this attitude. These people build an ordinary human being with their do's and don'ts. The child cannot find himself/herself, and is not free. Therefore, he/she cannot be expected to be creative. The child acts rebellious. Continuous reprimanding, beating, discriminatory behavior from his/her siblings, accusing the child of everything, lack of love and care, not fulfilling the needs of the child, etc., are the stereotyped behaviors of these families. Their own lives are more important than the needs of the child. These parents know nothing about the living of the child. These children may experience behavioral disorders due to the lack of love and care. Children of these types of families may hurt their friends and damage their

properties, stand up against their teachers, skip school, fail at their courses, and continuously try to draw attention. In general, urchins are the children of such families. They are lonely, full of hatred, aggressive, they seek for love outside, do not trust anyone, and they lack self-control.

This is the attitude demonstrated by democratic parents who respect their child, care about what he/she says, ask for his/her opinion, show their love, have indulgence and are just, discuss the problems of the child and let the child make the final decision, in other words, who help the child realize himself/herself. These children are well-balanced, social, respectful, self-confident, creative, and assertive because they are raised in a free and respected environment without criticism. They are aware of their responsibilities.

These children learn problem-solving from their parents. Because their first social habitat is their families. It is impossible for an individual with certain genotypes, who spends his/her critical period of personality development with his/her parents to have a different personality formed outside of family life. All relevant studies show that there is a significant correlation between the psychological state of the children and parent attitudes.

The present study differs from similar studies for it examines the behaviors of children raised with careless parent attitudes towards other children raised with oppressive and democratic parent attitudes and different reactions of children of oppressive and democratic parents exposed to violence. Moreover, agent-based modeling and simulation is used to show how parental attitudes affect the behaviors of schoolchildren and interactions between children in a virtual school environment, and to try to find solutions in this

environment. Agent-based modeling is a computational method, which is an important tool in order to model complex adaptive systems in a wide range of applications, such as in the social sciences [1]-[4]; since a model developer can create models where components of systems and interactions of components are directly represented. In this method, models are created as computer programs and these programs represent the processes considered to occur in the real social world. For example, in a virtual school environment, the teacher and students are programmed as agents; therefore it is possible to observe students' interactions with each other and their teachers in a simulation environment where agents are used to understand the social world.

In this paper, we present our model for impacts of parent attitudes in school environment in detail. The principal way in the model proposed is very simple: Simple rules identified for students and interactions between students according to their parent attitudes. Our aim in this regard is to provide a virtual system that is very basic through a bottom-up modeling approach. The remaining sections of this paper are organized as follows. The section titled "Parental Attitudes" provides background information detailing the attitudes of the parents frame the behaviors of the child. The section titled "Materials and Method" presents a brief explanation of the fundamentals of agent-based modeling and simulation. The section titled "Agent-based Modeling and Simulation of the Relation Between Parental Attitudes and Behaviors of Schoolchildren" introduces the agent-based model. The section titled "Experimental Study" illustrates the experimental model developed for the study, presents the data, our analysis, and a discussion of the approach we used. The conclusion section presents a summary of this research study.

II. PARENTAL ATTITUDES

Attitudes are the tendencies that regularly form the thoughts, feelings, and behaviors of individuals regarding certain psychological objects. Stereotyped attitudes of individuals are formed with cumulative information from an early age. First role model of the child is his/her parents. Personality is developed between the ages of 0-6. Therefore, during this period, the child interacts mostly with his parents. The child regards his parents as faultless and patterns them. A child who grows up in an unhealthy family environment cannot establish healthy relationships with his own family in the future. The parent-child relationship is based on the attitudes of the parents. It has been determined that the first cause of adjustment disorders among children in many cases is the inadequate and inappropriate parent-child relationship.

A. *Oppressive and Authoritative Behavior*

Gürsoy states that if a family adopts authoritarian, oppressive behavior with strict rules, lacking tolerance instead of safe, sincere, warm relationships; unconditional obedience is expected from the child, there is a conditional love relationship, and the understanding of punishment is deprivation of love [5]. It is important to consider the quality of the control and discipline applied by the parents to the child's behavior as well as the love exhibited by the parents to the child. Daily observations reveal that strict and oppressive

disciplinary approach may cause passive, timid, easily submissive, inanimate, and inquisitive, or on the contrary, aggressive personalities [6]. Some families do not show love and do not take care of the child in order to prevent the child from becoming spoiled. They lose control over the child if they follow a different course of action. Parents who act like this in the name of authoritarianism actually lose the child for good. The child only shows the necessary respect or may turn against the parents in the following years. Such children are shy, lack confidence, are afraid of making mistakes, and do not like to take risks. In the end, an adult settles in the body of a primary school student. In the future, these people will have a certain standard of life that they do not want to violate. A child who is constantly criticized and under pressure cannot be expected to be compatible. Such children always become distanced to their parents. In the future, despite the efforts of the parents, the child may refuse to communicate. This is a never-ending standoff. Boys growing up in such families often develop rebellious personalities and become overreactive, and nurture resentment against their parents. They are aggressive. The child, who is under the pressure of one or both of the parents, may have an overly sensitive personality and become shy and easily influenced by others despite behaving kindly, honestly, and carefully. According to Ekşi in [6], authoritarian parenting is the strict dictation of rules and orders established and given by the parents, without asking for the opinion of the child, mutually agreeing, finding a midway, and paying regard to the desires of the child in any way. Studies indicate that this attitude causes decreased self-esteem, unhappiness, and introversion. Authoritarian parents exert pressure on their child(ren) in order to sculpt their dream human model. The child is always monitored. Each action of the child is considered a mistake. The child's opinion is not cared. The child is only the vassal for the desires of the parents. Some parents may resort to violence as a punishment. Rules are the supreme parameters and absolutely everything that the parents say or do is true, without a question. This type of family is intolerant. There is no flexibility in anything. The child refrains from his/her parents in regards to sharing his/her problems. Families with a low level of education mostly adopt this attitude. These people build an ordinary human being with their do's and don'ts. The child cannot find himself/herself, and is not free. Therefore, he/she cannot be expected to be creative. According to Yavuzer in [7], the children of parents who punish, accuse, and intervene are the ones who easily cry. Children who grew in an oppressive environment generally develop rebellious attitudes and inferiority complex. Moreover, strict and authoritarian father may lead to the formation of negative attitudes in the child and make him/her a maladaptive individual. As a matter of fact, in the relevant study conducted, it is reported that the biggest factor that causes delinquent teenagers to run away from home and in a sense to take their first steps towards anti-social behavior is 59% of the father's pressure. These teenagers are generally chastised by their parents.

B. *Rejective-Careless Behavior*

Rejecting, in a sense, can be defined as nurturing hostile feelings towards the child by failing to meet his physical and spiritual needs. Rejected child may develop an unhelpful and

irritable personality and become emotionally upset, hostile to others, especially to the younger and weaker ones [7]. Continuous reprimanding, beating, discriminatory behavior from his/her siblings, accusing the child of everything, lack of love and care, not fulfilling the needs of the child, etc., are the stereotyped behaviors of these families. These children may experience behavioral disorders due to the lack of love and care. Children of these types of families hurt their friends and damage their properties, stand up against their teachers, skip school, fail at their courses, and continuously try to draw attention. According to Kılıçarslan in [8], the child is rejected if the child is born as a result of an illicit relationship, has any disability if the mother or father is overly fond of the child, and neglects his/her spouse if the father prevents the mother from working and if the child becomes an unwanted member of the family. Such children are moved away from the house at the earliest opportunity. They are sent to family elders or forced to work [8]. There are mothers who are jealous of their spouses for their newborn children, complain that their freedom ends with the birth of the child, and therefore say that they hate their child [7]. Gürsoy in [5] states that in such families, fathers are not interested in their children and domestic life, and do not want another child. Mothers, on the other hand, are people who do not like housework, attach importance to education, adopt the responsibilities of motherhood, and who are distant towards the child. Even child abuse may be experienced in such families. Kılıçarslan in [8] states that depression, stubbornness, irritability, disharmony, being a gang leader and being a member of gangs, committing illegal acts, neuroses and suicidal tendencies can be seen in the children of such families in the future. Violent and oppressive emotions may lead to the formation of an unbalanced personality. In general, urchins are the children of such families. They are lonely, full of hatred, aggressive, they seek for love outside, do not trust anyone, and they lack self-control. A child needs a balanced emotional interaction environment in order for him/her to have a healthy emotional development. The child should find the love, tenderness, and trust necessary for him/her in this environment.

C. Democratic Approach

This is the attitude demonstrated by democratic parents who respect their child, care about what he/she says, ask for his/her opinion, contribute to his/her development in many ways, show their love, have indulgence and are just, discuss the problems of the child and let the child make the final decision, in other words, who help the child realize himself/herself. These children are well-balanced, social, respectful, self-confident, creative, and assertive because they are raised in a free and respected environment without criticism. They are aware of their responsibilities. Gürsoy in [5] states that you have a democratic and healthy family if the rules and standards to be followed in the family are predetermined and explained to the children, options are offered to the child, a choice is given to him/her instead of strict limitations, there is unrequited love and this love is explicitly exhibited via the attitudes of both sides, and the punishments are moderate and educative. According to Yavuzer in [7], accepting parents prepare an environment that will develop the child's abilities by taking into account the

interests of the child. The accepted child is generally sociable, cooperative, friendly, emotionally stable, and happy. Each child has dreams and hopes about what he/she wants to do. They are not to be underestimated. A supportive family supports the child for the realization of these dreams. Being ignored as a human being, not being taken into account, and being neglected are the core reasons for the child to not self-regard and develop self-awareness. Ideal parents are those who sense the needs of the child, give appropriate answers, are not overly tolerant or rigid, have a flexible approach towards the child, provide a certain continuity and determination in their behavior, and always listen to the desires of the child before opposing them. Kılıçarslan in [8] states that the most successful parental attitude is reassuring, accepting, supportive, tolerant and democratic parental attitude. Physically, mentally, and spiritually healthy individuals can be raised only with this flexible approach. The child, who grows up in harmonious relationships and in a safe family environment with love and understanding, matures, develops a solid personality, and learns to fly on his own. Love nurtures the trust, and supports the self-esteem. The child learns to be tolerant as he/she is being tolerated and understood, and to act independently as he/she takes responsibility.

III. MATERIALS AND METHOD

The method used in this study is an agent-based modeling and simulation method [9]. An agent-based model is composed of agents, simulated environment, and simulation environment. Agents mimic the behaviors of actors of the real processes in the world and they are capable of behaving with a certain degree of autonomy, perceiving the changes in their environment, and performing their actions according to their perceptions. As a result of the actions of agents, the environment and other agents in the environment may also be affected. The simulated environment includes also active and passive objects that cannot be represented as agents, and these components and agents all represent the real world when the simulation runs.

The simulation environment with the simulated environment and agents comprises the simulation model that it provides services such as running the simulation, scheduling agents, messaging, runtime information and storing results. Simulations utilize time steps as the concept of time. In each time step, each agent in the model exhibits its behavior by performing an action and interacting with other agents and components in the environment. In the next section, we explain our agent-based model that exhibits the relationship between parental attitudes and students' behaviors in detail.

A. Agent-based Modeling and Simulation of the Relation Between Parental Attitudes and Behaviors of Schoolchildren

We have built a simple agent-based model involving primary school aged students having families that adopt authoritarian-oppressive behavior, rejective-careless behavior, or democratic behavior. The students having families with authoritarian-oppressive or democratic behaviors and the students having families with rejective-careless behaviors are the agents of the model. These student

agents have attributes and rules and they respond to changes in the environment. The type of family, which is an attribute of the student, defines the parental attitudes, such as authoritarian-oppressive behavior or democratic behavior. Whereas the students with rejective-careless parents sometimes engage in physical or verbal bullying to some students, students having families with authoritarian-oppressive or democratic behaviors become victims. Victims may not fight bullies; if they have authoritarian-oppressive parents, they mostly prefer to stay unresponsive while the students with democratic parents show their reactions to these bullies. These affect interactions among agents of the model and between agents of the model and the simulated school environment.

In the model, the simulated environment consists of a grid with 20×20 grid cells to represent the school environment. Each grid cell provides a suitable environmental layer for students to interact with each other in a virtual classroom. In this study, we have used the Repast Symphony 2.7 simulation environment to create agents that are coded using Java programming language. After we define the agents in the simulated environment, it is necessary to briefly explain the behaviors of the agents.

B. Students Having Rejective-careless Families

At the initialization, the programmer defines the number of students with rejective-careless families to create for the simulation. Those students with rejective-careless families are created and randomly assigned on the grid. Each student is randomly distributed on the virtual classroom environment (simulation environment) represented by a grid with 20×20 grid cells. They have five types of behaviors and one of them is randomly re-assigned to each student with rejective-careless parents: 1) Staying calm (they don't do anything to draw attention); 2) Unnecessary speech, complaint, speaking without permission to draw interest; 3) Moving around; 4) Wandering around looking for victims to attack physically or verbally. For behaviors in items 2,3, and 4, the "error" attribute of the student with rejective-careless parents increases when the student performs one of these behaviors. If the student with rejective-careless parents performs the behavior in the item 4, it determines where the most students with authoritarian-oppressive and democratic families are within its neighborhood and moves there. All the students with authoritarian-oppressive and democratic families at the student's (with rejective-careless parents) grid location are obtained and a student with authoritarian-oppressive or democratic parents is selected at random among these students. The student with rejective-careless parents attempts to harm that randomly chosen student at that location and consequently, that student becomes a victim. The attacking behavior may be repeated over time to the same victims or other new victims.

In the second part of the simulation, when the error scores of the students having rejective-careless family increase over 20, those students receive warnings and their families are informed about the situations. As they receive the warnings, their error score decreases. In order to achieve this, when the error score of a student with rejective-careless family exceeds 20, the students receiving warnings perform their behaviors in randomly chosen time steps.

C. Students Having Authoritarian-oppressive or Democratic Families

At the initialization, the programmer sets the number of students with authoritarian-oppressive and democratic families to create for the simulation. Students are created and the family types are randomly assigned to those students. Students are randomly distributed in the grid. The basic behavior for a student with democratic or authoritarian-oppressive parents is to react by running away from that area when a student with rejective-careless parents comes within its local neighbourhood. Moreover, the student with democratic parents complains and his complaint score increases in the attack of the students with rejective-careless parents.

IV. EXPERIMENTAL STUDY

We performed four experiments in order to observe the impact of parental attitudes on behaviors of schoolchildren in the agent-based class environment. First, we run our simulation when there are students with rejective-careless and authoritarian-oppressive families in the virtual class environment. Second, we run our simulation when there are students with rejective-careless, democratic, and authoritarian-oppressive families in the virtual class environment. Then, we run our simulation when there are students with rejective-careless and democratic families in the virtual class environment. Lastly, we run our simulation when students having rejective-careless parents receive warnings.

A. Experiment 1: Students Having Authoritarian-oppressive and Rejective-careless Families

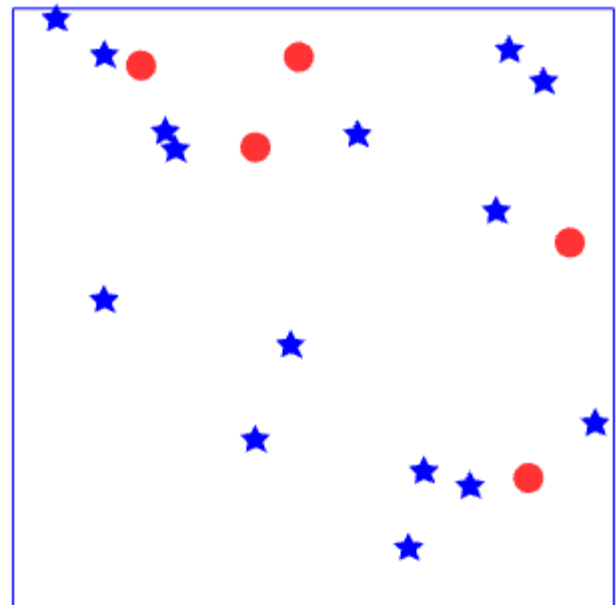


Fig. 1 At the initial time step, the settlement of students

In this experiment, the simulation runs with the students having authoritarian-oppressive and rejective-careless families. At the initial time step, 15 students with

authoritarian-oppressive families and 5 students with rejective-careless families were created in the Repast Simphony simulation environment. As illustrated in Figure 1, students with rejective-careless families are represented as red, students with authoritarian-oppressive families are represented as blue.

The error scores of 5 students with rejective-careless families and the complaint scores of 15 students with authoritarian-oppressive families are shown in Figure 2. The simulation ends at 60. tick count (time step). It means the virtual class environment is observed during 60 days. The error score increases until the 60th tick, whereas the complaint scores of students with authoritarian-oppressive families stay at zero, as we expected. Because students with authoritarian-oppressive families do not respond to students with rejective-careless families as long as they are attacked.

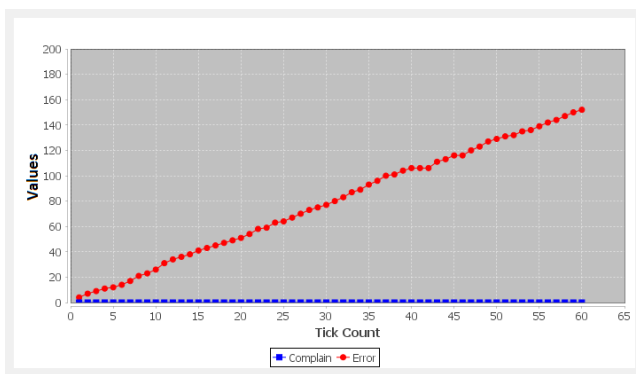


Fig. 2 The error and complaint scores of students

B. Experiment 2: Students Having Authoritarian-oppressive, Rejective-careless, and Democratic Families

In this experiment, simulation runs with the students having authoritarian-oppressive, democratic, and rejective-careless families. At the initial time step, while 9 of the 15 students were randomly determined to have a democratic family, the rest were determined to have an authoritarian-oppressive family. Those students and 5 students with rejective-careless families were created in the Repast Simphony simulation environment. The error scores of 5 students with rejective-careless families and the complaint scores of 15 students with authoritarian-oppressive and democratic families are shown in Figure 3. The simulation ends at 60. tick count. The error score increases until the 60th tick, whereas the maximum of complaint scores of students with democratic families reaches 2 at the end of the simulation. Because students with authoritarian-oppressive families do not respond to students with rejective-careless families as long as they are attacked. Also, the students with rejective-careless families mostly did not randomly choose the attacking behavior in this simulation.

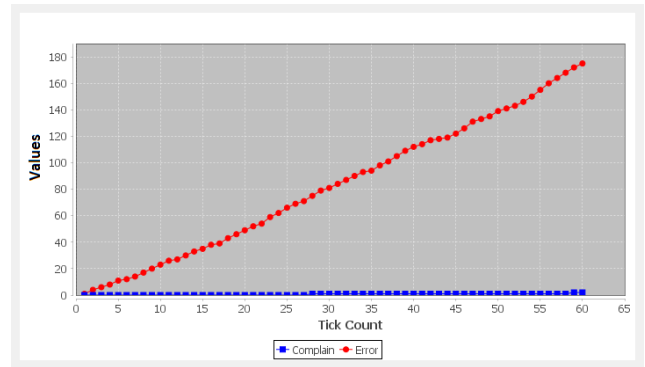


Fig. 3 The error and complaint scores of 15 students with democratic and authoritarian-oppressive families and 5 students with rejective-careless families

In order to observe the impact of the numbers of students in the same experimental settlement, at the initial time step, 16 students with democratic families, 14 students with authoritarian-oppressive families and 10 students with rejective-careless families were created in the Repast Simphony simulation environment. The scores of all students are shown in Figure 4. The simulation ends at 60. tick count. The error score increases until the 60th tick and exceeds 300, whereas the maximum of complaint scores of students with democratic families reaches 26 at the end of the simulation. In this simulation, as the error score increases until the 60th tick, the total complaint scores of students with democratic families also increase, as we expected. However, this increase is not as much as the error score increases. Because the value of complaint increases only when students having Rejective-careless families harm other students and the student having a democratic family explains this.

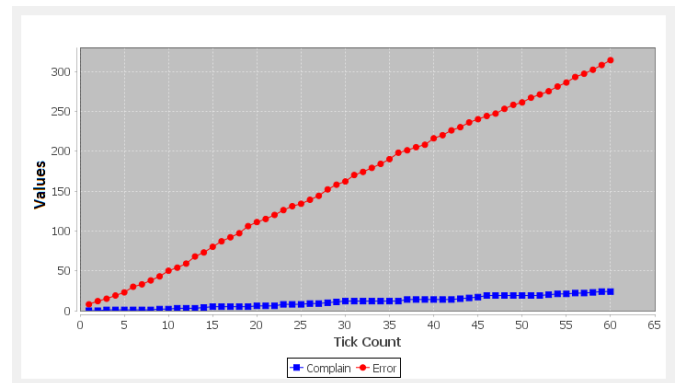


Fig. 4 The error and complaint scores of 16 students with democratic families, 14 students with authoritarian-oppressive families and 10 students with rejective-careless families

We obtained similar results as shown in Figure 5 when 45 students with democratic and authoritarian-oppressive families and 15 students with rejective-careless families were created in the Repast Simphony simulation environment.

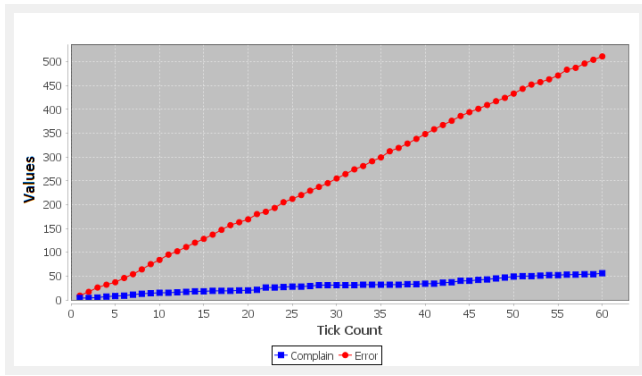


Fig. 5 The error and complaint scores of 45 students with democratic and authoritarian-oppressive families and 10 students with rejective-careless families

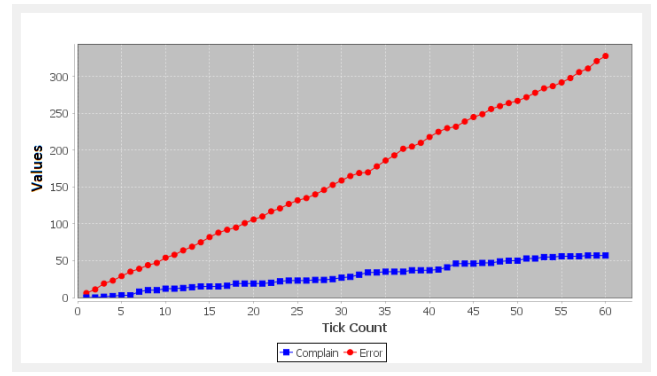


Fig. 7 The error and complaint scores of 30 students with democratic families and 10 students with rejective-careless families

C. Experiment 3: Students Having Rejective-careless and Democratic Families

In this experiment, the simulation runs with 15 students having democratic families and 5 students with rejective-careless families.

The simulation results are shown in Figure 6. The simulation ends at 60. tick count. The error score increases until the 60th tick and exceeds 150, whereas the maximum of complaint scores of students with democratic families reaches 16 at the end of the simulation. With the same experimental settlement, when 30 students with democratic families and 10 students with rejective-careless families were created in the Repast Symphony simulation environment, the error score reaches 320 whereas the complaints score of the students having democratic families exceeds 50 at the end of the simulation (Figure 7). When the number of students having democratic families and rejective-careless families are set to 45 and 15, respectively, the both error and complaint scores increase as shown Figure 8.

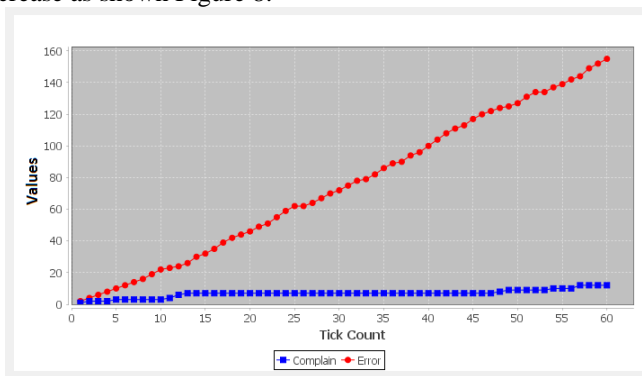


Fig. 6 The error and complaint scores of 15 students with democratic families and 5 students with rejective-careless families

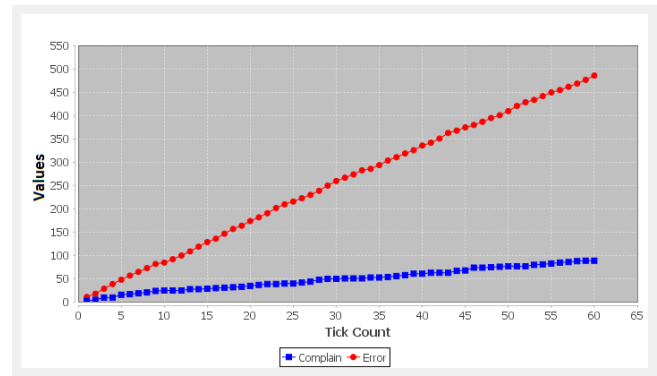


Fig. 8 The error and complaint scores of 45 students with democratic families and 15 students with rejective-careless families

D. Experiment 4: Warnings to Students Having Rejective-careless Families

In this experiment, the simulation runs with the students having democratic, and rejective-careless families. At the initial time step, 45 students with democratic families and 15 students with rejective-careless families were created in the Repast Symphony simulation environment in order to compare the results shown in Figure 8 in the previous experimental settlement. The results are given in Figure 9. As seen from the figure, the both error and complaint scores decrease when the students receive warnings for their errors compared to the scores shown in the Figure 8.

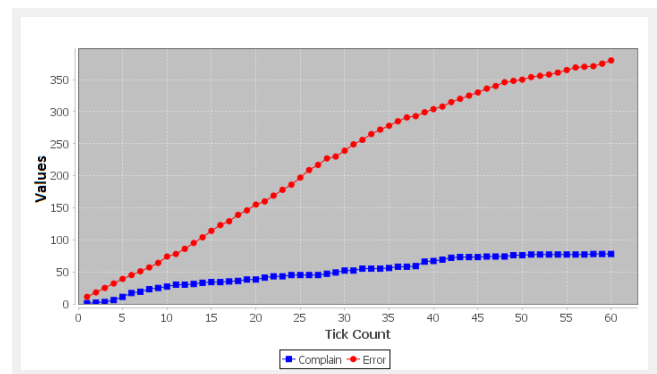


Fig. 9 In case of warnings, the error and complaint scores

V. CONCLUSION

Agent-based modelling and simulation is drawing interest in researches of complex systems and it has been used with success in many domains. However, this approach has not been used much in the field of education. In the present paper, we explained how the parental attitudes could affect the behaviors of schoolchildren at school and we proposed to observe the impact of parental attitudes on undesired behaviors of students by using the agent-based model. There are some challenges for applying agent-based modeling and simulation in the field of education since this study is an interdisciplinary study. However, it provides some of the potential benefits, such as providing a virtual school environment where a young teacher could train for handling students with different school scenarios.

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