SYSTEM BEHAVIORS ON EDUCATIONAL PROBLEMS

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Abstract

This paper is attempting at modeling and simulation of an educational problem at junior and senior high schools. Our model consists of seven level-variables, ten rate-variables and twenty auxiliary-variables. Also we discuss marks of students in the model that are figured from 0 to 100. Results of the computer simulation are given to illustrate the our model.

1. Introduction

It has been a difficult problem to make clear that for students who have not interest in study, what kind of good ideas, do we give them?

Our interest in this study concentrates on relation among school marks, educational eiviroments, study hours, number of friends, and so on. The variables of our model consist of the following, that is, seven for level variables, ten for rate variables, and twenty for auxiliary variables. Also, we discuss marks of students in the model that are figured from 0 to 100. It is shown that the marks are influenced by educational enviroments, study hours and number of friends.

From the computer simulation of the model implemented by BASIC on personal computer PC-9801VX, we have results that are summarized as follows: (1)Marks, stress and number of friends are closely related to each other. (2)Marks depend on educational enviroments rather than study hours.

2. Purpose of Our Models and System Boundary

The purpose of the model is to analyze that what factors are related to school marks of students? Thus we shall concentrate on school marks as an educational problem. The school mark defined in this paper means that it synthesizes each mark for a student, which is like an average mark. Why should we think so, it comes

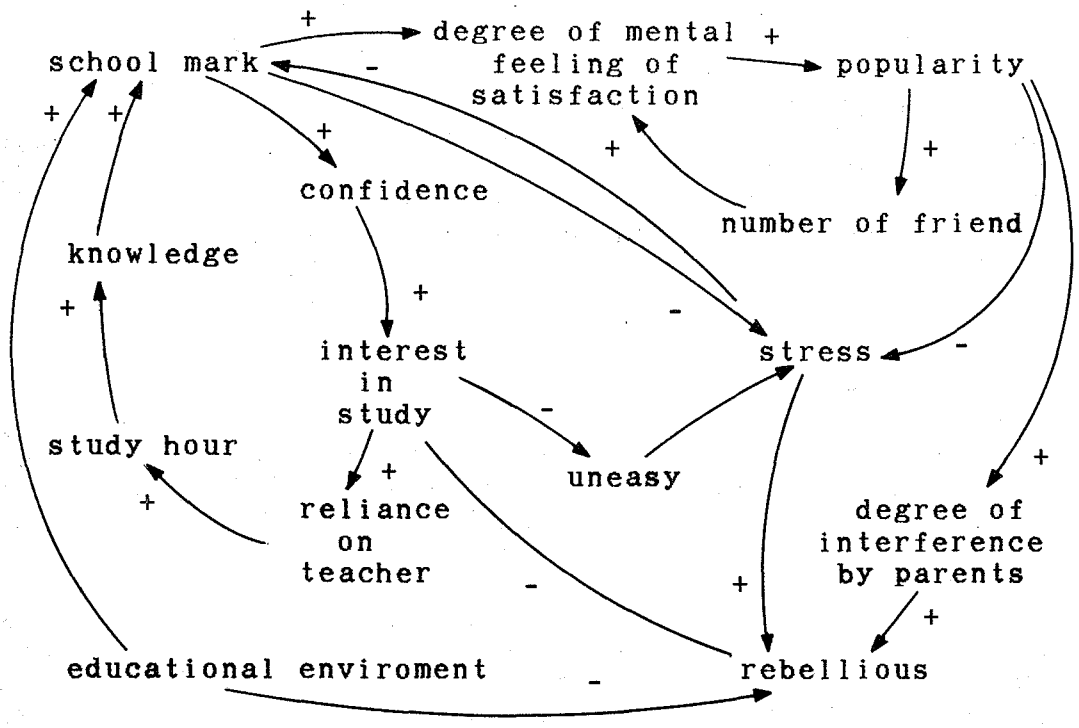

Fig.4 Total causal-loop of the model.

4. Flow Diagram

From the preceding discussions, we shall construct the flow diagram for the model. All variables are presented by three capital letters, such as LMA for school marks, LST for stress, and so on. The head letters are used by L, R, A, and T for level, rate, auxiliary, and parameter, respectively. However we do not have the letter A for IN, because it is a smooth function of ASA. Also we have some special cases, such as WSA, WST for multiplier constants. All variables and parameters of the model are listed as follows.

(a)lebel variables	LMA	school marks
	LST	stress
	LEF	number of friends
(b)rate variables	RM1	increasing rate for marks
	RM2	decreasing rate for marks
	RS1	increasing rate for stress
	RS2	decreasing rate for stress
	RF1	increasing rate for number of friends
(c)auxiliary variables	AKN	knowledge
	AED	educational enviroment
	AST	study hours
	AIN	interest in study

from the fact that it is recklessness and non-realistic to indicate the mark by only one numerical value.

System boundary is considered private matters mainly, and some influence in family and school. The private matters that we have chosen are interest in the study, a degree of rebellious, popularity, knowledge, study hours, and also include educational enviroment in school, degree of interference by parents.

3. Causal-Loop Diagrams

We shall construct three causal-loops, that is; loop for school marks, loop for stress, and loop for number of friends. In our model, the main causal-loop arises from the school mark. A discussion of the main causal loop is given in the following.

3-1. Main causal-loop

Figure 1 shows the main causal-loop in the model. By doing well at school, they cause confidence for study, and by getting confidence, they causes having an interest for study. By taking the interest in study, they will increase reliance on a teacher. By having reliance on the teacher, they will increase study hours, and also by increasing study hours, they will have much knowledge. Consequently, we obtain a positive causal-loop that by increaseing study hours, they will be doing well at school.

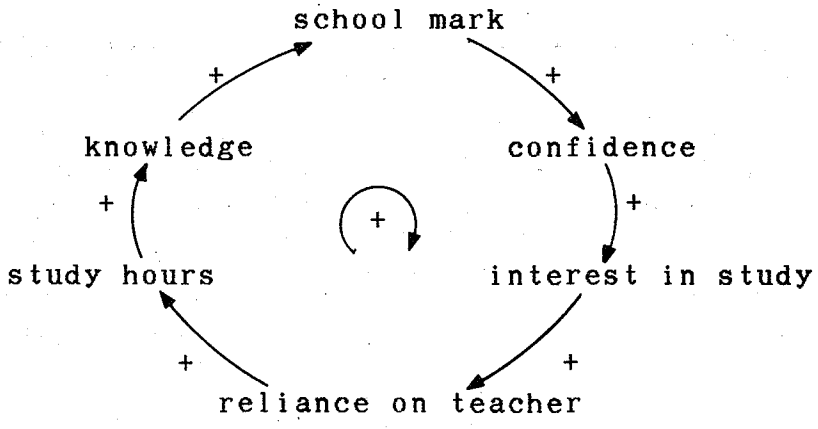

Fig.1 Main causal-loop.

3-2. Auxiliary causal-loop

We shall consider two auxiliary causal-loops in addtion to the main loop, which are about in stress and number of friends. Figure 2 shows a loop for stress that comes from uneasy about in study. By building up stress, they increase rebellious. By increasing rebellious, they will take no interest in study. By

taking no interest in study, they will increase uneasy, so that by increasing uneasy, they will build up the stress.

Another loop of auxiliry is about in number of friends, which is shown in Fig.3. This loop follows. By doing well at school, they will be increased a feeling of satisfaction, so that they will be won popularity with the friends increased. By wining popularity, they will increase the number of friends, and consequently, by increasing the number of friends, they will be increased the feeling of satisfaction.

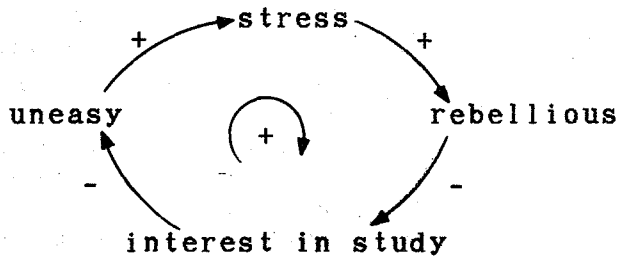

Fig.2 Loop in stress.

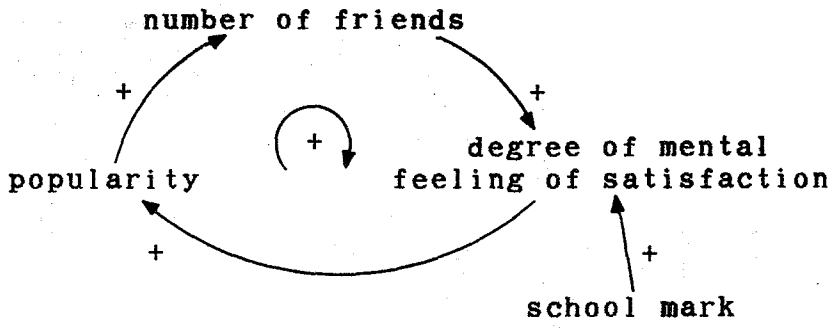

Fig.3 Loop in number of friends.

3-3. Total causal-loop

We construct a total causal-loop by conbining three loops described above, which is shown in Fig.4, where in the total causal-loop, we add two more factors, one is an educational enviroment, the other is a degree of interference by parents. We think that by increasing popularity, degree of interference by parents will be decreased. This causal-loop is one that if degree of interference by parents is increased, then rebellious to the parents will also be increased. Educational enviroment at school will influence school marks and rebellious.

	ARE	rebellious
	ACO	confidence
	APO	popularity
	ANN	uneasy
	ASA	degree ofmental feeling of satisfaction
	IN	recognized mental feeling of satisfaction
	WSA	degree of mental feeling of satisfaction caused by doing well at school
	WST	degree of desent of marks caused by stress
(d)parameters	TSC	possible study hours
	TKU	understandability
	TKF	degree of oblivion
	TIT	reliance on teacher
	TRI	degree of interference by parents
	TED	educational enviroment

Now we have completed for construction of the flow diagram of our model. Figure 5 shows the flow diagram that is constructed from the total causal-loop shown in Fig. 4.

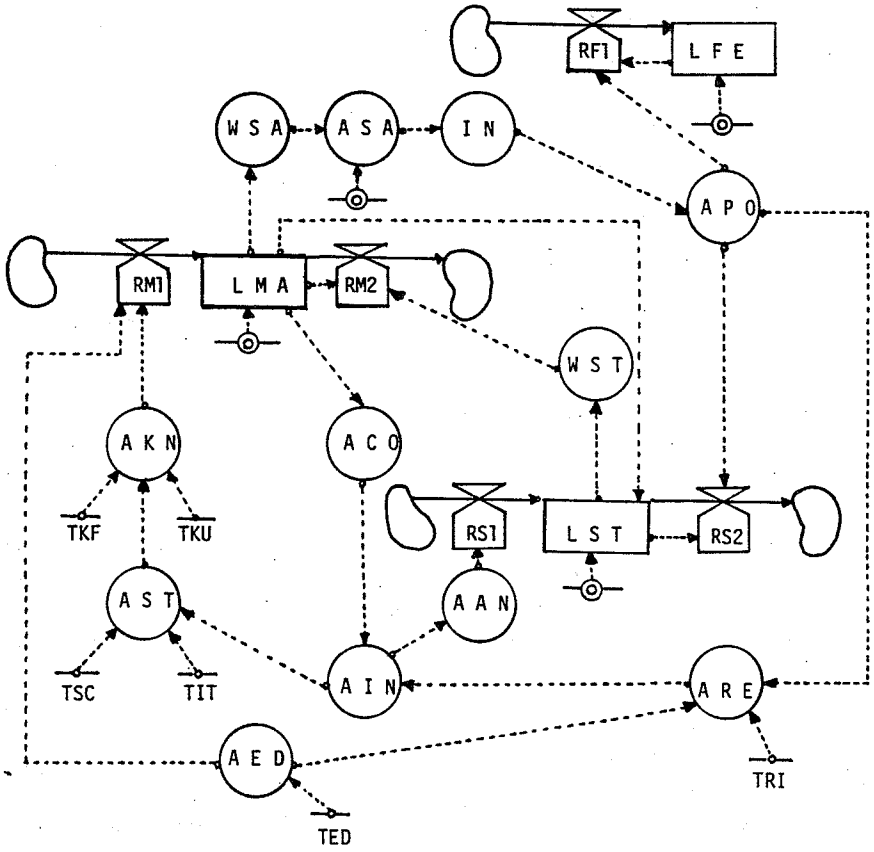

Fig.5 Flow diagram.

5. BASIC Equations and Simulation

The computer simulation of our model is accomplished by the simulator programmed by BASIC on personal computer PC-9801VX. Main part of the BASIC programming except for constants, rate variables, and initial conditions is shown Fig.6.

```
Rate and auxiliary equations
 3020 AS   =IN
 3030 IN   =FUSMTH(ASA,2,IN)
 3040 APO  =FNTABL(APO$,AS,0,1,.25)
 3050 RFI  =APO*LFE
 3060 RS2  =APO*(LST+LMA)
 3070 WSA  =FNTABL(WSA$,LMA,0,100,25)
 3080 ASA  =WSA*LFE
 3090 AED  =FNTABL(AED$,TED,0,100,20)
 3100 ARE  =AED*LST+APO*TRI
 3110 ACO  =FNTABL(ACO$,LMA,0,100,25)
 3120 AIN  =ACO-ARE
 3130 AST  =TSC*AIN*TIT
 3140 AKN  =AST*(TKU-TKF)
 3150 RM1  =AKN*AED
 3160 AAN  =FNTABL(AAN$,AIN,0,70,35)
 3170 RS1  =AAN*LST
 3180 WST  =FNTABL(WST$.LST,0,100,25)
 3190 RM2  =WST*LMA

Level equations
 4020 LMA  =LMA+DT*(RM1-RM2)
 4030 LST  =LST+DT*(RS1-RS2)
 4040 LFE  =LFE+DT*RF1
```

Fig.6 Main part of the BASIC programming

We shall show three cases, that is, Case-1, Case-2 and Case-3, that are carried out by the computer simulation, which correspond to each value of constants, table variables and initial conditions in the BASIC equations. These cases are shown in Fig.7, Fig.8, and Fig.9, respectively.

Note that all numerical values of constants listed in Fig.7 to Fig.9 are not based on real values, because in this model, these values lie in having vagueness. It is difficult to find the exact value, so that some are based on supposition. We believe that, however, they are resonable ones, because the most important thing for constructing like the model is to find relativity among variables that are defined in the model.

(1)

```
2020 LMA   =75
2030 LST   =30
2040 LEF   =10
2041 TED   =60
2045 ASA   =.5
2050 TSC   =180
2060 TKU   =.8
2070 TKF   =.5
2080 TIT   =.005
2085 TRI   =4
2090 IN    =ASA
2100 APO$  ="    0/.004/.006/.01/.01"
2110 WSA$  ="    0/.025/.04 /.05/.06"
2120 AED$  ="    0/.02 /.04 /.05/.08/.08/"
2130 ACO$  ="    0/  10/  25/ 60/ 80"
2140 AAN$  ="    0/.05 /.05/.03/.03/.02"
2150 WST$  ="    0/.008/.009/.0 /.01"
```

Fig.7 Case-1 for constants, table variables and initial conditions.

(2)

```
2020 LMA   =75
2030 LST   =30
2040 LEF   =10
2041 TED   =60
2045 ASA   =.05
2050 TSC   =180
2060 TKU   =.8
2070 TKF   =.5
2080 TIT   =.005
2085 TRI   =40
2090 IN    =ASA
2100 APO$  ="    0/.002/.003/.075/.08"
2110 WSA$  ="    0/.025/.004/.005/.06"
2120 AED$  ="    0/.02 /.04 /.08 /.08/.1"
2130 ACO$  ="    0/  10/  25/  60/ 90"
2140 AAN$  ="    0/.05 /.075"
2150 WST$  ="    0/.01 /.02 /.03 /.04"
```

Fig.8 Case-2 for constants, table variables and initial conditions.

(3)

```
2020 LMA   =75
2030 LST   =30
2040 LEF   =10
2041 TED   =60
2045 ASA   =.05
2050 TSC   =180
2060 TKU   =.8
```

```
2070 TKF    =.5
2080 TIT    =.005
2085 TRI    =40
2090 IN     =ASA ⊙
2100 APO$   ="     0/.025/.005/.075/.08"
2110 WSA$   ="     0/.025/.004/.005/.06"
2120 AED$   ="     0/.02 /.04 /.08 /.08/.1"
2130 ACO$   ="     0/  10/  25/  60/ 90"
2140 AAN$   ="     0/.05 /.075"
2150 WST$   ="     0/.01 /.02 /.03 /.04"
```

Fig.9 Case-3 for constants, table variables and initial conditions.

Now our simulation results are given in Fig.10, Fig.11, Fig.12, correponding to three cases, which are printed out only three variables, such as the school mark, stress and number of friends that we think it is especially interest to find relations among these variables. Case-1 may not provide us an useful information, because it does not change remarkably.

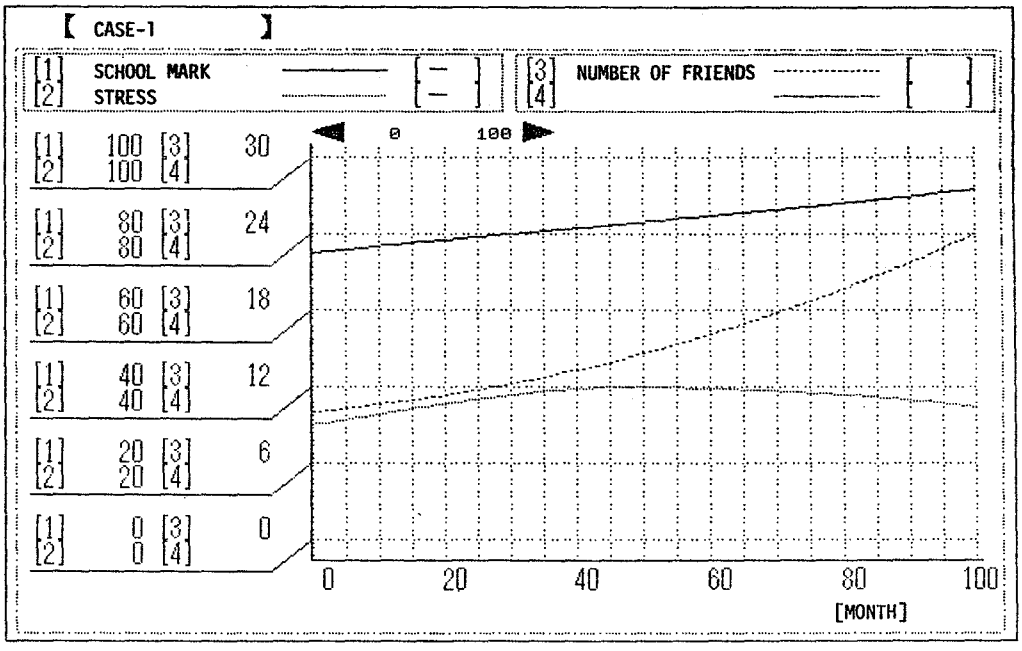

Fig.10 Simulation for Case-1.

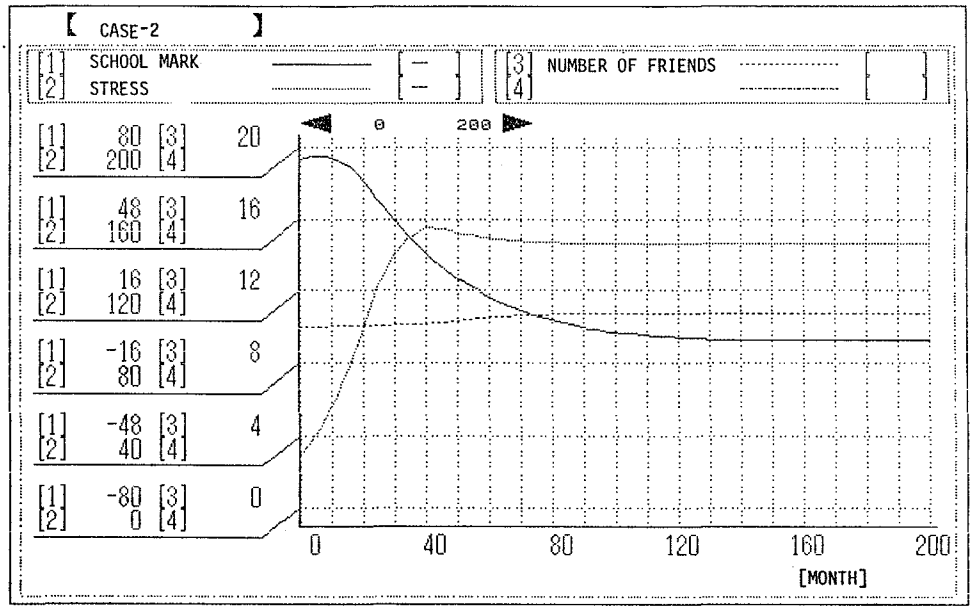

Fig.11 Simulation for Case-2.

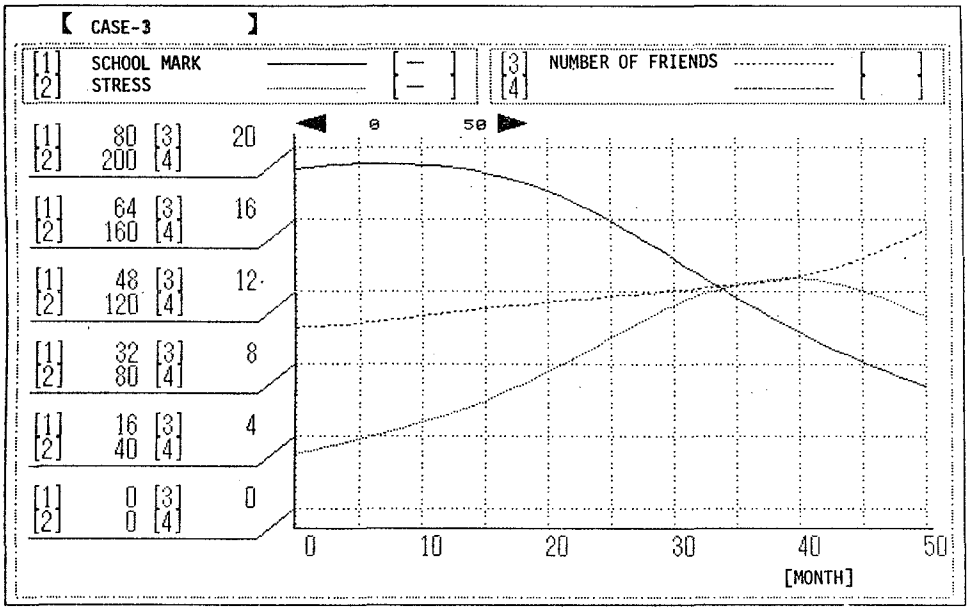

Fig.12 Simulation for Case-3.

Case-2 and Case-3 provide useful information that each variable is a remarkable change relatively.

6. Concluding Remarks

We have constructed one educational model describing behaviors of students at junior and senior high schools. Also we have shown the simulation results that are printed out by the simulator. In this paper, we have concentrated on three variables, such as school mark, stress and number of friends. As is known, modeling of an educational problem including children's behaviors with mental factor is quite a difficult. Our approach to this kind of problem is the first attempt at constructing the system dynamics model. It is without saying that many problems remain for further research. As is described in this paper, we defined numerical values, such as constants, rate variables. In order to built the model more precisely, it must be proved that these numerical values are resonable. Therefore, it is an interesting question for us that do you have any basis to determine those numerical values? or have you investigated to adopt those numerical.

Detailed discussions will be appear in the near future.

References

[1]Hisao Shiizuka, Fumie Kouchi, Toishi Tomoko and Etsuko Totoda:"System behaviors on educational problem - A system dynamics approach -", Proc. of the 1987 Fall Conference of Operations Society of Japan, 2-D-8, pp.170-171, Oct.,1987.

[2]N. Roberts, et al:"Introduction to Computer Simulation - A System Dynamics Modeling Approach -", Addison-Wesley, 1983.