Title of the submission: A Study of Causal Variables Affecting Learning Achievement in Biology of Mathayomsuksa IV Students of Khon Kaen University Demonstration School.

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ABSTRACT

The purpose of this study was to investigate causal variables that affected learning achievement in Biology. There were 215 Mathayomsuksa IV students of Khon Kaen University Demonstration School participated in this study. The independent variables were students' characteristics and family involvement. The dependent variable was a learning achievement in Biology. The data were analyzed using Path Analysis Technique. The results indicated that a group of best predictors which could predict learning achievement in Biology was consisted of fundamental knowledge (β=.460, $p < 0.05$), scholastic aptitude (β= .161, $p < 0.05$), critical thinking (β=.149, $p < 0.05$), parental expectation (β= -.119, $p < 0.05$) and science process skills (β=.115, $p < 0.05$). The variance of these predictors accounted for learning achievement in Biology was 41.7% (R=.646). The standard error of the estimate was 7.8755.

INTRODUCTION

Nowadays science and technology play an important role in human living. According to the National Education Act B.E. 2542 (1999), learning reform is the vital part. The Act put emphases on the integration of scientific and technological knowledge and skill, as well as knowledge understanding and experience in management, conservation, and utilization of natural resources and the environment in a balanced and sustainable manner as stated in paragraph 2 of Section 23. The students' achievement in science and technology subjects can be used to reflect the outcomes of the implementation of science and technology curriculum in terms of quality and efficiency of the programs. It was found those Thai students possess lower performance in science and technology when compared to those students in the other Asian countries (Office of National Education Committee, 1999). It is necessary to foster students' knowledge of modern science and technology in order to help them survive in the present knowledge-based society. (Wattanachai, 2001). Kaewdaeng (2001) mentioned that the Thai Promotion and Development in Science and Technology

Institute should upgrade the level of science and technology of Thai students. In processing the previous mentioned is not easy. The performance in science and technology of students depend on various factors such as family factor students' characteristics factor and school factor (Bloom, 1976)

Biology is one of the important science basic subjects. In 1999, the Office of Educational Promotion in Khon Kaen Province evaluated the education quality of secondary students (Mathayomsuksa 6) in Khon Kaen Province using high-leveled criteria. It was found that the students of Khon Kaen University Demonstration School achieved high scores in Biology when compared to other schools. The reasons for such a good achievement in studying Biology may relate to various factors. This stimulated the researcher' s curiosity to question what were the factors affected the students' achievement in studying Biology. In order to fulfill this need, the researcher had studied concepts and theories such as Bloom's Theory of School Learning (Bloom,1976), Prescott's concept (Prescott,1961), Klausmeir's concept (Klausmeir, 1961) and Maddox's concept (Maddox, 1965). The researcher also conducted a literature reviews and interviewed teachers, students and parents. It was found that there were three important aspects related to students' achievement. They were family involvement, school management and students characteristics. The information leaded the research to study causal variables affecting direct and indirect learning achievement in Biology of Mathayomsuksa IV students of Khon Kaen University Demonstration School. Path Analysis Techniques were employed in this research.

In conducting this research, the researcher selected only causal variables affecting learning achievement in Biology, which both teachers and the school can provide experience and learning activities to develop students' good characteristic aspects. A recursive model of path analysis was used. The variables of students' characteristic aspects were fundamental knowledge, achievement motivation, Biology attitude, study habit, additional study time, critical thinking, science process skills and scholastic aptitude. The variables of family involvement, which could be advised by teachers, comprised parental support and parental expectation. The researcher created a recursive model according to independent variables that would affect learning achievement in Biology as depicted in Figure 1.

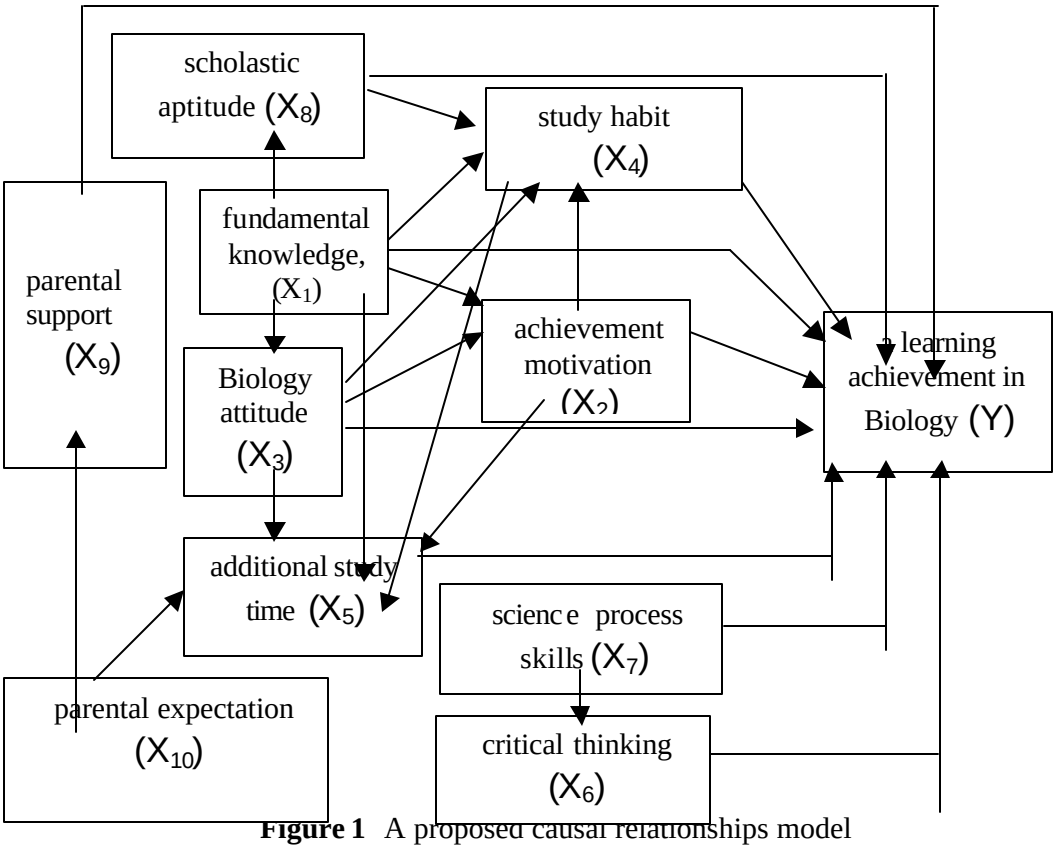


Figure 1 A proposed causal relationships model

PURPOSE OF THE STUDY

The purpose of this study was to investigate causal variables affecting learning achievement in biology of Mathayomsuksa IV students of Khon Kaen University Demonstration School.

METHOD

Participants were 215 Mathayomsuksa IV students of Khon Kaen University Demonstration School who studied in Science-Mathematics Program of second semester, the academic year of 2001.

The research instruments were an achievement test in Biology, a critical thinking test, a scientific skill process test, a scholastic aptitude test, a Biology attitude survey , an achievement motivation survey , a study habit survey, an additional study time survey, a parental support survey and a parental expectation survey.All instruments are listed in

Table 1. The table lists the reliability coefficients (alpha) and number of items of each instrument. The students were requested to indicate their opinion, behaviour, and attitude on the 5-point rating scale. These scores then used to correlate with other variables and grade awarded in Biology to determine the causal relationship among variables.

Data were analyzed using Path Analysis Techniques and Statistical Package for the Social Science for Windows (SPSS)

Table 1 Coefficient alpha estimates of reliability and number of item for each instrument

The research instruments	Type	No. of Item	Reliability
an achievement test in Biology	Multiple choices	60	.84
an achievement motivation survey	Rating scale	25	.91
a Biology attitude	Rating scale	20	.92
a study habit survey	Rating scale	45	.94
an additional study time survey	Short answer	4	-
a parental support survey	Rating scale	15	.82
a parental expectation survey	Rating scale	15	.66
a critical thinking test	Situation conclusion	54	.84
a science process skills test	Multiple choices	40	.89
a scholastic aptitude test - Verbal - Numerical - Reasoning	Multiple choices	 30 25 32	 .81 .76 .78

RESULTS

Basic statistics of each variable are illustrated in Table 2. Table 3 shows the correlation coefficients among independent and dependent variables.

Table 2 Descriptive statistic of Variables

Variables	**Total score**	**mean**	S.D.	**min**	**max**	**Skewness**	**kurtosis**	C.V. **(%)**
X_1	4	2.01	.94	1	4	0.48	-0.80	46.77
X_2	125	88.57	9.92	64	115	0.18	-0.20	11.20
X_3	100	67.22	11.58	29	94	-0.31	0.28	17.22
X_4	225	144.23	20.09	91	220	0.45	0.99	13.95
X_5	-	6.61	2.89	1.5	14	0.61	-0.28	43.72
X_6	54	30.93	4.36	18	39	-0.99	0.60	14.11
X_7	40	20.10	5.05	7	31	-0.15	-0.61	25.10
X_8	87	61.87	8.22	24	77	-1.48	4.26	13.28
X_9	75	52.43	8.16	22	73	-0.26	0.59	15.55
X_{10}	75	56.31	6.63	37	75	-0.26	0.10	11.77
Y	60	30.47	10.20	9	52	0.08	-0.94	33.47

Table 3 Intercorrelation coefficients

Variables	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	Y
X_1	1.000										
X_2	.203*	1.000									
X_3	.215*	.309*	1.000								
X_4	.236*	.655*	.367*	1.000							
X_5	-.007	.045	.128	.087	1.000						
X_6	.086	.015	.072	.051	.072	1.000					

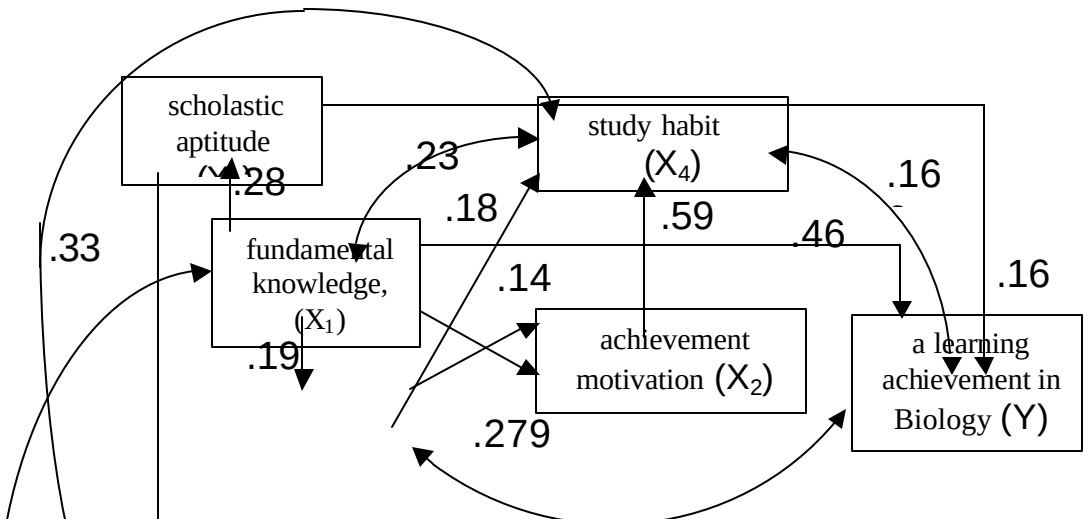
X_7	.179*	.101	.015	.064	.109	.119*	1.000				
X_8	.285*	.093	-.002	.029	-.040	.114	.344*	1.000			
X_9	.102	.410*	.181*	.339*	.005	.031	.044	.011	1.000		
X_{10}	-.230*	.117	.017	.046	-.038	-.141*	-.071	-.066	.170*	1.000	
Y	.567*	.120	.163*	.166*	-.028	.237*	.279*	.357*	.101	-.264*	1.000

* $p < .05$

The results indicated as follows.

1. The variances of 9 independent variables in the causal relationships model affecting learning achievement in Biology according to the assumption accounted for the variances of learning achievement in Biology of 41.3% (R=.642). The standard error of the estimate was 7.9851.

2. The improved model of causal relationships affecting learning achievement in Biology was modified and showed the congruence between a conceptual model and empirical data as illustrated in Figure 2. From the figure 2, the independent variables in the improved model of casual relationships of learning achievement in Biology, which were the casual variables and had direct effect on the learning achievement in Biology were fundamental knowledge (β=.460, $p < 0.05$), scholastic aptitude (β= .161, $p < 0.05$), critical thinking (β=.149, $p < 0.05$), parental expectation (β=-.119, $p < 0.05$) and scientific skill process (β=.115, $p < 0.05$). The variance of these predictors accounted for the variance of learning achievement in Biology was 41.7% (R=.646). The standard error of estimate was 7.8755.



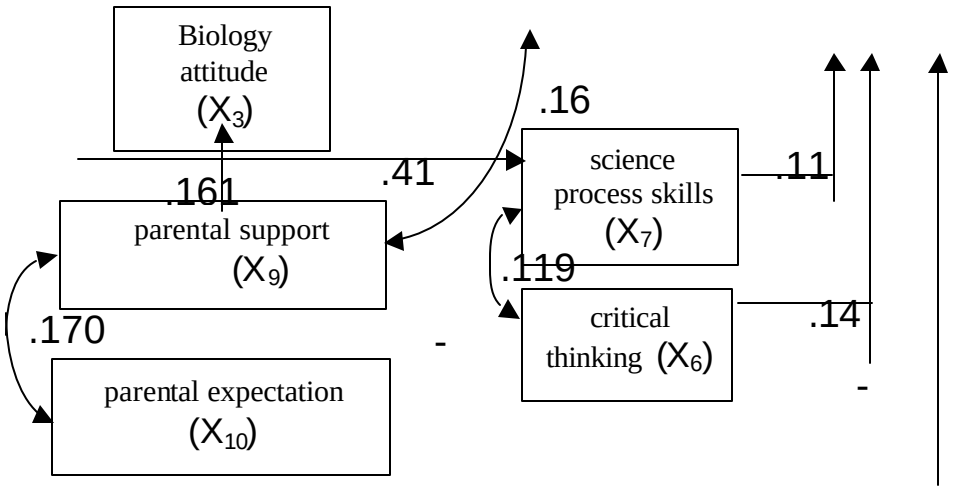


Figure 2 A modified causal relationships model

CONCLUSION

There were various variables, which affected learning achievement in Biology of Mathayomsuksa IV students of Khon Kaen University Demonstration School. The students' characteristic aspects were the main variables, which could help both teachers and school to provide Biology experience and develop good characteristic aspects. Teachers could also give useful advice of these variables to parents. Hence, the researcher suggested that the school, parents and teachers should cooperate in promoting good characteristic aspects by setting up various promotion projects, such as good fundamental knowledge in Biology, scholastic aptitude and pre-learning preparation. There should be activities promoting critical thinking and science process skills. The activities would help and support students' learning and these variables would have positive influence on students' achievement in Biology. Besides, parents should not push and pay too much expectation toward their children's learning. The parents should realize and accept their children's ability and should not use their own feeling or opinion as criteria to judge their children. Over expectation of parents might increase students' tension and have negative effect on their learning. Besides, over expectation on their children's learning would also reduce the students' critical thinking ability.

REFERENCES

Anastasi, Anne. (1982). Psychology Testing. 6th ed. New York: Mc.Millan.

Bloom, Benjamin S. (1976). Human Characteristics and School Learning. New York :

McGraw-Hill Book Company.

Cronbach, L.J. (1977). Educational Psychology. 3 rd ed. Harcourt Brace Jovanovich, New York.

Edwards, A.L. (1979). Multiple Regression and The Analysis of Variance and Covariance. New York: W.H. Freeman and Company.

Kaewdaeng, R. (2001). Report of seminar on science learning reformation according to the National Education Act of 1999. Remarks from case study of foreign countries. (In Thai) [http://www.onec.go.th]. 14 July 2002

Klausmeir, Herbert J. (1961). Learning and Human Abilities : Educational Psychology. New York : Harper & Brothers.

Maddox, Harry. (1965). How to Study. New York : Fawcett World Library.

Office of Education Reform. (2001). The Report of Education Reform. Bangkok: Amarinprinting and plublishing Co.Ltd

Office of Khon Kaen Education. (2001) Report of Education Quality for Senior High School Students for the Academic Year of 2000. Khon Kaen: Group of Developing Educational Standard.

Office of National Education Committee. (1999). Thai children and learning in science. Thai Post, November 11, p.p 13.

Piumsomboon, P. (1984). Path Analysis in Social and Behavioral Science. Bangkok: Odianstore (In Thai) .

Prawanlapruek, S. (2002). A Study of Present Situation and Success in Science Teaching and Learning at the Lower Seconday School level..[http://www.watpon.com/journal/abstract1.htm]. January 18, 2002

Prescott, Daniel A. (1961). A Report of the Conference on Child Study. Educational Bulletin. Bangkok: Faculty of Education.

Stoelting, R. (2001). Structural Equation Modeling/Path Analysis. [http://userwww.sfsu.edu~efc/classes/biol710/path/SEMwebpage.htm]. August 17, 2002.

Thathong, N. (2002). Statistical Applications in Education II. Khon Kaen: Khon Kaen University. (In Thai)

Tuckman, B.W. (1999). A Tripartite Model of Motivation for Achievement: Attitude/Drive /Strategy. [http://all.successcenter.0hio -state.edu/all-

tour/apa99paper.htm]. July 19, 2002.

Wattanachai, K. (2001). University Administration in knowledge based society. The Report of high administrative training of KhonKhan University. Khon Kaen: Klangnanawittaya. (In Thai)