DEVELOPING A CAUSAL RELATIONSHIP MODEL OF THE CHARACTERISTICS OF SCIENTIFICALLY TALENED STUDENTS: A MIXED RESEARCH METHODOLOGY

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ABSTRACT

The objective of this research is to develop a causal relationship model of factors affecting the character of scientifically gifted and talented students. The methodology is a mixture of quantitative and qualitative research methods. The research procedure comprises 3 phases : phase 1 – the formulation of an initial hypothetical model of factors affecting the character of scientifically gifted and talented students , based upon related documentary analysis, in-depth interview of experts in science , and multi-case studies; phase 2 – the verification and modification of the initial hypothetical model through the connoisseurship seminar ; phase 3 -- Test the goodness of fit of the modified model into the empirical data through quantitative research. Data were collected from 1,000 students on the basis of the variables in the model These are the research results derived from phase 1 and 2 of research procedure : The character make-up of scientifically gifted and talented students consists of 7 components , namely, cognitive ability and scientific inquiring mind, scientific creativity, reasoning and deliberating, perseverance, self-confidence, responsibility, self-confidence, scientific problem-solving ability, whereas 5 factors are found to be affecting the character of scientifically gifted and talented students : socio-economic status of parent/guardian, family environment, parent/guardian supports, classroom social climate, and school environment

Keywords: Scientifically talented students, Characteristics, Affecting factors

BACKGROUND OF THE RESEARCH

In the development of the nation, the well-being of the public is the ultimate goal and to achieve the goal of the development, knowledge and science play a crucial role for the effective operations. However, in the development of science in Thailand in the past, it is evident that we still lack persons with scientific expertise, who will conduct research and create scientific productivity to bring up natural resources for optimum use.

Due to the aforementioned state of the problem, the government has been trying to find out the solution by developing human resources -- those with scientifically gifted and talented character to be experts in science. Special curriculum, scholarships for further studies, research scholarships have continually and extensively been provided for the development of persons with scientific potential at all levels. It is found that science instructions are currently conducted in three ways: 1. science instruction program provided for scientifically gifted and talented students in the schools established for this specific purpose such as Mahidolnusorn School,and Chulapornrachavitayalai schools 2. Science instruction programs intended for the scientifically gifted and talented students studying along with the students in normal classrooms such as the project for development and promotion of scientifically gifted and talented students. 3 Science instruction, regularly conducted in schools in general.

In the past, the scientifically gifted and talented students were not the group of special academic focus. Normally, it was assumed that these students were able and could pursue their studies on their own to fulfill their potential. A number of these students probably emerged as high achievers in life However, it is accepted that this might be because of an unidentified impetus or their better opportunities , not because of special favorable programs purposively extended to them.

In order to develop scientifically gifted and talented students to achieve their full potential, it is necessary that those who are concerned possess knowledge and understanding pertaining to factors affecting the character of scientifically gifted and talented students in order to promote them.

For this reason, the researcher is interested in the development of a causal model of factors affecting the character of scientifically gifted and talented students. The focus is placed on the students of the fourth secondary-education level (10^{th} -12^{th} Grade) , since it is the highest level before their further studies in higher education.

The results of the research will reveal a causal relationship model of factors affecting the character of scientifically gifted and talented students as well as the information needed for creating scientific innovation to help them achieve their full potential.

RESEARCH QUESTIONS

1. What is the character make-up of scientifically gifted and talented students?
2. What are the factors affecting the character of scientifically gifted and talented students ?
3. What does it look like -- a causal relationship model of factors affecting the character of scientifically gifted and talented students?

RESEARCH OBJECTIVES

General Objective

To formulate and develop a causal relationship model of factors affecting the character of scientifically gifted and talented students

Specific Objectives

1. To study the character make-up of scientifically gifted and talented students
2. To study the factors affecting the character of scientifically gifted and talented students
3. To construct a causal relationship model of factors affecting the character of scientifically gifted and talented students

4. To verify and modify the causal relationship model of factors affecting the character of scientifically gifted and talented students

5. To test the goodness of fit of the modified model into the empirical data and modify the causal relationship model of factors affecting the character of scientifically gifted and talented students

SCOPE OF THE RESEARCH

The research procedure uses a methodology mix: quantitative and qualitative and comprises 3 phases:

Phase 1 – the formulation of an initial hypothetical causal relationship model of factors affecting the character of scientifically gifted and talented students, based upon related documentary analysis, in-depth interview of experts in science , and multi-case studies.

Source of data

1. The synthesis of theories, concepts, documents, research related to factors affecting the character of scientifically gifted and talented students

2. In-depth interview of experts in science

3. Three multi-case studies

Phase 2 – the verification and modification of the initial hypothetical model through the connoisseurship seminar.

Source of data

Connoisseurship seminar of three groups of experts: experts at the policy level, academia level and operation level

Phase 3 – test the goodness of fit of the modified model into the empirical data through quantitative research. Data were collected from 1,000 students on the basis of the variables in the model

Source of data

One thousand students in the fourth secondary-education level (10^{th} -12^{th} Grade), obtained through multi-stage random sampling.

RESEARCH PROCEDURES

The research procedure comprises 3 phases :

Phase 1 – the formulation of an initial hypothetical model of a causal model of factors affecting the character of scientifically gifted and talented students ,

1. The synthesis of theories , concepts, documents, and research related to factors affecting the character of scientifically gifted and talented students

2. In-depth interview of experts in science

3. Three multi-case studies

3.1 The only one student who was studying in science program of the fourth secondary-education level (10^{th} -12^{th} Grade) and won the goal medal in the International Olympic Science Competition

3.2 The non-science student studying in the fourth secondary- education level (10^{th} -12^{th} Grade) , analytic induction method and content analysis were employed for data analysis. The results were used as the basis for the formulation of an initial hypothetical causal model of factors affecting the character of scientifically gifted and talented students

Phase 2 – Verification and modification of the initial hypothetical model through the connoisseurship seminar, consisting of 8 experts in educational provision for scientifically gifted and talented students from 3 different levels ; 1. at the policy level 2. in academics , specializing in educational provision and 3. at the operational level . Analytic induction method was used for data analysis. The results were used as the basis for making the model complete.

Phase 3 - Verification of the concurrence of the modified hypothetical model obtained from phase 1 and 2 with the empirical data ; Statistical Package of LISREL was employed for the analysis of linear structural relationship of the model.

The researcher constructed an measuring inventory on the basis of the factor variables in the formulated model, and these factor variables were measured with 1, 000 students of the fourth secondary- education level (10^{th} -12^{th} Grade) , the sample obtained through a multi-stage sampling from the following schools.

1. The schools established for the purpose of science instruction.

2.The schools in the project for development and promotion of the students gifted and talented in science, mathematics, and technology.

3. Normal schools in Education Inspection Region 3

Then the analysis was made on the linear structural relationship model of factors affecting the character of scientifically gifted and talented students with Statistical Package of LISREL. The model was readjusted for the parts that did not fit the empirical data.

RESEARCH RESULTS

The research results are derived from phase 1 and 2 of research procedure and presented in response to 3 research objectives as follows:

1. The character of scientifically gifted and talented students consists of 7 prominent components which tend to be the indicators to scientific achievements:

1.1 cognitive ability and scientific inquiring mind, characterized by such observable behaviors as intelligent expressions, high achievement in science learning , interest and enthusiasm in knowledge researching from a variety of learning sources , including observing behavior , knowledge sharing habits, and enjoying challenging activities.

1.2 scientific creativity, characterized by such observable behaviors as imaginations, new challenging creatives as the alternatives in use in terms of thinking, inventing, repairing scientific tools and equipment as well as their applications.

1.3 reasoning and deliberating, characterized by such observable behaviors as decision-making based on reasons – taking into account cause-effect relationship, and adequate supporting information rather than groundless beliefs, conforming to rules and regulations at work, systematic work planning , and tolerating criticisms for the sake of work improvement.

1.4 perseverance , characterized by such observable behaviors as commitment in carrying on scientific activities until achieving accurate results, devoting time, efforts, perseverance despite obstacles, difficulties and time consuming, working consciously and attentively, and tolerating criticism for the sake of professional achievement.

1.5 self-confidence, characterized by such observable behaviors as doing things with confidence, courage-showing expressions and acts, readiness to do what is right rather than comply with the just-majority trends,

preference of competing and disseminating scientific productivity to public.

1.6 responsibility, characterized by such observable behaviors as attentiveness in task assignments without shirking one's duties, willingness to help out group activities, punctuality, eagerness to learn in depth scientific phenomena, accountability for the outcome of his/her own work with transparency and integrity.

1.7 scientific problem-solving ability , characterized by such observable behaviors as using scientific skills and process for the analysis of scientific complex problems, envisaging potential the outcomes with accuracy , adjusting and applying a problem-solving method , appropriate for a situation, and evaluating his /her own problem-solving outcomes .

2. Found to be affecting the character of scientifically gifted and talented students are 5 latent variable factors, all of which consist of 20 observable variable components.

2.1 socio-economic status of parent/guardian, measured by 3 observable variables : 1. education level of parent/guardian 2, career of parent/guardian 3. income of parent/guardian

2.2 family environment , measured by 3 observable variables :1. mode of upbringing 2. relationship in family 3. role model of parent/guardian

2.3 parent/guardian supports , measured by 3 observable variables :
1. education media supports of parent/guardian 2. loving and energizing of parent/guardian 3. shared expectation in learning by student and parent/guardian

2.4 classroom social climate, measured by 5 observable variables : 1. in-class behaviors of student 2. process of learning management in class 3 competition in learning in class 4. relationship in class 5. student-teacher relationship

2.5 school environment , measured by 6 observable variables : 1. sources of science learning 2. readiness and access to supporting facilities in science
3. extra-activities for science learning 4. Role-model in science of a teacher
5. Role-model of a high achiever in science in school 6. School policy on science

3. The causal relationship model of factors affecting the character of scientifically gifted and talented students is depicted as the framework by the following diagram:

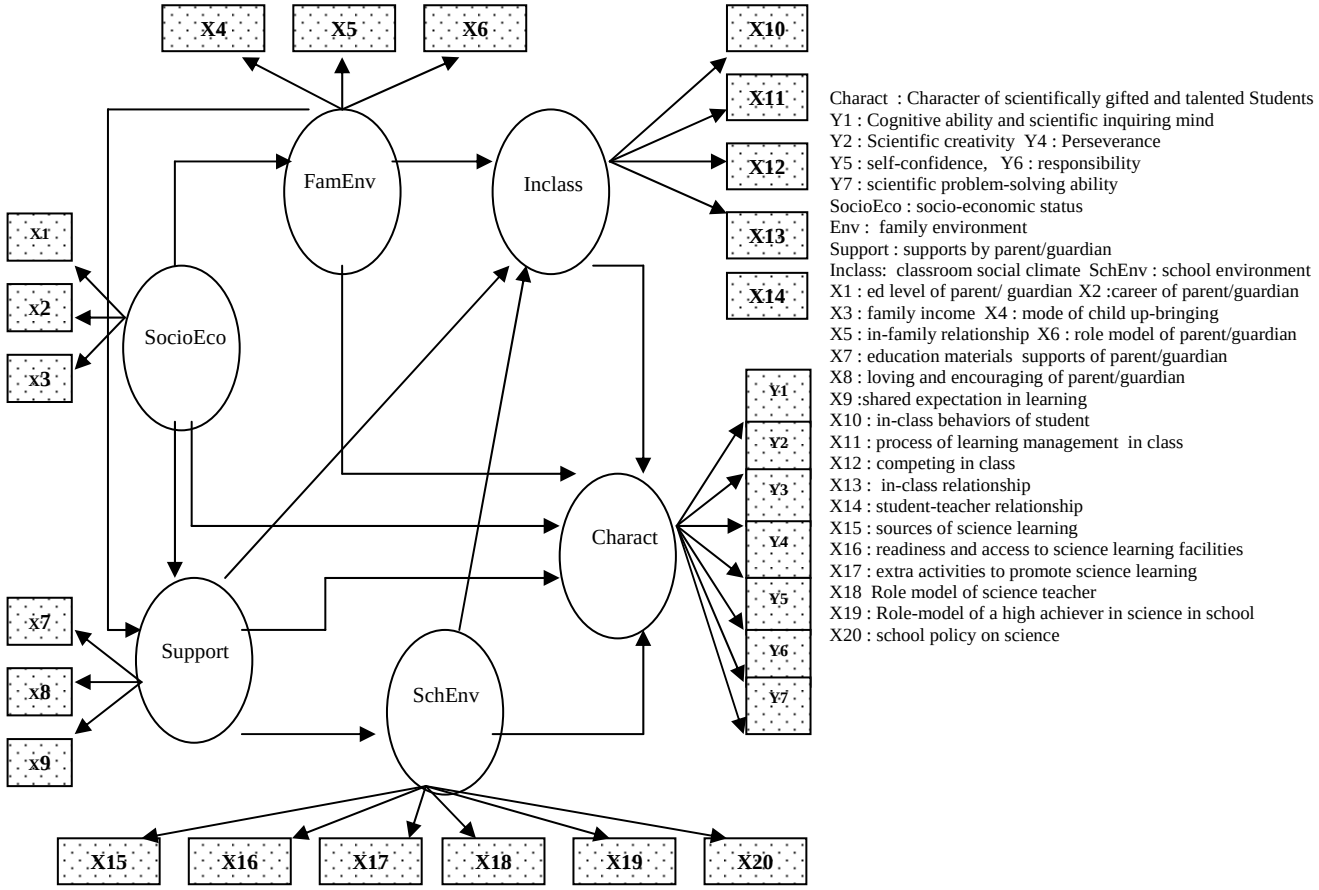

Figure 1 The causal relationship model of factors affecting the character of scientifically gifted and talented students

REFERENCES

Department of Academics. (B .E. 2545). Learning Standards : Subject Group Science , Basic Education Curriculum 2544 (A.D. 2001). Bangkok, Ladprao : Kuruspa Printing House.

Nongluck Virachcahi (B.E. 2542). LISREL MODEL : Analytical Statistics for Research (3 th. edition). Bangkok , Chulalongkorn University Press.

Wasan Punpol .(B.E. 2551). Developing the Indicators of Character of Scientifically Gifted and Talented : The application of research methodology mix. Dissertation Ph.D. , Naresuan University..

Anderson, O Roger; et al. (1995). The role of ideational networks in laboratory inquiry learning and knowledge of evolution among seventh grade students.(Online).H.W. Wilson.

Bullock.,M.(1994). "Development of Reasoning in Childhood" The International Encyclopedia of Education BPC Wheatons LTD : Excter.

Byrne, Barbara M. (1998). Structural Equation Modeling with LISREL, PRELIS, and SIMPLIS: Basic Concepts, Applications, and Programming. New Jersey: Lawrence Erlbaum Associates.

Frances,L.& Louise, Bates Ames.(1995). Child Behavior. New York : Holt.Rinchart and Winston.

Kelloway, E.K.(1996). Using LISREL for structural equation modeling : A researcher's guide. California : Sage Publications,Inc.

McDermott , Paul A ; Mordell, Melissa ; Stoltzfus, Jill C. (2001). "The Organization of student performance in American school : Discipline, motivation, verbal learning, nonverbal learning." Journal of Educational Psychology.93

Moos, Rudoft h. (1987). "Classroom Social Climate and Student Absences And Grades." Journal of Educational Psychology. 70(2).

Robbins, S.P.(1986). Organization Behavior: Concepts. Controversies and Applications. 3rd ed. Englewood Cliff. N.J. Prentice-Hall Privated Limited.

Robert K. Yin. (2003). Case study research : design and methods. 3rd ed. United State of America : Sage Publications ,Inc.

Schwartz, David D. and others.(1986). "Influence of Personal and University on the Subsequent Performance of Performance of Persons with Type A Type B behavior Patterns" Journal of Performance of Persons Social Psychology.51(20)

Weiss, Richard Victor. (1997,September). Cognitive ability, classroom learning behavior, and Achievement responsibility as predictor of Concurrent academic performance. Dissertation Abstracts.