Structural Equation Modeling of Casual Factors of Effectiveness of Enrichment Program of Science, Mathematics, Technology and Environment (SMTE) of Secondary School in the Northeast Region

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Abstract

The purposes of this research were 1) to study characteristics of causal factors in Structural Equation Modeling (SEM) influencing the effectiveness of science, mathematics, technology, and environment (SMTE) of Secondary Schools in the northeast region, 2) to examine the causal factors of SEM the selected developed model affecting the effectiveness of SMTE in the northeast with the empirical data, and 3) to obtain guidelines for developing the selected factors that affected the effectiveness of science, mathematics, technology, and environment special classroom project in the northeast. This study consisted of 561 related persons involved, consisting of 11 people involved in the project, 1 school director and 1 deputy director, 3 science teachers, 3 mathematics teachers and 3 teachers in computer subjects. The research methodology was conducted in 3 phases: 1) constructing the hypothesis model, 2) examination of conformance with empirical data, and 3) finding ways to develop causal factors. The tools used for the collection were a questionnaire with a five rating scale and an interview form. Statistics used for data analysis were percentage, mean, standard deviation, Pearson's coefficient, Alpha coefficient, and the analysis of structural equation modeling.

The results of the research were as follows: 1) The structural equation modeling that was created consisted of causal variables, namely school management and participation of parents and student's physical environment in teaching and learning science and mathematics; 2) The causal factors of structural equation modeling of the project effectiveness; 3) This research presents guidelines for the development of causal factors that directly, indirectly, and overall affect the project effectiveness as follows: school management, The participation of parents and students, the physical environment and science and mathematics teaching and learning management.

Keywords: Structural Squation Modeling, Project effectiveness, Science special classroom, SMTE, Northeast

Introduction

Education management for gifted people is considered an important part of learning reform according to the National Education Act B.E. 1999 and all amendments; section 10, paragraph four states that "Education for people with special abilities must be organized in an appropriate format by taking into account the talents of that person. It must be organized in an appropriate format considering the person's abilities. Section 22 stipulates that educational management is based on the principle that learners can learn and develop themselves and considers the learners to be the most important The educational management process must encourage learners to develop naturally to their full potential together with the concept of developing the quality of learners to have learning skills for continuing education and life skills in the 21st century in Section 24 on the organization of the learning process, content, and activities must be arranged per the interests and aptitudes of the learners taking into account individual differences practice skills in the thinking process, management, coping with situations application of knowledge by allowing students to learn from actual experiences. (Office of the National Education Commission, 2010)

As for education management for students with exceptional abilities in science and mathematics in the particular science, mathematics, technology, and environment classrooms, there is one important principle. Educational management to develop human resources to become researchers, inventors, and innovators in science, mathematics and technology with high international potential. At present, Thailand still needs to improve. In the past, the management of mathematics education, science, and technology in Thailand, both at the primary and tertiary education levels, emphasizes graduates having the ability to use science and technology for their living and occupations efficiently and knowingly by dividing the students into groups. 1, it is a study for life so that all Thai people can apply the basic knowledge of Mathematics, Science, and Technology as well as thinking total processes and scientific processes used in life, and can choose and use various products at efficiency economically and safely. Group 2 is occupational education for people who need skills and knowledge, math ability, science, and technology directly applied in the profession, which requires more specialized skills and abilities than group 1, able to work effectively, economically, and safely. Examples of such professions include doctors, nurses, engineers, and science teachers' industrialists, technologists, etc. In the past, Science, Mathematics, and Technology education in Thailand was not enough for students to be researchers and inventors. There is an initiative to create a new body of knowledge in Mathematics, Science, and Technology. This is because the budget allocation to support talents is still limited to some groups of students. As a result, it affects the creation of wisdom for the nation in many respects. The education management for those with talents in science and mathematics must be carried out in conjunction with creating guidelines for exceptional classroom management in Science, Mathematics,

Technology, and the Environment. This is another way to help teaching and learning management be effective (Chewpreecha, 2012).

Therefore, the management of special classrooms is considered one of the important concepts for learning management for special education students. A collaboration with the Institute for the Promotion of Teaching Science and Technology Mahidol Wittayanusorn School Ministry of Science and Technology higher education institutions, departments, and organizations set guidelines for requesting special classes in Science, Mathematics, and Technology, and the Environment to develop the potential of high school students. The Bureau of Academic Affairs and Educational Standards under the OBEC is the operator of the project to support 220 schools, recruiting students who have graduated from junior high school with exceptional abilities in mathematics and science to attend, high school level according to a special learning curriculum that is different from the general classroom, and they are also in charge of selecting equipment, places, and teachers to encourage students to experience and develop the potential of special classroom students to be successful. (Chewpreecha, 2012) The management of remarkable classroom projects in science, mathematics, technology and the environment of the region has been divided into regions, and each region jointly develops its students. This is to make it easier to manage. According to this approach, the Special Science Classroom Project, The upper and lower northeastern networks, a total of 60 schools, each of which has set a way to determine activities. Mathayomsuksa level 4-6, for students to have the potential to think, solve problems, support, and increase their knowledge and experience in solving problems with quality scientific processes. (Chumphon Phon Phisai School, 2019) As well as, Management of Special Classroom Projects in Science, Mathematics, Technology, and Environment. In the past, there have been studies that reported that there is a total of 13 elements in the science classroom project administration, namely 1) Student recruitment and selection, 2) Student governance, 3) Classroom media usage, 4) Determination of measurement and evaluation methods, 5) Student development activities, 6) Teacher personality development, 7) Teacher specific competency development, 8) Classroom atmosphere creation, 9) Physical environment arrangement, 10) Special classroom teacher selection, 11) Learning support network creation, 12) Student participation, 13) curriculum-based learning management. (Dumcha-Om & Suksodkiew, 2019)

In determining what factors make managing of a special classroom project in Science, Mathematics, Technology, and the Environment less successful, there are many factors**.** Some may have an indirect effect, and some, directly and indirectly affect success or effectiveness**.** The researcher was therefore interested in studying causal factors affecting the effectiveness of special classroom project management in science, mathematics, technology and environment in the Northeast because it is a study from theory to modeling that shows the structure of relationships between variables**.** Structural equation modeling **(**SEM**)** is a causal relationship investigation**.** The theoretically constructed models derived from empirical data and testing the model**'**s consistency is a statistical technique used to test and estimate causal relationships in modeling equations**.** Action structure is available for both verification and survey purposes**.** The creation models are intended to confirm or test theories or read to the development of

theory, which is also suitable for research in the knowledge society era. Enhancement and expanding new knowledge lead to best practices. (Sanrattana, 2013) so there is an idea to test the theory and confirm the structure of the theory by analyzing the structural equation modeling that can be applied to accurate empirical data. The LISREL program was used to analyze the structural equation modeling because it is a program that has outstanding points which 1) displays the analysis results in both text and diagrams, making it easy to verify the accuracy, 2) There are many model consistency check indexes as if there were many experts. You can confirm and verify that the developed model is consistent with the empirical data or not 3) be able to analyze complex data more realistically. (Suksawang, 2014) To create and verify the validity of the causal factor structural equation modeling on the effectiveness of the special science, mathematics, technology, and environment classrooms project and find ways to develop the effectiveness of special classroom projects in science, mathematics, technology, and environment. Make this research lead to other excellent practices.

Research objectives

1. To study characteristics of causal factors Structural Equation Modeling (SEM) influencing the effectiveness of Science, Mathematics, Technology, and Environment (SMTE) of Secondary Schools in the northeast region.
2. To examine the causal factors of SEM, the selected developed model affecting the effectiveness of SMTE of Secondary Schools in the northeast with the empirical data.
3. To obtain guidelines for developing the factors that have directly affect the indirect and affect the effectiveness of the Enrichment Program of Science, Mathematics, Technology and Environment (SMTE) of Secondary Schools in the Northeast Region.

Methodology

This research used a causal- comparative research methodology to create a causal relationship model of factors affecting the effectiveness of a special science classroom project of mathematics technology and the environment in the Northeast under the theoretical knowledge and empirical research results and by the preliminary agreement (assumptions) to create a structural equation modeling that is a research model or a hypothesis model. The result will be a hypothesis model that consists of a measurement model and a structural equation modeling conducted according to statistical research methods. In order to answer the research question of whether the structured equation model was the supporting theory and research consistent with the empirical data, the data were analyzed using the LISREL program. The result was a causal relationship model of factors affecting the effectiveness of science classroom project management of mathematics technology and the environment of Secondary Schools in the Northeast, as shown in Figure 1.

The researcher reviewed the literature to create a research framework. The work of academics separating the variables as follows: External Latent Variables are School Management (K1) from the concept of Huffhines (1984, pp. 705-A); Brown (1988, pp. 81-90); Stribling (1992, pp. 71-87); Gold (2000, pp. 18-20); Hirtz (2002, p. 132); Intraprasert (2007);

Yenkai et al. (2011, p. 20); Saingam et al. (2017, p. 519); Chulewan and Kerdtip (2017, p. 36); Poonsub and Ruttanasiraprapa (2021, p. 65). There were 3 observed variables: 1) Personnel Leadership (PL), 2) Personnel Development (PD) and 3) Participatory Management (PM) and Parent and student involvement (K2) from the concept of Hollander (2002, pp. 317-327); Hakham et al. (2022, p.68); Sathanasaowapak et al. (2013, p. 108); Tohlu (2015); Pinkamlang (2019); Bergmark and Westman (2018); Washington University in St. Louis (2022). There are 3 observed variables: 1) Parenting (P), 2) Learning at home (LH), and 3) Collaboration with communities/universities in the region (PCUR). Internal Latent/Associated Variables were Physical environment (E1) from the concept of Prasitrat (2002); Kunyochai (2007); Napanut (2015, p. 6); Abdulloh and Niemted (2020, p. 231); Atthajinda (2020, p. 9); Baafi (2020, pp. 121-137). There are 3 observed variables: 1) Learning environment (EL), 2) Atmosphere and facilities of the place (AFP), and 3) Availability of equipment and learning materials (ATEM). Teaching and learning science and mathematics (E2) from the concept of Kibler (1970. pp. 15-20); Valaya Alongkorn Rajabhat University (2014, p. 4); Johnson (2016); Fongjangwang and Kongmanus (2017, p. 937); Sripimai (2018); Payane (2019); Sangthong (2020). There are 3 observed variables: 1) Implementation of project principles and objectives (IPPO) 2) Teaching and learning process (TLP) and 3) Measurement and evaluation (ME), and Project Management Efficiency (E3) from Inchai and Kueiniyom (2010, p. 17-20); Suranaree university of technology (2012); Puttajorn et al (2013, p. 106); World Class Schools (2013, online); Kaliski and Godfrey (2014, pp. 13-14); Howard County Public School System (2015, pp. 317-327); Education Promotion Group Office of the Secondary Educational Service Area 12. (2018); Yala Rajabhat University (2018); Chaeng Wittaya School (2018, p. 6-9); SMP-YRU Project Implementation Committee, Yala Rajabhat University. (2020); Chumphon Phon Phisai School (2019); School of Science and Technology (2019); ILocos Norte National High School (2019); Internationnal School Bangkok (2022). There are 3 observed variables: 1) Have high academic achievement (HAA), 2) Characteristics of being a researcher in science and technology (CRST) and 3) Potential to compete on the global stage (PCGS) as shown in Figure 2.

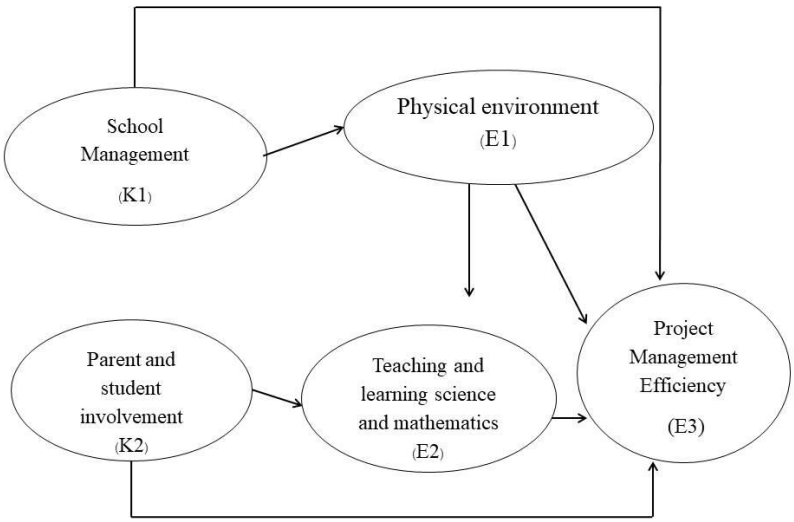

Figure 1 The hypothesis model of the structure, the cause of the effectiveness of the project, special classroom, science, mathematics, technology, and environment

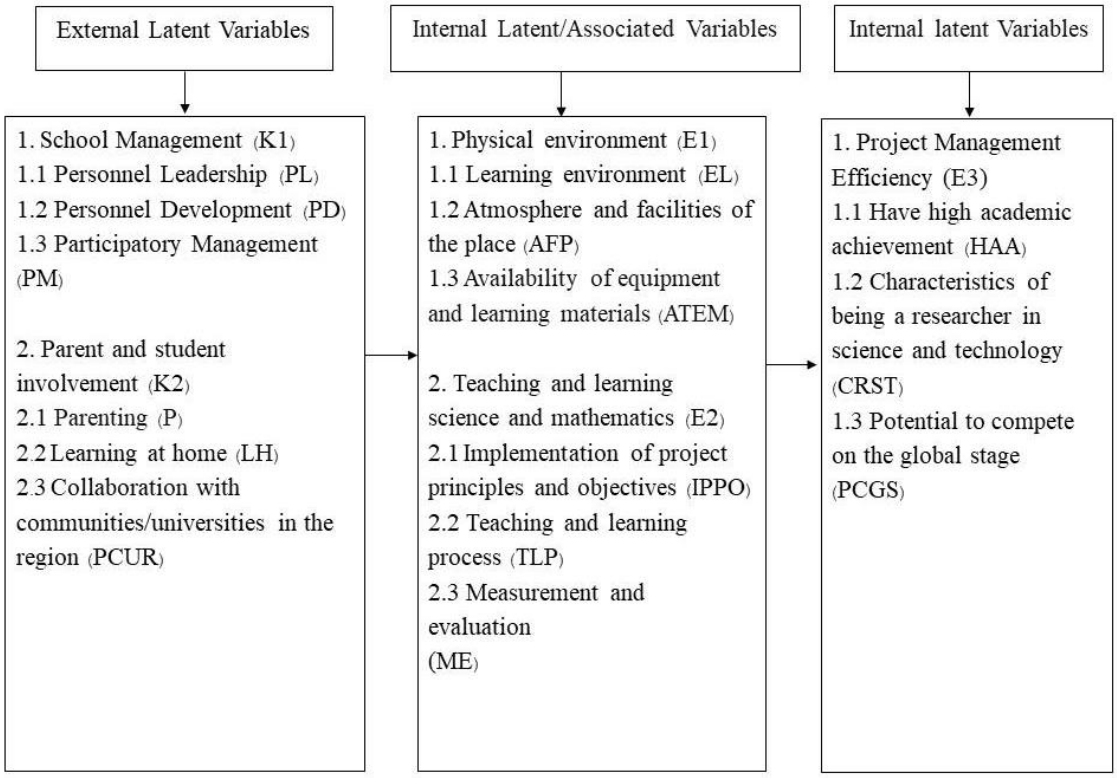

Figure 2 Conceptual Research Framework Elements

From the above information, the researcher divided the research method into 3 phases: Phase 1, modeling the hypothesis. Phase 2, Checking the consistency with empirical data (rating scale); Phase 3, finding ways to develop factors that influence classroom project effectiveness. Specialty in science, mathematics, technology and, environment in the Northeast. The details are as follows.

Research population and sample

The researcher sets up the scope of the population and informants based on the procedural research steps as follows:

1. Population in this study was those involved in the enrichment program of Science, Mathematics, Technology, and Environment (SMTE) of Secondary Schools in the Northeast Region for the academic year 2020 of 960 people consisting of 60 school directors, and 180 deputy directors, 240 science teachers, 240 mathematics teachers, computer teachers and 240 people from 60 schools.

2. The sample group in this research was those involved in the enrichment program of Science, Mathematics, Technology and Environment (SMTE) of Secondary School in the Northeast Region for the academic year 2020, a total of 561 students from 51 schools, using the criteria for determining the sample size. Specify the sample size as a function of the number of parameters to be estimated, i.e., and there must be approximately 20 sample sizes per parameter. (Wiratchai, 2005) Therefore, the researcher used the 0.7 ratios as a randomized unit to determine the total number of schools.

Choosing a random sample of schools using proportional stratified random sampling. Using the size of the school as a strata and assigning informants in each school. There was 11 people per school, including 1 school director and 1 deputy director, teachers in the content: 3 science teachers, 3 mathematics teachers, and 3 computer teachers, totaling being 561 samples.

Research and operational steps

The research tools, Certified by Sakon Nakhon Rajabhat University Ethical Committee COA No. 121/2022 and IEC NO. HE 65-086 were composed of five steps. Step 1: The questionnaire was constructed on a 5-level rating scale most, medium, and least. By creating questions from the definition of variables, divided into 6 parts. Step 2: The researcher conducted a content validity check by examining the consistency between the questionnaire text and the operational definitions (rating scale) from 5 experts. Step 3: The researcher examined the confidence of the tool. (Reliability) by using the questionnaire to experiment (Try Out) with the data users who have the same characteristics as the actual samples, namely 9 schools in the Science, Mathematics, Technology, and Environment Special Classroom Program in the Northeast, totaling 9 schools, 6 each. There is 1 school director, 1 deputy director, 2 science teachers, 1 mathematics teacher, and 1 computer teacher, totaling 54 people. Step 4: The reliability of the questionnaire was analyzed using the alpha coefficient formula according to Cronbach's method (1970, p. 161). The confidence of the whole questionnaire was 0.970, and the side confidence was between 0.219-0.789. Then selecting, questions with discriminating power of 0.23 or higher to be used to collect real data. (Pinyoanuntapon, 2002), Moreover, Step 5: The researcher analyzed the data from the questionnaire. The researcher

analyzed the mean ($\bar{x}$), standard deviation (SD), skewness, and individual kurtosis of the data using a packaged program by setting the criteria for the mean ($\bar{x}$). which considered the research data by using advanced statistics, namely Confirmatory Factor Analysis (CFA). Structural equation modeling (SEM) analysis and linear model analysis using Chi-square statistics.

Results and discussion

The results of the linear structural relationship analysis and the analysis of the influence of the factors of the project effectiveness Acceptance criteria used the program LISRELversion 8,52. According to the method of Diamantopoulos and Siguaw (2000, pp. 83-87) in Table 1.

Table 1 The statistic measures the model' s concordance with the empirical data after adjustment

Index	Acceptance level	Obtained statistics	Consideration
1. Chi-square	p-value > 0.05	$\chi^2 = 44.66$ p. = 0.08	qualify
2. χ^2/df	< 2.00	1.35	qualify
3. GFI	> 0.90	0.99	qualify
4. AGFI	> 0.90	0.96	qualify
5. RMSEA	< 0.08	0.03	qualify
6. CN	> 200.00	669.12	qualify
7. CFI	> 0.90	0.99	qualify
8. RMR	<0.08	0.01	qualify

From Table 1, after model adjustment, it was found that the model was consistent with the empirical data with statistical values measuring the model's harmony as follows: Chi-square value equal to 44.66 at degrees of freedom (df) equal to 33. Probability (p-value) = 0.08, relative chi-square value (χ^2/df) = 1.35, less than 2.00, GFI = 0.99, AGFI = 0.97, RMSEA = 0.02, CN = 669.12, CFI = 0.99 and the RMR value = 0.01 as shown in Figure 3.

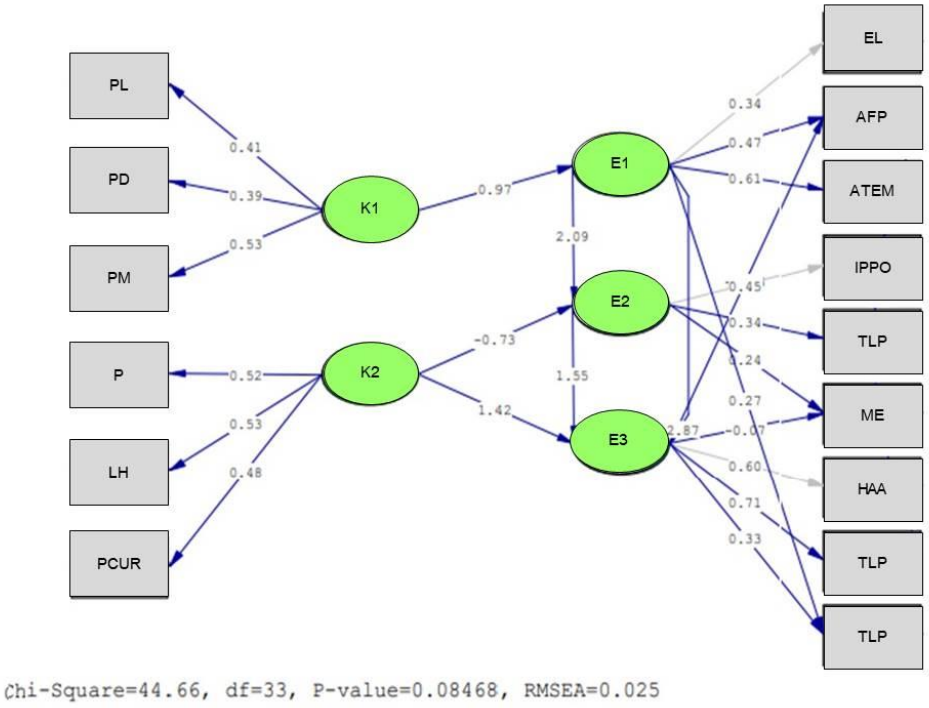

Figure 3 Model analysis results with empirical data after adjustment.

The researcher used data from checking the consistency of the linear structural equation modeling of the project effectiveness factor. After modeling, the program. LISREL version 8.52 was used to rearrange the model to show the path of influence more clearly, as Figure 4

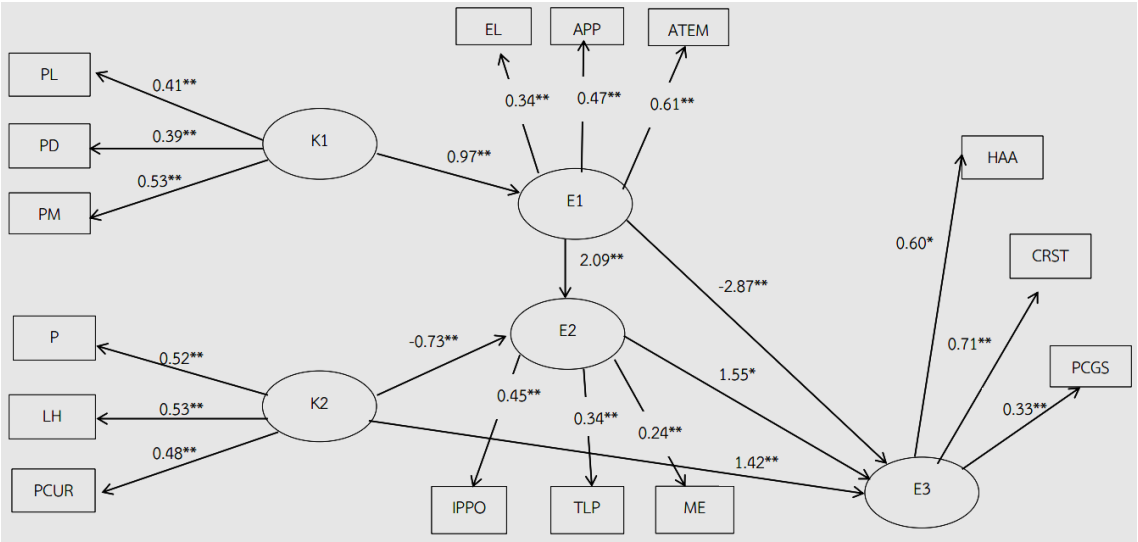

Figure 4 The results of verifying the consistency of the linear structural equation modeling of the factors of project effectiveness after modeling.

Results of direct influence analysis, indirect and combined influences of causal factors of project effectiveness by using the LISREL for Windows program as shown in Table 3

Table 3 The results of the analysis of the influence between cause and effect variables as a whole.

Result variable	Cause variable														
	K1			K2			E1			E2			E3		
	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE
E1	0.97** (0.07)	0.97** (0.07)	-	-	-	-				-	-	-	-	-	-
E2	2.03** (0.22)	-	2.03** (0.22)	- 0.73** (0.21)	- 0.73** (0.21)	-	2.09** (0.27)	2.09** (0.27)	-	-	-	-	-	-	-
E3	0.36** (0.09)	-	0.36** (0.10)	0.29** (0.09)	1.42**	-1.13* (0.92)	0.37** (0.10)	- 2.87**	3.24* (0.39)	1.55* (0.62)	1.55* (0.62)	-	-	-	-
Statistics															
Chi-square = 44.66	df = 33	p-value = 0.08	GFI = 0.99	AGFI = 0.96	RMR = 0.01										
Observable variable	PL	PD	PM	P	LH	PCUR									
R^2	0.39	0.39	0.39	0.58	0.58	0.62									
Observable variable	EL	AFP	ATEM	IPPO	TLP	ME	HAA	CRST	PCGS						
R^2	0.24	0.24	0.27	0.51	0.51	0.51	0.51	0.56	0.47						
Latent variable	E1	E2	E3												
R^2	0.51	0.25	0.55												
Correlation matrix between variables															
Latent variable	E1	E2	E3	K1	K2										
E1	1.00														
E2	0.96	1.00													
E3	0.67	0.63	1.00												
K1	1.09	1.15	0.68	1.00											
K2	0.90	0.76	0.67	0.83	1.00										

Note: ** means statistically significant at the 0.01 level ($p<0.01$)
* means statistically significant at the 0.05 level ($p<0.05$)

The causal Factor Relationship Model of Special Classroom Project Effectiveness in Science, Mathematics, Technology, and Environment is consistent with empirical. data This is by the hypothesis's the latent variable outside school management (K1) indirectly influences the project effectiveness (E3) through two routes. The physical environment variable (E1) and the second pathway through Science and Mathematics Instructional Management variable (E2) were latent external variables, and parent-student participation (K2) had both direct and cognitive influences. There was an indirect effect on the science and mathematics teaching and learning management variable (E2). Mathematics (E2) and indirectly on project effectiveness variables (E3)

Considering the total influence of the project effectiveness variables (E3) as a whole, it was found that latent variables within science and mathematics teaching and learning management (E2) had the highest total influence, followed by latent variables within the

physical environment (E1) Latent variables outside school administration (K1) and latent variables outside parent and student participation (K2), respectively.

1. Science and mathematics teaching and learning management (E2) directly influenced the project effectiveness variables due to the factors of science and mathematics teaching and learning positively affecting students. It is caused by those involved having learned and understood the principles and objectives of the Science, Mathematics, Technology and Environment teaching and learning management project. So well that they understand and can be used in various operations, such as creating educational institute curricula, teaching media, teaching methods, measurement, and assessment, and the teachers have a relatively permanent knowledge of science and mathematics as a result of experience. A continuous sequence of steps from beginning to end helps them achieve effective learning leading to the success of the student's goals in this project, including having high academic achievement. The student's expression indicates being a scientific researcher, such as observant, inquisitive, and curious cause. The effect is initiative with effort and patience until students have a good attitude towards science that gives have the potential to compete on a global stage. Therefore, the teaching and learning of science and mathematics under Special classroom projects results are effective and consistent with the research report of Chaisawat (2015) said teaching management is an indicator of the success of special education management in Science, Mathematics; and English (SME) classrooms. Teaching materials and learning resources, as well as the quality of students, align with the research report of the National Research Council (1988, online). Reported the results of improving science and mathematics education quality indicators at the basic education level, consisting of 4 components: 1) Science teaching and learning and mathematics, 2) student behavior, 3) technology quality, and 4) curriculum. Teaching management related to student learning. As the research report of Thakham et al, (2018) learning skills achievement motivation and learning behavior of students was a positive correlation with the success of teaching special science-mathematics classrooms in schools under the Office of the Basic Education Commission with statistical significance at the .01 level. Student characteristics were positively correlated with the success of opening special classrooms at the .05 significance level.

2. The physical environment (E1) includes the learning environment. The atmosphere and facilities of the place and the availability of equipment and teaching materials directly and indirectly influenced science and mathematics teaching and learning management variables and have direct and indirect influences on project effectiveness variables. Educational institutions have a learning environment, including classrooms, and laboratories, or the construction of a building or room for science, mathematics, and technology learning source within the school, a learning area such as a botanical garden, a butterfly dome, or a relaxation area under the shade of a building or tree, wich promotes learning of science and mathematics enjoyable and to have atmosphere and facilities conducive for students learning, such as lighting, sound, and well ventilated classrooms. The classroom, will have tables, chairs, blackboards, information boards, and science and math learning classroom illustrations. In addition, there is the availability of equipment and instructional materials for conducting

experiments or arranging teaching that is good and sufficient to meet the needs of the students and it will result in better learning of science and mathematics for students. It will affect the effectiveness of the project, for example, students will have higher learning achievement, students will develop the characteristics of being researchers in science and technology, students will have the potential to compete on a global stage, and students will have higher academic achievement.

From the causes and effects of the above project effectiveness factors, it shows that organizing the physical environment is conducive to learning making teaching and learning such as science and mathematics more effective. The science and mathematics classrooms have the atmosphere, facilities, and equipment for learning materials ready for learning management. When these things are available for learning, it affects the project's success. This is in line with the concept of Paknara (2021), which states providing an environment conducive to learning consists of 2 factors: 1) The external physical environment and 2) The internal psychological environment. All of these affect learning by having a good physical environment that promotes good physical health and hygiene. The psychological environment affects the learning atmosphere. Having good mental health and having desirable characteristics according to curriculum expectations allow teachers to manage the learning process effectively and make the students happy and successful in learning.

3. School Management (K1) consists of Personnel Leadership. Personnel development and participative management indirectly influence physical environment variables. Due to the management of educational institutions, there is an an operational process in various activities of the educational institution, These aspects are Academic administration, Budget Management, Personnel Management, and General administration, with administrators, teachers, professors and personnel from various departments of the local community participating in the educational management plan within the educational institution in a systematic manner according to the established standards to benefit the management of education correctly and efficiently. Consistent with the concept of (Boonmuang, 2018) said that the management of educational institutions is the formulation of policies, planning, control, correction and improvement of various environments in educational institutions to be in good and hygienic condition: School administrators are the proner leader in setting directions and policies and leading educational institutions to implement physical environmental management, build buildings and facilities that facilitate student learning to be successful.

In addition, School Management also had an indirect effect on science and mathematics teaching and learning management variables, consisting of applying the principles and objectives of the project in the teaching learning process, measurement and evaluation, and the project effectiveness variables, therefore, contain high academic achievement characteristics of being a researcher in science and technology and the potential to compete on a global stage due to the management of school administrators that aim to develop students to have knowledge and abilities and skills that can compete internationally and can live happily. Educational institution administrators, therefore, promote and support educational management in various forms in terms of budget, academics, personnel, and buildings per the

activities of the four educational institutions, namely academic administration. Budget management Personnel Management and general administration. In particular, academic administration is the main mission of school administrators and is an administrative process in various activities organized by educational institutions which directly and indirectly influence the students. This is to improve, promote and develop students' standard quality with the intent of education as much as possible. (Pratoom, 2016)

Therefore, administrators can have good educational institute management, by the process of persuasion. For others to act by the intentions of work under various circumstances leading to the same destination and have personnel development as well as having participatory management together to plan and manage the physical environment and science and mathematics teaching and learning to achieve the same goal. It will make the management of the school affect the effectiveness of the project, for example, students have higher learning achievement. Students develop the characteristics of being researchers in science and technology. That enables them to have the potential to compete on a global stage.

4. Parent-student involvement (K2) includes: learning at home and cooperation with communities/universities in the region. Which in directly and indirectly influences project effectiveness variables because parents and students participate in learning and develop educational institutions in many dimensions. It also allows students to study according to their aptitudes and interests independently based on individual differences with specialized experts as consultants to take care of these learning and developing the potential to become a talent. As a result students have higher learning achievement. Students develop the characteristics of being researchers in science and technology and students have the potential to compete on a global stage. Consistent with the research report of Dumcha-Om & Suksodkiew (2019) student's participation is the factor affecting the administration of special classroom projects in science, mathematics, technology and environment. There were 3 outcome indicators that resulted in this variable: 1) allowing students to study according to their aptitude and interest independently based on individual differences with specialists as consultants to take care of. 2) The questions must be as open-ended as possible and 3) the students participate in the selection of contents to organize learning-style activities in the classroom. The indirect influence was found through the science and mathematics instructional management variables because students receive knowledge and experience from teachers who manage teaching and learning. Make the students participate in teaching and learning activities from the grade level to the school level with school administrators. As a result, teaching and learning are effective at various levels in which students are involved consistent with the research of Kongcharoen (2013) A study of parent's participation in the teaching and learning development of students at Plai Bang Wat Sunthonthammikaram Municipal School, Bang Kuay District, Nonthaburi Province found that overall, there was a high decline sorted from the average to the least student's behavior and academic, respectively, and indicated that parents' participation affected teaching and learning management since it is related to academics, including the preparation of local curricula of educational institutions by using local wisdom from parents, students, and communities. Pay attention to follow-up on learning outcomes, and setting up an

environment that promotes learning. Measurement and evaluation according to actual conditions, with parents participating in the evaluation improvements, and repairs. Reports of improvements are made regularly and continuously in student behavior in a good direction, including support and encouragement, and by training students to be responsible.

Conclusions

1. The structural equation modeling of the causal factors of the constructed project effectiveness had causal variables. There were 5 internal and external panel variables and 15 observed variables. Which the latent variables consist of 1) School Management (K1) 2) Parent and student involvement (K2) 3) Physical environment (E1) 4) Teaching and learning science and mathematics (E2) and Project Management Efficiency (E3)

2. Causal factor structural equation modeling of project effectiveness generated is consistent with empirical data. The statistical value for measuring the harmony of the pattern is Chi-square; $\chi^2 = 44.66$ at degrees of freedom (df) = 33, relative chi-square $(\chi^2/df) = 1.35$, probability (p-value) = 0.08, root mean square error estimate (RMSEA). Was 0.02, GFI was 0.99, Adjusted AGFI was 0.97, Critical Sample Size (CN) was 669.12, Comparative Concordance Index (CFI) was 0.99, and Root Index was 0.02. The mean square of the residuals (RMR) was 0.01 and the forecasting coefficient (R2) of the latent variables was 0.55, indicating that the variables in the model could explain the variance of the project effectiveness 55% by School management (K1) indirectly affects Project effectiveness (E3) through 2 routes, i.e. route 1 via physical environment (E1) has an influence value of (0.97)×(-2.87) = (-2. 24) and the teaching and learning of science and mathematics (E2) directly affects Project effectiveness (E3) with an influence value equal to 1.55 as shown in the figure 5

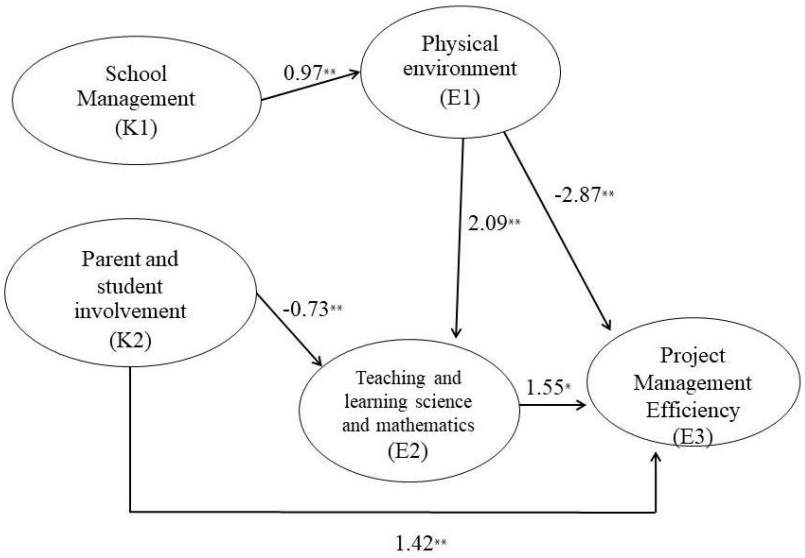

Figure 5 Causal Factor Relationship Model of Project Management Efficiency in Science, Mathematics, Technology and Environment

Note: ** means statistically significant at the 0.01 level (p<0.01)
* means statistically significant at the 0.05 level (p<0.05)

As for confirmation of the causal factor correlation model of the project effectiveness. Conducting a Focus Group Discussion with 10 experts, all experts agreed on the causal relationship model of the project effectiveness. Confirmation of direct influence values indirect and combined influences of causal factors of project effectiveness by using the model to confirm the linear structural relationship of the factors of project effectiveness. After adjusting the model, it was found that 10 experts agreed with the direct influence. Indirect influence and the combined influence of the causal factors of the project effectiveness.

3. Guidelines for developing causal factors that directly and indirectly affect project effectiveness experts offer the following: teaching and learning science and mathematics is the heart of learning management according to the curriculum with practical guidelines for special classroom projects in Science, Mathematics, Technology, and Environment. Namely: 1) Continuous science process skills enhancement for students; 2) The class schedule was consistent with the time management guidelines and 3) The design of learning activities based on projects that were unconventional and different from regular classrooms.

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