A Causal Relationship Model of Primary Public School Students' Achievement: A Multiple Group Analysis

Thanomwan Prasertcharoensuk[1]*, Jenphop Chaiwan[2], Keow Ngang Tang[3] and Pattrawadee Makmee[4]

[1]*General Education Teaching Institute, Khon Kaen University, 40002 Khon Kaen, Thailand*
[2]*Nongbua Lamphu, Primary Educational Office Area 2, Na Klang, 39170 Nongbualamphu, Thailand*
[3]*Institute for Research and Development in Teaching Profession for ASEAN, Khon Kaen University, 40002 Khon Kaen, Thailand*
[4]*Cognitive Science and Innovation Research Unit: CSIRU, College of Research Methodology and Cognitive Science, Burapha University Saensook, Mueang, 20131Chon Buri, Thailand*

ABSTRACT

This research aimed to examine the causal relationship model of primary school students' achievement. The coverage included all types of primary public schools, namely formal and extended primary, in urban and rural areas, respectively, throughout Thailand. A survey was carried out with 1,200 school administrators and teachers from 600 schools with the intention of testing the goodness of fit of the causal relationship model with the empirical data. Results disclosed that the causal relationship model of students' achievement were identified as congruous with empirical data, with χ^2 =58.381, df = 45, χ^2/df = 1.307, CFI = 1.000, TLI = 0.999, RMSEA = 0.016, and SRMR = 0.007. In addition, the three main variables, namely teachers' collective efficacy, transformational leadership, and professional learning community, significantly affected students' achievement, directly and positively. On top of that, transformational leadership significantly affected both the variables of teachers' collective efficacy and professional learning community; the professional learning community significantly affected teachers' collective efficacy directly and positively. Finally, the test of invariability of the linear causal relationship model of students' achievement indicated that the two models, in either formal primary school or extended primary, were found to have the goodness of fit with the empirical data. Results contribute significantly to knowledge by proposing the causal relationship model to provide a connection between the three key

factors, namely transformational leadership, professional learning community, and teachers' collective efficacy, to improve primary school students' achievement.

INTRODUCTION

Current educational reforms have been focused on improving instructional quality and student learning through teachers' collective efficacy (Goddard et al., 2007), transformational leadership (Prasertcharoensuk & Tang, 2016), and professional learning community (Ariratana et al., 2016; Somprach et al., 2017). Therefore, innovative strategies must be identified to improve the quality of Thai primary school education, particularly to serve the needs of individuals as well as those of Thai society. This is because primary school students' capabilities for competitiveness and creative cooperation will strengthen Thailand's international competitive position. Although Thailand has embarked on an ambitious series of reforms, schools and teachers have not always been given the support and skills they need to implement the recommended new approach. Thailand has a comprehensive system of standardized national assessments, namely Ordinary National Educational Tests (O-NETs), but it lacks the capacity to ensure that the O-NET tests reinforce the aims of the curriculum and support reform efforts rather than undermine them (OECD/UNESCO, 2016). This is because school administrators and teachers are required to have the capacity to gain knowledge and understanding, and, accordingly, develop their school systematically to promote student achievement (Sirisooksilp et al., 2017).

Goddard et al. (2007) suggested that collective efficacy benefited teachers' practice in various ways, which in turn affected students' achievement indirectly. This is further supported by recent studies (Daly et al., 2010) which have demonstrated that strong teacher networks for school conditions can enhance student achievement. Furthermore, education reforms can be motivated by indications that strong professional development communities of teachers, indeed, produce student learning (Newmann et al., 2000). As a result, collective efficacy is a concept that merges these benefits, as it articulates shared perceptions of a group's ability to achieve collective goals, and is a mechanism that can explain how configurations of teacher networks affect student learning or achievement (Goddard, 2002; Goddard et al., 2004).

According to Davis and Darling-Hammond (2012) and McKibben (2013), principals are rated second to teachers in the improvement of student achievement and they account for up to 25% of the variance in student learning. As a result, Davis and Darling-Hammond (2012) suggested that principal preparation programs must provide a comprehensible focus on leadership practices and theory that would improve student learning. Previous research indicated

that effective and capable transformational principals were essential to produce the success of educational reform efforts (Al-Omari & Sharaah, 2012; Pugh et al., 2011). This is because transformational principals are able to generate positive school cultures (MacNeil et al., 2009) and strengthen their culture through celebrating successes and reinforcing the established standards and values (Turan & Bektas, 2013). Moreover, Prasertcharoensuk and Tang's (2016) hierarchical linear modeling findings showed that the effects of teachers' teaching behavior potentially emerged and, added together with the transformational leadership of school administrators, particularly in intellectual stimulation and contingency reward dimensions, would provide the greatest impact on teaching efficiency.

Stoll et al. (2006) emphasized that teachers' individual and collective capacity in a professional learning community, and its link with school-wide capacity, enabled the promotion of students' learning. They also argued that developing a professional learning community appeared to hold considerable promise of capacity building for sustainable improvement. Andrews and Lewis (2007) found that a professional learning community not only enhanced teachers' knowledge base but also had a significant impact on students' learning in Australia. Somprach et al. (2017) proposed that essential leadership styles would guide school principals in promoting teachers' participation in a professional learning community, which, in turn, would improve

students' learning. They also found that there were four significant predictors, namely learning, transformational, collaborative, and individual leadership styles, which together contributed 55.6% of the variance in teachers' participation in a professional learning community.

The O-NET is administered annually by the National Institute of Educational Testing Service (NIETS) to Primary 6, Grade 9, and Grade 12 students according to the Basic Education Core Curriculum 2008 in Thailand. The O-NET aims to assess students' academic proficiency, provide information to the schools to improve teaching and learning activities, and evaluate the quality of education at the national level. However, as reported in the article 'O-Net scores still disappointed' of Online Reporters (2018), the ONET results taken by around 372,000 Grade 12 students were worse than the previous year, with average scores falling in all five key subjects tested in the 2017 academic year.

Basic education in Thailand is divided into six years of primary schooling (Grade 1 to Grade 6), followed by three years of lower secondary (Grade 7 to 9) and three years of upper secondary schooling (Grade 10 to 12). In 2003, compulsory education was extended to nine years (Grade 9), with all students expected to complete Grade 12 (Ministry of Education, 2007). Owing to some remote areas of Thailand not having any secondary schools, the existing primary schools have had to extend their educational service to lower secondary Grade 9, the so-called extended primary

school. This mainly aims to help students in remote areas to complete their compulsory education of nine years in order to fulfill the Thai Education Policy of 2003. A total of eight core subjects form the Thai National Curriculum: the Thai language, mathematics, science, social studies, religion and culture, health and physical education, arts, careers and technology, and foreign languages. However, teachers are encouraged to integrate local wisdom and culture so that it is consistent with the set learning standards of each of the core subject groups. The promotion of thinking skills, self-learning strategies, and moral development is at the heart of teaching and learning in the Thai National Curriculum (Ministry of Education, 2007).

CONCEPTUAL FRAMEWORK AND RESEARCH AIMS

Even though past researchers (Goddard et al., 2007; Prasertcharoensuk & Tang, 2016; Somprach et al., 2017), as discussed above, had explored and proven that there were significant relationships between the independent variables such as transformational leadership, collective efficacy, and professional learning community toward the dependent variable that was students' achievement but the researchers would like to apply Structural Equation Modeling (SEM) to determine whether a model which consists of all study variables is valid. The strengths of using SEM in our research were to derive unbiased estimates for the relations between latent constructs because SEM allows multiple measures to be associated with a single latent construct. In other words, an SEM implies a structure of the covariance matrix of the measures. Since the model's parameters have been estimated, the resulting model-implied covariance matrix could then be compared to an empirical or data-based covariance matrix. If the two matrices are consistent with one another, then the SEM could be considered a reasonable explanation for relations between the measures. Hence, the researchers utilized a multivariate analysis to calculate the relationship of the dependent variable with each of the independent variables, while controlling for the effect of all other independent variables in the causal relationship model; this would be the major contribution on how to enhance student achievement.

The main aim of this research was to test the causal relationship model of transformational leadership, professional learning community, teachers' collective efficacy, and students' achievement. First of all, the researchers validated the appropriateness of the causal relationship model of students' achievement according to the evident data. This was followed by examining the direct, indirect, and overall effects of the causal relationship on student achievement. In addition, the researchers also studied the invariability of the constructed linear structural model when comparing the formal primary schools (Kindergarten to Grade 6) and extended primary schools (Kindergarten through Grade 9).

The variables included in this research, namely transformational leadership, professional learning community, teachers' collective efficacy, and students' achievement are elucidated in Figure 1. Transformational leadership is defined as a paradigm in which the school administrator influences the teachers to perform beyond expectations by making them more aware of the importance and value of goals (Prasertcharoensuk & Tang, 2016). Prasertcharoensuk and Tang (2016) found that transformational leadership acted at the macro-level with five dimensions that could be used to explain 81.76% of teaching efficiency variance. As a result, the researchers proposed five dimensions of transformational leadership: idealized influence, inspirational motivation, intellectual stimulation, individual consideration, and creation of supportive school culture. Confirmatory factor analysis (CFA) provided support for the hypothesized factor structure of the measures selected to assess these dimensions, and also provided support for the discriminant validity of the dimensions with each other. Idealized influence in this study means the ability of the school administrator to elicit pride, faith, and respect from their employees (Covin et al., 1997). Inspirational motivation refers to the degree to which a school administrator articulates the vision that is appealing and inspirational to employees (Bass, 1999). Intellectual stimulation is defined as the behavior of a school administrator who develops the teachers' ability and inclination to think about problems in a new way (Rafferty & Giffin, 2006). Individual consideration refers to paying attention to each teacher or dealing with his or her problems (Bass, 1999). The creation of a supportive school culture means a number of behaviors including articulating an ideology that enhances goal clarity, task focus, and value congruence by the school administrator to create a supportive school culture (House, 1977).

The professional learning community model, which was proposed by Borman (2012), was utilized in this research. There are six characteristics in this professional learning community model, namely shared vision and values, supportive and participatory leadership, cooperating and applying learning power, cooperating in good practice, relation/structural supporting condition, and outcome-orientation and continuous development. The shared vision and values characteristic means that all school staff, including the school administrator, are instrumental in the development of the school's mission and vision statement. The supportive and participatory leadership characteristic refers to a school administrator and teachers illuminating and cultivating norms among themselves regarding quality standards for student performance and taking cooperative responsibility for the students' achievement. Cooperating and applying the learning power characteristic refers to teachers who focus on student learning as the end consequence, and on teaching as the means to achieve it. Cooperating in the good practice characteristic is a school practice that is co-constructed from beliefs and

knowledge of the entire staff relating to how it can best assist the school's students. Next, the relation/structural supporting condition characteristic means a group of collaborative teams who share the collective purpose to improve instruction and learning. Finally, the outcome-orientation and continuous development characteristic refer to all the school staff routinely sharing expertise and perspectives on teaching and learning processes, examining student data, and developing a sense of mutual support and shared responsibility for effective instruction (Somprach et al., 2017).

Collective efficacy is conceptualized as a group-level phenomenon that links learning and the functioning of the teacher groups. Bandura (1997) defined collective efficacy as a group's shared belief in its conjoint capabilities to organize and execute the teaching actions required to produce the given levels of achievement. As such, collective efficacy in this research encompasses the teaching actions such as instructional analysis, instructional competency evaluation, experiences from the success of oneself and others, social influence, and emotional condition. The dependent variable of this study is the students' achievement, which is measured by their O-NET score in the five core subjects: mathematics, sciences, social studies, Thai language, and English.
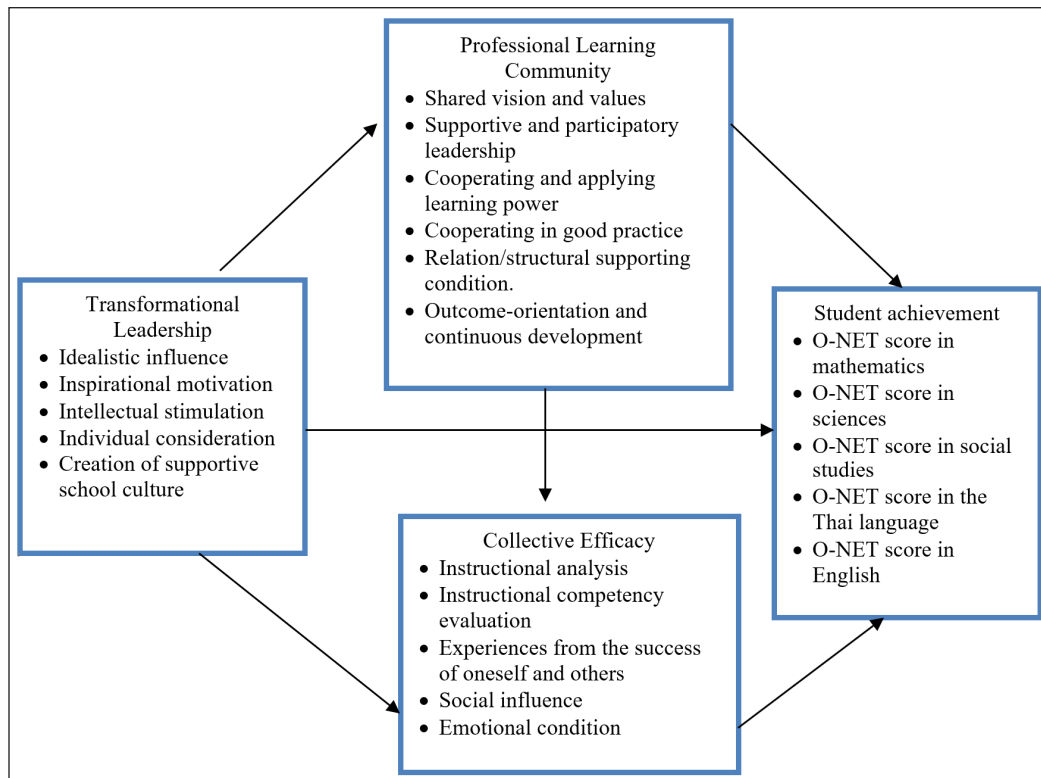

Figure 1. Conceptual framework

METHOD

The researchers employed causal research, or so-called explanatory research design, to investigate the cause-and-effect relationships. This study was based on the premise that transformational leadership was performed as an external latent variable, while the professional learning community, teachers' collective efficacy, and students' achievement were the three internal latent variables. Meanwhile, the professional learning community and teachers' collective efficacy were the two mediating latent variables. In order to determine causality, it is essential for researchers to observe variation in the variables (transformational leadership of school administrator, professional learning community, teachers' collective efficacy) assumed to cause the change in the other variable (students' achievement), and then measure the changes in the students' achievement. Other confounding influences must be controlled for, so they do not distort the results, by using a statistical method. Multiple regression was employed as a group of related statistical techniques that control for various causative influences other than the ones being studied. If the data showed sufficient variation in the hypothesized explanatory variable of interest, its effect, if any, upon the potentially influenced variable can be measured (Brains et al., 2011).

Multistage sampling was employed as a sampling method that divided all the primary public schools in Thailand into clusters for conducting the research. The sampling method is suitable as the population is too vast and samples were from different types of primary schools located throughout Thailand. The samples were chosen randomly by regions, with 30% being selected from each region. This was followed by cities and educational service area offices with two different types of primary public schools. Schools were the unit of analysis. The researchers referred to the rule of thumb of Marsh et al. (1998) to determine adequate sample size (N) for a particular application of CFA; this included, but was not limited to N $\geq$ 200, the ratio of N to the number of variables in a model (p), N/p $\geq$ 10; the ratio of N to the number of model parameters (q), N/q $\geq$ 5; and an inverse relationship between construct reliability and adequate N. In this case, there were 52 parameters, four latent variables, and 21 observed variables. As a result, the selected target group consisted of 1,200 school administrators and teachers who worked in the 600 schools under the administration of 23 Primary Education Service Areas Offices throughout Thailand. These 600 schools comprised 300 formal primary schools and 300 extended primary schools. The proportion of school administrators to teachers was 1 to 1, giving a total of 600 samples from each target group. Table 1 shows the distribution of the samples.

The researchers utilized a survey questionnaire as a method to collect quantitative data. The Thai language survey questionnaire instrument comprised 276 items and divided into three sections. A five-point Likert scale was used. Section A was intended to collect information pertaining to respondents' perceptions of transformational

Table 1
Distribution of samples using a multi-stage sampling method

Region	Cities	Educational Service Area Offices	Total Primary Public Schools	No. of Formal Primary Schools	No. of Extended Primary Schools
North	Chiang Mai	1	93	8	8
	Utradit	1	177	15	15
	Phayao	1	100	9	9
Northeastern	Khon Kaen	5	259	22	22
	Bungkan	1	215	18	18
	Ubon Ratchatanee	1	252	22	22
	Chaiyaphoom	2	268	23	23
	Udonthani	3	214	18	18
	Sakon Nakhon	3	182	16	16
Central	Samutprakarn	2	71	6	6
	Saraburi	1	128	11	11
	Aunthong	1	152	13	13
	Nakhonprathom	1	127	11	11
	Supunburi	3	128	11	11
	Nakhonnayok	1	134	11	11
	Phetchaboon	2	161	14	14
East	Trad	1	111	9	9
	Prajenburi	1	127	11	11
West	Prajubkenekan	1	122	10	10
South	Ranong	1	85	7	7
	Chumporn	1	119	10	10
	Nakornsrithumrat	4	142	12	12
	Suratthanee	3	157	13	13
6	23	23	3524	300	300

leadership practice. There were questions about the five transformational leadership dimensions: idealistic influence (22 items), inspirational motivation (24 items), intellectual stimulation (20 items), individual consideration (31 items), and creation of supportive school culture (20 items), giving a total of 117 items. Section B was specifically designed by the researchers to gauge professional learning community practice at their schools. There were a total of 85 items encompassing shared vision and values (11 items), supporting and participatory leadership (12 items), cooperating and applying learning power (12 items), cooperating in good practice (13 items), relation/structural supporting condition (19 items), and outcome-orientation and continuous development (18 items). Section C of the instrument was used to gauge information about the teachers' collective efficacy. This section consisted of

74 items including instructional analysis (17 items), instructional competency evaluation (20 items), experiences from the success of oneself and others (14 items), social influence (8 items), and emotional condition (15 items).

This questionnaire was sent to five experts for comments and feedback on content validity. Following the receipt of feedback, the content validity index values were ranged from .80 to 1.00. This was followed by the reliability pilot testing of the questionnaire with 30 schools under the administration of the Primary Education Area Office 1, Lampang, using the same ratio of school administrators and teachers in the actual study, i.e. 1 to 1, giving a total of 60 pilot study candidates. The high Cronbach alpha values of .97, .98, and .99 were obtained from Section A to C, respectively. The researchers concluded that the instrument was valid and reliable to use because the content validity index and reliability values were high.

Researchers distributed questionnaires to 1,200 research schools with assistance from the officers in the Primary Educational Service Area Offices throughout Thailand in the first round of data collection. Researchers received 879 schools' responses, which was equivalent to 73.25%. Researchers continued with a second follow-up and successfully received an additional 321 schools' responses, giving a total of 1,189 schools: the response rate was 99.08%.

Structural Equation Modeling, which is a combination of factor analysis and regression or path analysis, was utilized in this research, as it implies a structure for the covariance between the observed variables. SEM is often used on theoretical constructs which are represented by the latent factor. This implies a structure for the covariance between the observed variables. The M-plus 7.30 program was utilized to allow the model to be specified in a graphical way, by letting the user draw the path diagram directly in an interactive command window. CFA is a part of SEM and plays an important role in measurement model validation in a path or structural analysis (Brown, 2006). SEM was used to obtain estimates of the parameters of the model, for example, the factor loading, the variances and covariance of the factor, and the residual error variances of the observed variables. This was followed by assessing the fit of the model, for example, to assess whether the model itself provided a good fit to the data.

RESULTS

The results of this research are presented in accordance with the research aims indicated above. The initial results are factor loading and the validity of observable variables to test the goodness of fit of the constructed linear structural model with the empirical data. This is followed by examining the direct, indirect, and collective effects of causal factors that affect primary public school students' achievement. Finally, the researchers present the invariability of the constructed linear structural model between formal primary public schools and extended primary public schools, thus comparing the different effects of the three groups of variables.

Goodness of Fit of the Constructed Linear Structural Model with the Empirical Data

The result of the initial phase aimed to obtain estimates of the parameter of the constructed linear structural model, the factor loading, and the validity of observable factors of primary public school students' achievement. As indicated in Table 2 below, factor loading of all the primary public school students' achievement factors was statistically significant at .01; the exception was the creation of supportive school culture, which was statistically significant at .05.

Table 2

Factor loading, validity of observed variables, and coefficient of prediction

Components of measuring model	Factor loading matrix				
	b	β	SE	t	R^2
Transformational leadership					
Idealized influence	1.000	.977	.003	369.008**	.954
Inspirational motivation	.982	.967	.003	309.761**	.935
Intellectual stimulation	1.170	.995	.000	4526.207**	.989
Individualized consideration	1.191	.990	.000	2345.147**	.980
Creation supportive school culture	1.150	.998	.000	13110.357*	.996
Professional learning community					
Shared visions and values	1.000	.977	.003	335.820**	.955
Supporting and participatory leadership	.874	.978	.003	312.754**	.957
Cooperating and applying learning power	1.034	.991	.001	1092.332**	.982
Cooperating in good practice	1.019	.997	.000	7537.137**	.994
Relation/structural supporting condition	.945	.989	.002	577.815**	.978
Outcome-orientation and continuous development	.985	.974	.003	330.700**	.949
Collective efficacy					
Instructional analysis	1.000	.992	.000	3074.535**	.984
Instructional competency evaluation	1.139	.977	.002	498.219**	.955
Experiences from the success of oneself and others	1.037	.944	.005	171.969**	.892
Social Influence	.966	.997	.000	6963.286**	.993
Emotional condition	.428	.125	.027	4.573**	.016
Student achievement					
O-NET score in mathematics	1.396	.808	.012	67.462**	.652
O-NET score in sciences	1.146	.791	.013	62.899**	.625
O-NET score in social studies	1.307	.888	.009	103.240**	.788
O-NET score in Thai language	1.000	.870	.008	102.745**	.756
O-NET score in English	1.216	.761	.014	53.344**	.579
R^2 of SEM of student achievement (F4) = .792					
R^2 of SEM of teachers' collective efficacy (F3) = .888					
R^2 of SEM of professional learning community (F2) = .922					

*Note: *p<.05; **p<.01

Factor loading is basically the correlation coefficient for the primary school students' achievement model and each factor. Factor loading shows the variance explained by the variable on that particular factor. In the SEM approach, as a rule of thumb, 0.7 or higher factor loading represents that the factor extracts sufficient variance from that variable. As a result, each factor in the primary public school students' achievement model had been taken into consideration. The co-variance with primary public school students' achievement factors was 79.2%. The factor with the highest factor loading was transformational leadership. This was followed by the professional learning community. The factor that had the lowest factor loading was collective teacher efficacy. As a result, all the latent variables were found to be important constructs of primary public school students' achievement.

The linear SEM of factors affecting the primary students' achievement was found to have goodness fit with the evident data or well corrected with empirical data, with χ^2 = 58.831, df = 45, *p-value* = .080, CFI = 1.000, TLI = .999, RMSEA = .016, SRMR = .007, and χ^2/df = 1.307. This result revealed that the structural model was valid and correlated with the CFI value and TLI value, which were close to 1, the RMSEA value < .06, SRMR value <.08, and χ^2/df<2. The result fulfilled the cut-off criteria for fit indexes in covariance structure analysis proposed by Hu and Bentler (1999).

Effects of Causal Relationships on Students' Achievement

The direct effect results showed that: (i) teachers' collective efficacy, transformational leadership, and professional learning community have significant, positive and direct effects on student achievement at .01 significant level, with the coefficients of effect sizes being .760, .140 and .01, respectively; (ii) professional learning community and transformational leadership also have significant, positive and direct effects on the teachers' collective efficacy at .01 significant level, with the coefficient of effect sizes at .880 and .064, respectively; and (iii), transformational leadership was found to have a significant, positive and direct effect on the professional learning community at .01 significant level, with the coefficient of effect size at .960.

In addition, the indirect effect results indicated that: (i) professional learning community and transformational leadership have significant, positive and indirect effects on students' achievement via the teachers' collective efficacy at .01 significant level, with the coefficients of effect sizes of .669 and .049, respectively; and (ii), transformational leadership has a significant, positive and indirect effect on students' achievement through the professional learning community at .01 significant level, with the coefficient of the effect size of .845.

Finally, the overall effect showed the highest coefficient of effect size, for example, 1.620, which was statistically significant at .01 level. The overall teachers' collective efficacy showed the highest

coefficient of effect size, followed by the professional learning community and transformational leadership, with the overall effects of .760, .670, and .190, respectively, at a .01 significant level.

The results from the coefficient of prediction (R^2) revealed that: (i) transformational leadership, professional learning community, and teachers' collective efficacy jointly accounted for 79.2% of the variation in the students' achievement; (ii)

transformational leadership and professional learning community can explain 88.8% of the variation in teachers' collective efficacy; and (iii), transformational leadership accounted for 92.2% of the variation in the professional learning community. Table 3 shows the direct, indirect, and overall effects of the causal relationship model, while Figure 2 shows the empirical model of the structural relation model in all types of primary schools.
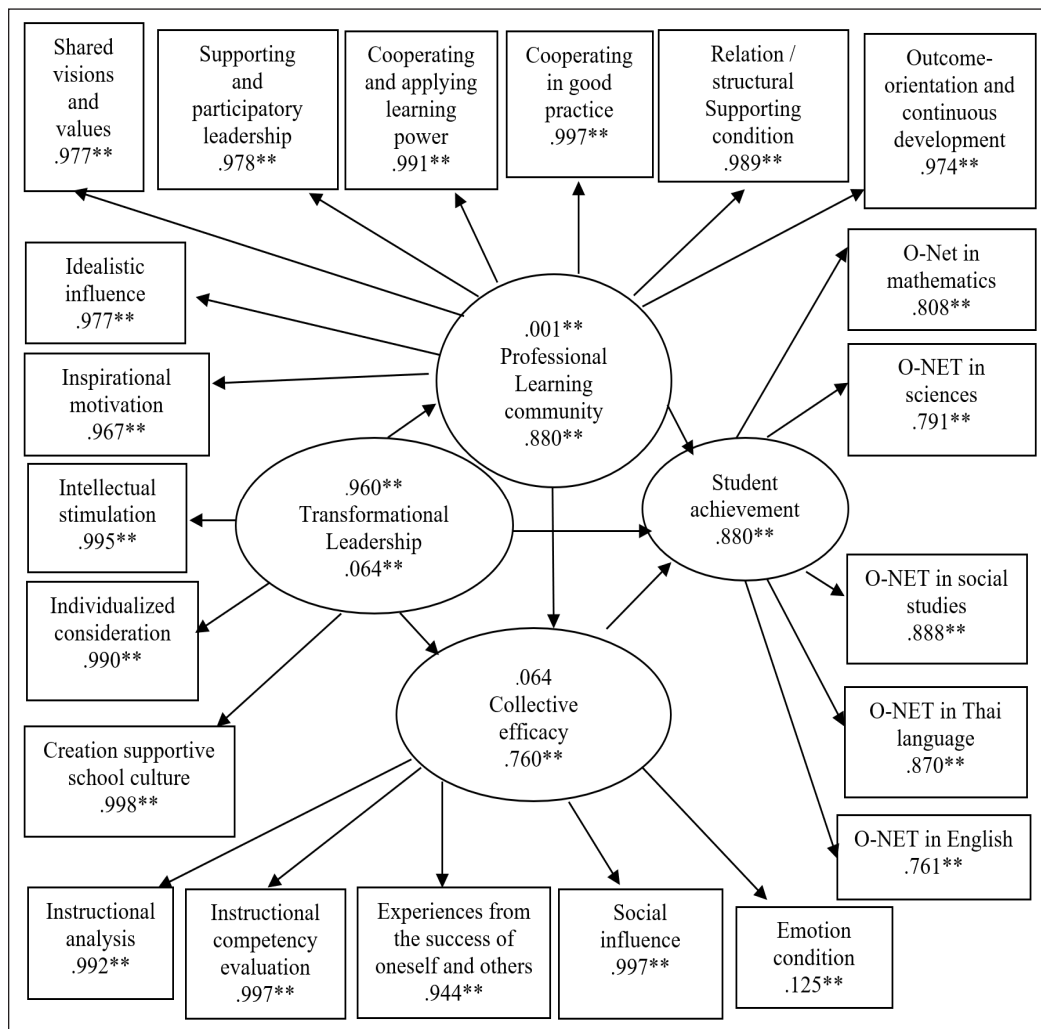

Figure 2. Empirical structural relation model of students' achievement for all types of primary schools

Table 3

Direct, indirect, and overall effects in the causal relationship model

Predicting variables	Student achievement (F4)					Teachers' collective efficacy (F3)					Professional learning community (F2)		
	DE	IE		OE		DE	IE		OE		DE	IE	OE
		F3	F2				F3	F2					
Transformational Leadership (F1)	.140**	.049**	.001**	.190**		.064**	-	.845**	.909**		.960**	-	.960**
Professional learning community (F2)	.001**	.669**	-	.670**		.880**	-	-	.880*		-	-	-
Teacher collective efficacy	.760**	-	-	.760**		-	-	-	-		-	-	-

Note: χ^2 = 58.831, df = 45, *p-value* = .080, CFI = 1.000, TLI = .999, RMSEA = .016, SRMR = .007, and χ^2/df = 1.307

Test of Invariability of the Constructed Linear Structural Model between Formal Primary School and Extended Primary Schools

The test of invariability of the constructed linear structural model between the formal primary schools (Kindergarten to Grade 6) and the extended primary schools (Kindergarten to Grade 9) was invariable, with the following parameters: χ^2 = 204.649, df = 124, p = .00, CFI = .99, TLI = 1.00, RMSEA = .03, SRMR = .03, and χ^2/df = 1.65.

Although the value of χ^2 was statistically significant ($p <$ .05), χ^2/df was still lower than 2; CFI and TLI were 1; RMSEA was lower than .07; and SRMR was lower than .08, which were all in the acceptable range (Hooper et al., 2008). This implies that the model had the goodness of fit with the empirical data and correlated with the assumption. The details of the results are presented in Table 4, Table 5, Figure 3, and Figure 4.
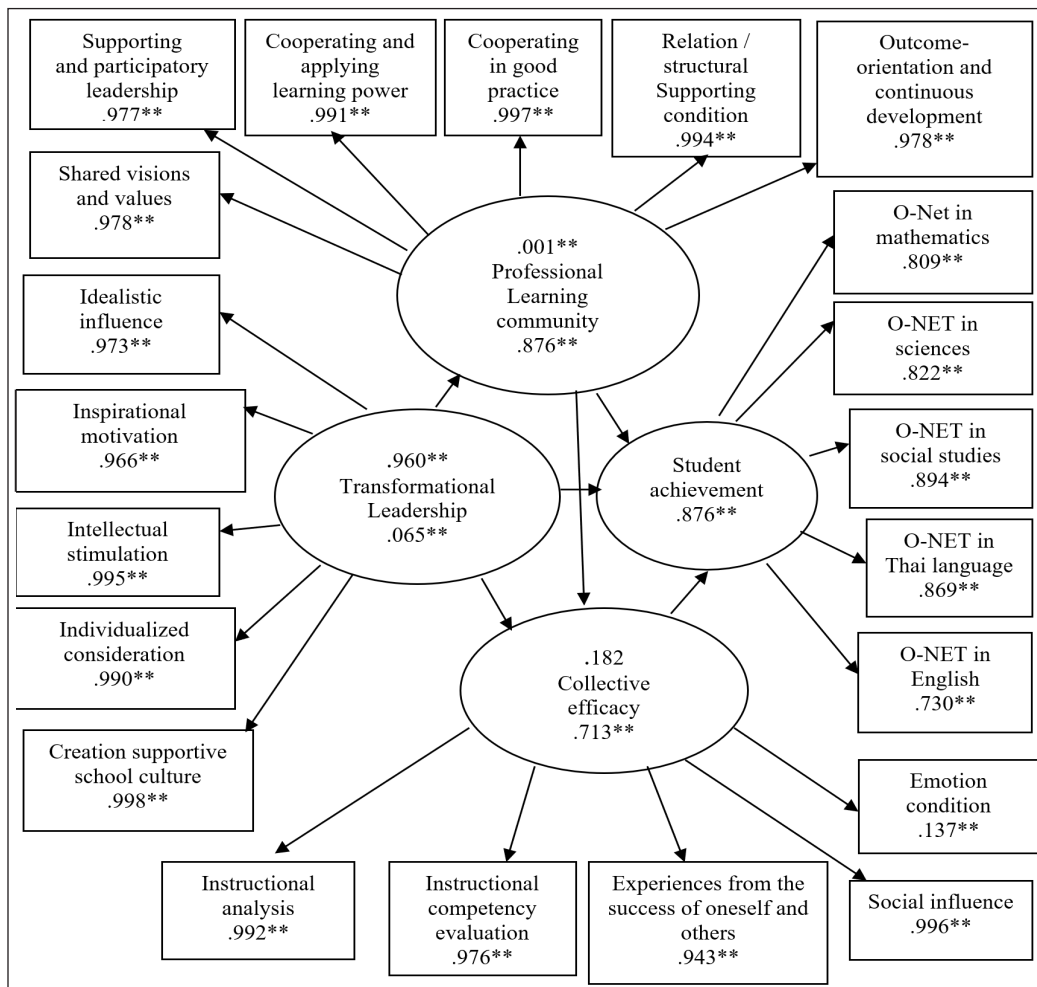

Figure 3. Empirical structural relation model of student achievement for formal primary schools

Table 4
Comparative results of factor loading, validity of observed variables, and coefficient of prediction

Components of the constructed linear structural model	Types of schools			
	Formal Primary School (ELE)		Extended Primary School (EXT)	
	β	R^2	β	R^2
Transformational leadership				
Idealized influence	.973**	.947	.979**	.959
Inspirational motivation	.966**	.934	.967**	.935
Intellectual stimulation	.995**	.989	.995**	.989
Individualized consideration	.990**	.979	.990**	.979
Creation supportive school culture	.998**	.996	.998**	.996
Professional learning community				
Shared visions and values	.978**	.956	.976**	.952
Supporting and participatory leadership	.977**	.954	.978**	.957
Cooperating and applying learning power	.991**	.983	.991**	.982
Cooperating in good practice	.997**	.993	.997**	.994
Relation/structural supporting conditions	.994**	.987	.983**	.967
Outcome-orientation and continuous development	.978**	.956	.970**	.942
Teachers' collective efficacy				
Instructional analysis	.992**	.984	.992**	.985
Instructional competency evaluation	.976**	.953	.980**	.960
Experiences from success of oneself and others	.943**	.889	.948**	.898
Social influence	.996**	.993	.997**	.993
Emotional condition	.137*	.019	.113*	.013
Student achievement				
O-NET score in mathematics	.809**	.655	.798**	.637
O-NET score in sciences	.822**	.676	.736**	.541
O-NET score in social studies	.894**	.800	.867**	.752
O-NET score in Thai language	.869**	.755	.859**	.739
O-NET score in English	.730**	.533	.784**	.615

Note:
**$p<.01$; *$p<.05$
R^2 of SEM of student achievement in ELE (F4) = .778
R^2 of SEM of student achievement in EXT (F4) = .806
R^2 of SEM of collective efficacy in ELE (F3) = .882
R^2 of SEM of collective efficacy in EXT (F3) = .890
R^2 of SEM of professional learning community in ELE (F2) = .922
R^2 of SEM of professional learning community in EXT (F2) = .922

Table 5
Results of multiple group analysis of SEM between formal primary school and extended primary school

Predicting variables	Student achievement (F4)				Teachers' collective efficacy (F3)				Professional learning community (F2)		
	DE	IE		OE	DE	IE		OE	DE	IE	OE
		F3	F2			F3	F2				
Formal Primary School (ELE)											
Transformational Leadership (F1)	.182**	.047**	.001**	.230**	.065**	-	.841**	.906**	.960**	-	.960**
Professional learning community (F2)	.001**	.624**	-	.625**	.876**	-	-	.876*	-	-	-
Teachers' collective efficacy (F3)	.713**	-	-	.713**	-	-	-	-	-	-	-
Extended Primary School (EXT)											
Transformational Leadership (F1)	.007**	.056**	.001**	.064**	.063**	-	.848**	.911**	.960**	-	.960**
Professional learning community (F2)	.001**	.786**	-	.787**	.883**	-	-	.883**	-	-	-
Teachers' collective efficacy (F3)	.890**	-	-	.890**	-	-	-	-	-	-	-

Note: χ^2= 204.649, *df* = 124, *p-value* = .000, CFI = .99, TLI = 1.00, RMSEA = .03, SRMR = .03
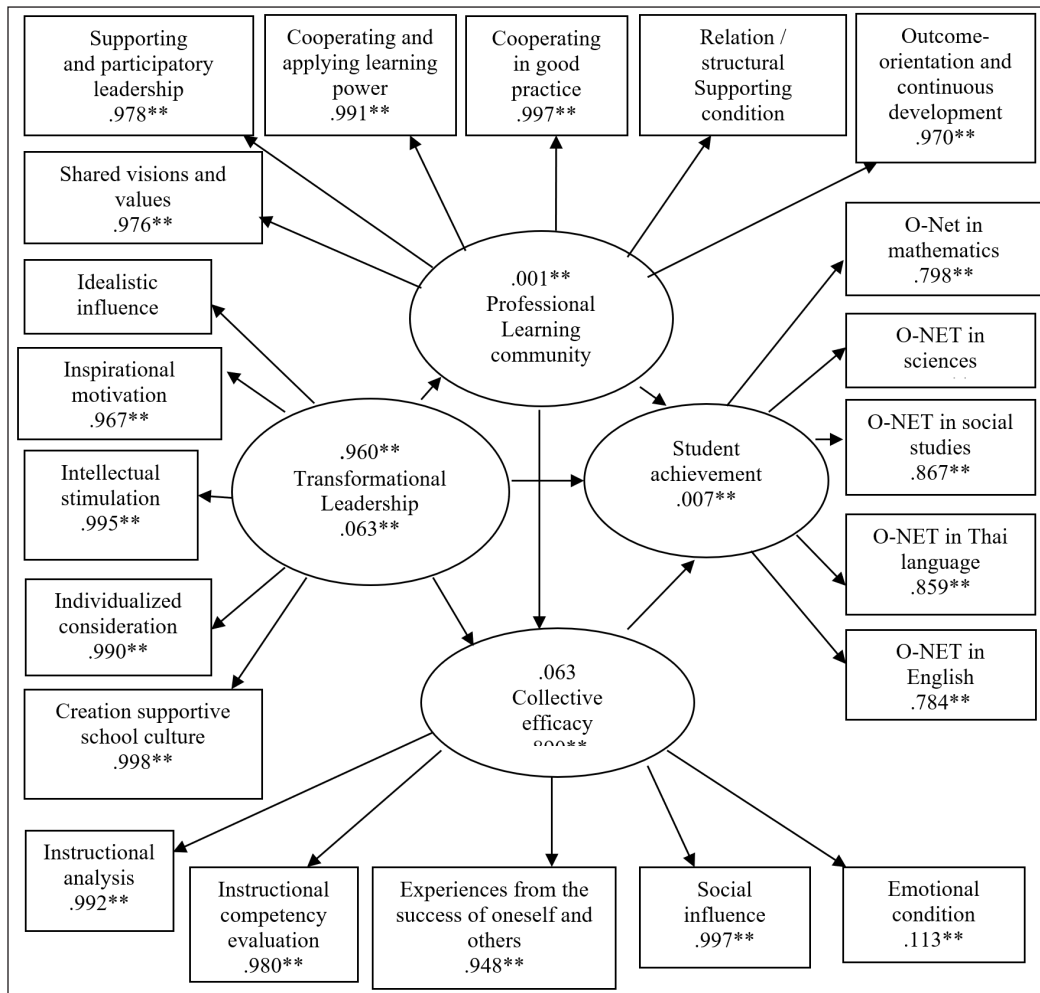
Figure 4. Empirical structural relation model of students' achievement for extended primary schools

DISCUSSION AND CONCLUSION

The results of this research revealed that the proportion of variance of students' achievement in all types of primary schools in Thailand could be explained by the causal relationship model, which comprised transformational leadership, professional learning community, and teachers' collective efficacy, at 79.2%. This implies that all the latent variables of this causal relationship model were found to be the important construct of the causal relationship model of primary public school students' achievement. On top of that, the causal relationship model showed the goodness of fit, which could be described as how well it fits a set of observed variables. The measures of goodness of fit, in this case, are typically summarized in the discrepancy between the observed values and the values expected under the causal relationship model are acceptable. On this line of reasoning, the researchers found the

attempt to fit the causal relationship model to the observed data was well-matched with the empirical data.

In addition, teachers' collective efficacy had the highest direct and indirect effects on students' achievement. This implies that those teachers who are practicing their collective efficacy such as conducting self-assessment, developing teaching competency, having good group influence in teaching and dedicating, doing their research, analyzing their job, seeking for new knowledge, and using new teaching methods to improve their capabilities could affect their students' achievement. This result is in accordance with Eells's (2011) and Voelkel's (2011) results. Eells (2011) conducted a meta-analysis regarding the correlation between teachers' collective efficacy and student achievement from 26 research studies; they highlighted that the teachers' collective efficacy such as shared beliefs had a direct positive impact on students' achievement. This is supported by Voelkel's (2011) study, which found that teachers' collective efficacy had the highest effect on student achievement compared to other factors.

Furthermore, the result further showed that the professional learning community had both direct and indirect effects on students' achievement. This result supports Somprach et al.'s (2017) findings. They mentioned that teachers who worked in a professional learning community shared decision-making about educational issues in their school, and they learnt together to concentrate their efforts toward student learning improvement, which positively impacted students' achievement. Further, the result correlates with those of Brooks (2013), Claycomb (2014), Lomos (2012), and Wiseman and Arroyo (2011). For example, Wiseman and Arroyo (2011) carried out a meta-analysis study on 13 theses done from 2008 to 2010; they found that nine out of the 13 studies showed a significant correlation between the professional learning community and students' achievement.

Finally, the results of this research showed that transformational leadership not only had its direct and indirect effects on students' achievement but also on professional learning community and teacher efficacy. The results were congruent with those of Chen (2014) and Prasertcharoensuk and Tang (2016) in terms of the significant relationship between transformational leadership and students' achievement. Chen (2014) found that the transformational leadership of school administrators had improved the students' achievement scores in the Californian standardized test. Moreover, Prasercharoensuk and Tang (2016) indicated that teachers' teaching behaviors were potentially merged and structured together with the transformational leadership of school administrators; in return, this improved students' achievement. The effects of transformational leadership on the professional learning community were found to be parallel with the findings of Chen and Yu (2014) as well as Somprach et al. (2017). Both studies found that transformational leadership was a significant

predictor of the professional learning community. On top of that, the result of the effect of transformational leadership on teachers' collective efficacy was in agreement with the study of Dussault et al. (2008). They found that 487 teachers from 40 public schools perceived the transformational leadership was correlated positively and significantly with teachers' collective efficacy.

Despite the government's rhetoric in support of Education for All (EFA), particularly universal primary education, the EFA framework never became an integral part of planning within the Ministry of Education. Given Thailand's development status, the National Education Reform of primary education (93%) is problematic, as are the disparities among the continued disadvantage of remote areas such as extended primary public school students and the system's poor performance in ONETs (Shaeffer, 2018). Therefore, the entire results of this research, i.e. the causal relationship model, will help to solve the above problems by giving more attention to teachers' collective efficacy and professional learning community from the teachers' perspective, and transformational leadership from the school administrators' perspective. The ultimate problems such as the low capacity of teachers trained more in content than in pedagogy (Manmai et al., 2020), inequality among teachers (Tang & Lim, 2015), and school administrators seeing themselves more as civil servants than transformational leaders (Somprach et al., 2016), will be automatically dissolved by this causal relationship model.

Based on the aforesaid discussion, the Thai primary school administrators and teachers should comprehend and be aware of the significance of the causal relationship between transformational leadership, professional learning community, and teachers' collective efficacy toward students' achievement. Following this line of reasoning, educational directors of Primary Educational Service Areas should provide all the necessary training and program development to school administrators and teachers to maximize their instructional potential and outcomes.

The researchers would like to suggest that the Thailand Ministry of Education utilizes the results of this research in preparing school administrator preparation or teacher teaching professional programs so that the future primary school administrators and teachers are well equipped with the knowledge and skills of transformational leadership, professional development, and collective efficacy. Through heightening awareness of a school's capacity for organizing and implementing effective interventions in the three essential latent variables of this causal relationship model, student achievement is a powerful concept for both leadership and the successful implementation of reform.

In conclusion, the results of this study could be related to the global education context, like Ross and Gray (2006) also found that transformational leadership had an impact on the collective teacher efficacy of a school; teacher efficacy alone predicted teacher commitment to community

partnerships, and transformational leadership had direct and indirect effects on teachers' commitment to school missions and commitment to the professional learning community. In this line of reasoning, the empirical models of this study can be applied not only in Thailand but also across global educational contexts.

ACKNOWLEDGMENT

REFERENCES

Al-Omari, A., & Sharaah, M. (2012). Leadership readiness among prospective school leaders in Jordan. *International Online Journal of Educational Science, 4*(1), 50-61.

Andrews, D., & Lewis, M. (2007). Transforming practice from within: The power of the professional learning community. In L. Stoll & K. S. Louis (Eds.), *Professional learning communities: Divergence, depth and dilemmas*. Maidenhead, England: Open University Press.

Ariratana, W., Sirisooksilp, S., & Tang, K. N. (2016). The effect of leadership styles on professional learning community. *New Trends and Issues Proceedings on Humanities and Social Sciences, 8*, 60-69. https://doi.org/10.18844/gjhss. v2i7.1181

Bandura, A. (1997*). Self-efficacy: The exercise of control*. New York, USA: W. H. Freeman.

Online Reporters. (2018, March 31). O-Net scores still disappointed. *Bangkok Post.* Retrieved June 24, 2020, from https://www.bangkokpost. com/thailand/general/1438387/o-net-scores-still-disappoint

Bass, B. M. (1999). Two decades of research and development in transformational leadership. *European Journal of Work and Organizational Psychology, 8*(1), 9-32. https:// doi.org/10.1080/135943299398410

Brains, C., Willnat, L., Manheim, J., & Rich, R. (2011). *Empirical political analysis* (8th ed.). Boston, USA: Longman.

Brooks, S. L. (2013). *The relationship between professional learning communities, personal teacher efficacy, and student achievement at the high school level* (Unpublished Doctoral dissertation), Regent University, Virginia, USA.

Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York, USA: Guilford.

Borman, G. (2012). *The senior urban education research fellowship series Volume VIII: An examination of professional learning communities in St Paul Public Schools*. Washington, USA: The Council of the Great City Schools.

Chen, S. S. (2014). *The effects of transformational leadership of principals on student academic achievement* (Unpublished Doctoral dissertation), California State University, Long Beach, USA.

Chen, J. S., & Yu, P. (2014). *Junior high school teachers' perceptions of principals' transformational leadership and schools as professional learning communities in Taiwan.* Paper presented at the annual meeting of the 56th Annual Conference of the Comparative and International Education Society, Caribe Hilton, San Juan, Puerto Rico.

Claycomb, C. L. (2014). *Professional learning communities: PSEA promising practices to close student achievement gaps.* Philadelphia, USA: PSEA's Education Services Division.

Covin, T. J., Kolenko, T. A., Sightler, K. W., & Todor, R. K. (1997). Leadership style and post-merger satisfaction. *Journal of Management Development, 16*(1), 22-33. doi:10.1108/02621719710155454

Daly, A. J., Moolenaar, N. M., Bolivar, J. M., & Burke, P. (2010). Relationships in reform: The rule of teachers' social networks. *Journal of Educational Administration, 48*(3), 359-391. doi:10.1108/09578231011041062

Davis, S., & Darling-Hammond, L. (2012). Innovative principal preparation programs: What works and how we know. *Planning and Changing, 43*(1/2), 25-45.

Dussault, M., Payette, D., & Leroux, M. (2008). Principals' transformational leadership and teachers' collective efficacy. *Psychological Report, 102*(2), 401-410. doi:10.2466/PR0.102.2.401-410

Eells, R. J. (2011). *Meta-analysis of the relationship between collective teacher efficacy and student achievement* (Doctoral dissertation)*,* Loyola University Chicago, USA. Retrieved June 28, 2019, from http://ecommons.luc.edu/luc_diss/133

Goddard, R. D. (2002). Collective efficacy and school organization: A multilevel analysis of teacher influence in schools. *Theory and Research in Educational Administration, 1,* 169-184.

Goddard, R. D., Hoy, W. K., & Woolfolk Hoy, A. E. (2004). Collective efficacy beliefs: Theoretical developments, empirical evidence, and future directions. *Educational Researcher, 33*, 3-13. doi:10.3102/0013189X033003003

Goddard, Y. L., Goddard, R. D., & Tschannen-Moran, M. (2007). A theoretical and empirical investigation of teacher collaboration for school improvement and student achievement in public elementary schools. *Teachers College Record, 109*(4), 877-896.

Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modeling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods, 6*(1), 53-60.

House, R. J. (1977). A 1976 theory of charismatic leadership. In J. G. Hunt, & L. L. Lawson (Eds.), *Leadership: The cutting edge* (pp. 189-207). Carbondale, USA: Southern Illinois University Press.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1-55. https://doi.org/10.1080/10705519909540118

Lomos, C. (2012). *Professional community and student achievement* (Unpublished Doctoral dissertation), University of Groningen, Groningen, Netherlands.

MacNeil, A. J., Prater, D. L., & Busch, S. (2009). The effects of school culture and climate on student achievement. *International Journal of Leadership in Education, 12*(1), 73-84. doi:10.1080/13603120701576241

Manmai, T., Inprasitha, M., Changsri, N., & Pattanajak, A. (2020). Development of reasoning habits through lesson study and open approach teaching practices. *International Educational Research, 3*(2), 29-36. doi:10.30560/ier.v3n2p29

Marsh, H. W., Hau, K.-T., Balla, J. R., & Grayson, D. (1998). Is more ever too much? The number of indicators per factor in confirmatory factor analysis. *Multivariate Behavioral Research, 33*(2)*,* 181-220. https://doi.org/10.1207/s15327906mbr3302_1

McKibben, S. (2013). Do local-level principal preparation programs prevent principal turnover? *The Public Purpose, 11,* 69-85.

Ministry of Education. (2007). *Towards a learning society in Thailand*. Bangkok, Thailand: Office of the Education Council.

Newmann, F. M., King, M. B., & Youngs, P. (2000). Professional development that addresses school capacity: Lessons from urban elementary

schools. *American Journal of Education, 108*(4), 259-299.

Prasertcharoensuk, T., & Tang, K. N. (2016). The effect of transformational leadership and teachers' teaching behavior on teaching efficiency. *The Turkish Online Journal of Educational Technology, Special Issue for INTE 2016*, 826-833.

Pugh, A., Fillingim, J., Blackboum, J., Bunch, D., & Thomas, C. (2011). Faculty validation of the leadership practices inventory with secondary school principals. *National Forum of Educational Administration and Supervision Journal, 28*(3), 4-11.

Rafferty, A. E., & Griffin, M. A. (2006). Refining individualized consideration: Distinguishing developmental leadership and supportive leadership. *Journal of Occupational and Organizational Psychology, 79*(1)*,* 37-61. https://doi.org/10.1348/096317905X36731

Ross, J. A., & Gray, P. (2006). Transformational leadership and teacher commitment to organizational values: The mediating effects of collective teacher efficacy. *School Effectiveness and School Improvement, 17*(2), 179-199. https://doi.org/10.1080/09243450600565795

Sirisooksilp, S., Ariratana, W., & Tang, K. N. (2017). The effect of administrators' servant leadership on the excellence of Catholic school. *Contemporary Educational Researchers Journal, 7*(1), 11-19. doi:10.18844/cerj.v7i1.487

Shaeffer, S. (2018). Preschool and primary education: Thailand progress in achieving Education for All. In G. W. Fry (Ed.), *Education in Thailand, education in the Asia-Pacific Region: Issues, concerns and prospect.*

Retrieved June 28, 2019, from https://doi:org/10.1007/978-981-10-7857-6_593-124

Somprach, K., Prasertcharoensuk, T., & Tang, K. N. (2016). Factor affecting the effectiveness of Thai secondary world class standard school. *International Journal of Learning and Teaching, 8*(1), 20-29. doi:10.18844/ijlt.v8i1.513

Somprach, K., Tang, K. N., & Popoonsak, P. (2017). The relationship between school leadership and professional learning communities in Thai basic education school. *Educational Research for Policy and Practice, 16,* 157-175. doi:10.1007/s10671-016-9206-7

Stoll, L., Bolam, R., Mcmahon, A., Wallace, M., & Thomas, S. (2006). Professional learning communities: A review of the literature. *Journal of Educational Change, 7,* 221-258. doi:10.1007/s10833-006-0001-8

Tang, K. N., & Lim, C. S. (2015). Principal support in lesson study. *Procedia Social and Behavioral Sciences, 205*, 134-139. https://doi.org/10.1016/j.sbspro.2015.09.040

Turan, S., & Bektas, F. (2013). The relationship between school culture and leadership practices. *Eurasian Journal of Educational Research*, 52*,* 155-168.

Voelkel, Jr., R. H. (2011). *A case study of the relationship between collective efficacy and professional learning community* (Unpublished Doctoral dissertation), University of California, San Diego, USA.

Wiseman, P. P., & Arroyo, H. (2011). *Professional learning communities and their impact on student achievement*. La Verne, USA: University of La Verne.