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A Meta-Analysis of Instructional Management Models Affecting Creative Thinking Development

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Abstract: The main objective of this research was to study the effects of instructional management models and nominal variables on the development of students' creative thinking. The researchers used the research synthesis of 400 studies on the development of students' creative thinking by a meta-analysis of research according to Cohen. The meta-analysis results revealed that the average effect size of the instructional management model ($\bar{d}$ = 3.43; [3.10, 3.17]) was positive and had a very high effect size with statistical significance. The most significant influence on the creative thinking development model was creative development theory ($\bar{d}$ = 4.217; [3.32, 5.11]). In addition, effect sizes varied with the attribute variables of the research, particularly the attribute variable of the research on instruction with the highest effect consisted of research with the focus on language, at the primary level, applied Torrance's creativity theory, designed between one to six lesson plans. Moreover, there was less than one hour per plan, the instructional period including the experiment conducted more than 31 hours and there were four weeks of instruction. In addition, there were six steps for instruction, there had quiz as an assessment tool, number of exams varied between 30 and 39 questions, and knowledge sheets were used as instructional materials. In the context of the meta-analysis, the findings indicated that the teachers should apply creative development theory in developing the students' creative thinking for more effective instructional management.

Keywords: *Creative thinking, instructional management model, meta-analysis, research synthesis.*

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Introduction

Presently, the relationship between new instructional management and the development of student quality amid current social changes has been explained (Karatas & Zeybek, 2020) since, in the past, each country's instructional management emphasized human resource development to prepare for the rapidly changing and increasingly complex world (Kirikkaleli et al., 2021). Throughout the years, the promotion of advanced thinking skills allows students to develop information, skills, and expertise and apply knowledge to address societal problems appropriately since over time, the growth of core knowledge and abilities has not been sufficient to apply in daily life. Elements of developing higher-order thinking skills include critical thinking, communication, collaboration, and creativity (Ciğerci, 2020). The improvement of the process of lifelong learning depends critically on these thinking abilities. It can ensure that human resources are developed to a high standard and identify a student's readiness to enter the future, more complex working world (Özyurt & Özyurt, 2020). Consequently, instructional management today becomes a new challenge for teachers and stakeholders to improve the quality of the students to acquire human resources with intellectual excellence and intelligently come up with a solution to the current accumulated problems. Nevertheless, most instructional management problems remained overly adherent to the traditional beliefs that focus on cognitive domain outcomes (Thangamani & Eu, 2019), resulting in ineffective development of students' other skills. In addition, the teachers still lack clear instructional management guidelines. Due to the current variety of instructional styles, the teachers cannot select an appropriate instructional method for the context (Aytaç & Kula, 2020). According to the problems of the aforementioned instructional management, the researcher synthesized the key factors affecting the quality development of the students, for example, academic achievement, satisfaction, learning motivation, analytical thinking, computational thinking as well as creativity (Herdem, 2019; Trilling & Fadel, 2009). Many scholars agree that creative thinking skills are essential to living in the 21st century; it is undeniable that one of the skills students need to

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practice most is creative thinking. It is a crucial factor in differentiating the quality of students today (Fakhrou & Ghareeb, 2020). In particular, the previous body of knowledge has shown that students' intelligence and creativity are directly associated. As students with high academic background and abilities are more likely to develop creativity (Gajda et al., 2017; Kim, 2005), thereupon living in a rapidly changing society requires cognitive domain development along with creative thinking for the pursuit of new knowledge and adaptation to a globalized society.

In a literal sense, creative thinking refers to the brain's ability to see the relationships of things around them, enabling learning and understanding, brings to imaginative thinking leading to the invention of new things to serve needs or to address daily problems (Dani et al., 2018; Royston & Reiter-Palmon, 2019; Taylor & Kaufman, 2021). Enhancing creative thinking develops advanced intellectual skills in line with Bloom's Taxonomy's cognitive skills theory, which describes creating as the ultimate intellectual skill for describing a person's ability (Brown, 2004). The effects on the development of creative thinking can be divided into two aspects: (1) personal factors such as age, gender, educational level, and so forth; (2) environmental factors such as instructional model, instructional process, assessment, environment, parenting, etc. (Dani et al., 2018; Ulger, 2019). According to Hornby and Crowther (1995) and Collins and O'Brien (2011), the general definition of instruction can be summarized as follows: instruction is a method of transmitting academic knowledge or practical skills by teachers both in the classroom, outside of the classroom, and in the school environment by applying a variety of methods to enable students to learn in accordance with the goals set forth by the curriculum. The qualities of teaching in Thailand, as defined by the aforementioned definitions, are constant and can be utilized as a foundation for creating a range of instructional model management designs based on the ideas, theories, and objectives that students must attain. Therefore, the researchers have defined the meaning of the instructional management model for this research as a systematic learning management model from the curriculum analysis, design of instructional management process, and instructional operation using media to stimulate learning assessment of students. It includes reflecting results for development, as well as specific instructional management methods based on various approaches, principles, and theories. Every instructional management model can serve as a guideline for good instructional management (Bron & Barrio, 2019; Firdaus & Rahayu, 2019; Giesinger, 2017; Shah & Gustafsson, 2021; Wang, 2020). Currently, it leads to the development of new instructional innovations that focus on developing students' creative thinking in a variety of ways, and the number is growing all the time. Initially, the researchers compiled and synthesized the instructional management model that is commonly used in Thailand to develop students' creative thinking. As shown in Table 1, it can be summarized in eight models.

Table 1. The Synthesis Results of Instructional Management Models for Creative Thinking Development of the Students

Instructional Management Models	Description
1. Learning Experience	It is the process of developing creative thinking through direct experience changes from environment and situation to encourage experiential learning, focusing on encouraging the students to engage in activities related to thinking, exploring, questioning, decision-making, and application. The emphasis is on student-centered, instructional materials, starting with the basic principles since people learn best from different experiences (Anwar & Wardhono, 2019; Leadbetter et al., 2019; Özyurt & Özyurt, 2020; Pavelescu, 2019).
2. Project-Based Learning	It is a learning process through project activities. The teachers stimulate the interest arising from the surroundings of the students to design activities for researching knowledge by the students themselves, gaining knowledge from practice, listening, and observing from experts. The students may work in groups or individual, it leads to a conclusion as a body of knowledge through the writing process of project preparation, and the results of the activities are actual performance (Balemen & Keskin, 2018; Bron & Barrio, 2019; Quint & Condliffe, 2018; Ummah et al., 2019).
3. Media and Technology	It is a technique or method for applying a variety of instructional aids and materials to stimulate the students' creative thinking development by utilizing print media, digital media, and technology to organize teaching activities such as online lessons, skill exercises, activity sets, games, video clips, computer programs, applications, GSP programs, etc. (Danielson et al., 2019; Hobbs & Friesem, 2019; McLain, 2019; Thangamani & Eu, 2019).
4. Learning Integration	It is the process of organizing a learning experience based on the students' interests and abilities by integrating relevant knowledge content from different sciences in the same subject or different subjects in order for the students to create relationships and connect concepts of various sciences, enabling them to apply knowledge and skills from many disciplines to solve problems in authentic lives (Barber, 2012; Hoover & Harder, 2015; Klein, 2017; Weurlander et al., 2016).

Table 1. Continued

Instructional Management Models	Description
5. Cooperative Learning	It is instructional management with the emphasis on a learning environment provision for the students to design and collaborate to seek knowledge and co-learn in small groups. Each group consists of members with different ability levels, doing team activities, exchanging ideas, sharing learning resources, and encouraging each other (Ferguson, 2020; In'am & Sutrisno, 2021; Tran, 2019; Wang, 2020).
6. Creative Development Theory	It is instructional management that develops the students according to the concept of Creative Development Theory. It pays attention to the behavioral learning development in terms of knowledge, thoughts, and feelings or attitudes in the classroom with steps to identify problems, data collection, analysis, use of thought in data selection, thought process, synthesis, and evaluation to increase the ability to think creatively, for example, Torrance, Guilford, William, Jellen and Urban, and Wallach and Kogan (Desai, 2020; Fakhrou & Ghareeb, 2020; Nogueira et al., 2017; Shah & Gustafsson, 2021).
7. Laboratory Method	It is planned instructional management where the teachers allow the students to practice or conduct experiments to find knowledge on their own according to the scientific experiment process. It starts with identifying problems, formulating hypotheses, conducting experiments, analyzing data, and drawing conclusions (Berežný, 2017; Köseler & Kalyon, 2020; Lamb et al., 2020; Niazi et al., 2018).
8. Constructionism	It is a learning that allows the students to create their body of knowledge. They are the center of doing activities on their own or interacting with the external environment. They will be able to understand themselves, recognize the importance of what is learned, and can connect knowledge between prior knowledge and new knowledge (Clayson, 2021; Csizmadia et al., 2019; Gero & Levin, 2019; Giesinger, 2017).

In Thailand, many researchers are interested in applying the concepts and instructional guidelines from the eight groups to develop the students' creative thinking. From 1971 to the present, 826 studies related to creative thinking have been found from a database search on Thai Digital Collection (TDC), Chiang Mai University E-Library, Chulalongkorn University E-Library as well as Mahidol University E-Library. Four hundred studies developed teaching innovations. Most of the researchers were female (76.00%). The database indicated that the researches were university theses (75.75%), conducted by curriculum and instruction (33.50%). Most of those published in 2009-2017 (322.5%) collected data from private schools (55.25%), and they were courses promoting creative skills (27.75%). The sample consisted of primary school students (55.25%). One group (54.25%) was selected. The subjects of the research were elementary school students (55.25%), and there was only a research group (54.25%) using a simple random sampling method (38.50%) with a one group pretest-posttest pattern (54.00%). Assessment of research instruments was determined only by reliability (55.00%), using the t-test Dependent (52.75%). Research quality was at a good level (85.75%). According to the mentioned data, the researchers have significantly questioned three research questions:

1. The findings were consistent with all successful innovations (100%) in developing the students' creative thinking. In contrast, it found that the assessment of the students' creative thinking was low for the O-net test (National Institute of Educational Testing Service, 2020).

2. There had a lack of various systematic innovations, so it affected the teachers cannot select the instructional methods to apply in developing the creative thinking in their context.

3. The design of innovations was diverse, but it lacked procedural suggestions for designing new instructional methods to develop the students in the globalization era. Consequently, all problems led to the research synthesis by a meta-analysis for the benefit of those interested in further study.

A meta-analysis is a quantitative analytical technique to synthesize several studies aimed at the same issue with statistical methods in estimating effect sizes. In general, meta-analysis is used to find answers for confirmation that a phenomenon is true. There is also the effect size presentation, conflict resolution occurring in individual studies, and moderator variables identification resulting in changing relationships between variables (Dowdy et al., 2020). According to recent studies, the meta-analysis has favored most researchers to conclude the effectiveness of instructional methods to improve creative thinking, such as Aytaç and Kula (2020) They indicated that the management of learners' centered affects the development of creative skills in a positive direction in accordance with Er-Türküresin (2020) and Ulubey (2018) Furthermore, they stated that creative instructional methods are more effective than curriculum-based instruction, and that managing learning from situations is the most effective and beneficial to developing creative thinking skills. Furthermore, Alacapınar and Uysal (2020) discovered that creative thinking was strongly related to academic achievement and influenced how to maintain academic performance at a high level. As a result of the problems that arose, the researchers observed an increase in the variety of instructional innovations that promote creative thinking. They had not, however, been managed systematically with clarity to the new body of knowledge for guidelines to design the instructional model in various contexts. Furthermore, it will benefit

instructional management by increasing efficiency. Therefore, a meta-analysis is an appropriate method for searching for answers as the conclusion of the complete instructional management model developing creative thinking. However, no research founding studying on a meta-analysis by testing the difference in the effect size of the research is applied by the random effect model and the fixed effect model with the students' creative thinking as a variable. Accordingly, the objective of this research aims to the effect of the instructional management model and categorical variables affecting the students' creative thinking development.

Methodology

Research Design

This research applied the meta-analysis of experimental research on instructional management models developing the students' creative thinking. It is a quantitative data analysis method that systematically studies the same issues by calculating effect size (d) according to Cohen's method (1988). It displayed the average difference between the eight instructional model groups before comparing the effect size values between the instructional management models and moderator variables, which are all 19 categorical variables (Tufan, 2020).

Sample and Data Collection

Data for research can be obtained from theses at the graduate level and research articles on developing creative thinking in Thailand. The researcher defines keyword search terms as follows: "creative thinking," "creative development," "teaching method," "teaching techniques," "teaching style" and "instructional management model" for searching in the TDC, including Chiang Mai University E-Library, Chulalongkorn University E-Library and Mahidol University E-Library. The researcher found 826 related Thai research reports before selection according to four criteria as follows:

1. They are graduate theses and are published research articles and can be searched from the TDC and the university's electronic library.

2. They are experimental researches with a designed experimental model for investigating the independent variables as the instructional management models, and the dependent variable as the creative thinking.

3. They have sufficient necessary statistical values to convert into effect size (d), for example, mean ($\bar{x}$), standard deviation (S.D.), sample group, p-value, t value, F value.

4. They are studies conducted in Thailand between 1971 and 2020.

Reporting

The research in Thailand published on the official website of TDC, and the University. E-Library was taken into account through a systematic review. The selection process of research on creative thinking development was shown in Figure 1.

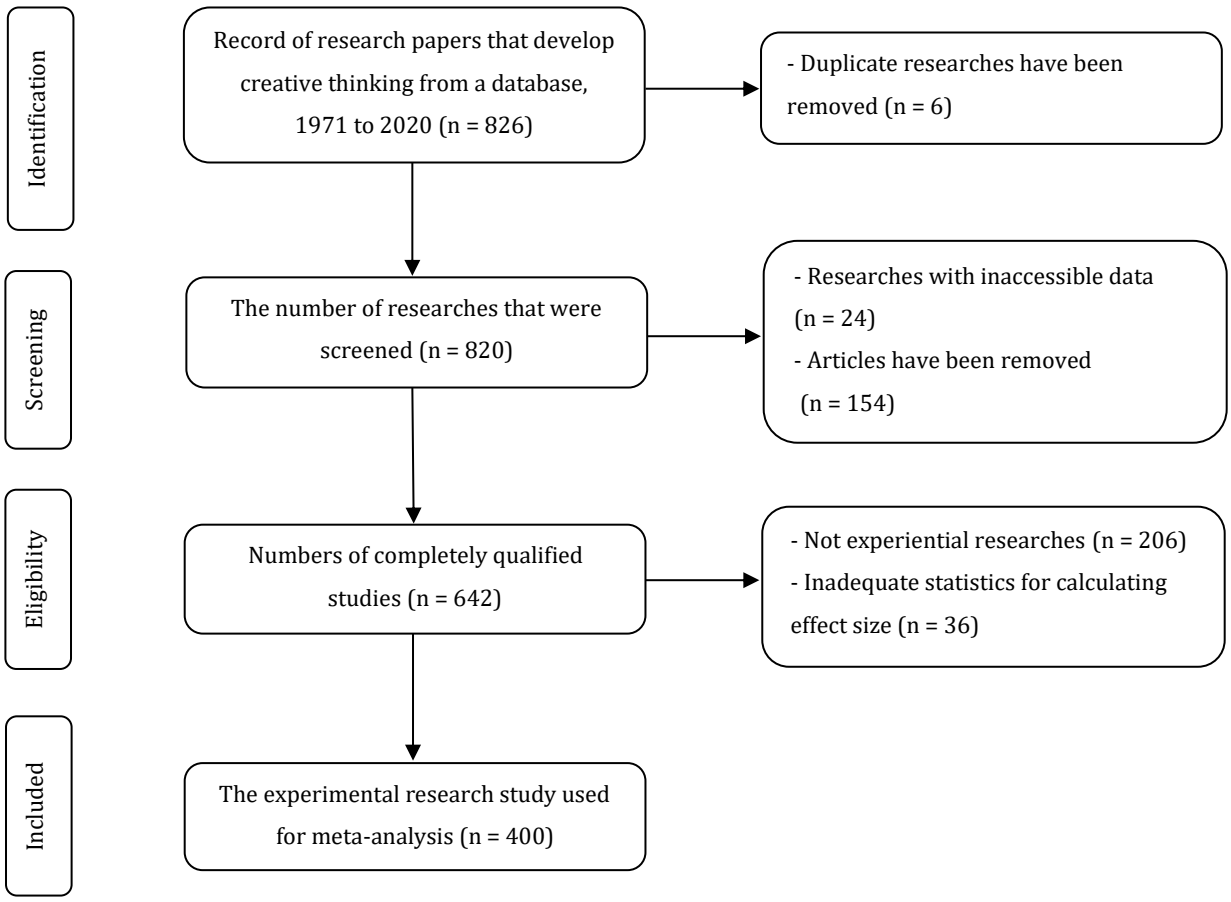

Figure 1. The Selection Process for Research Developing Creative Thinking

Selection Process

The researcher identified all the studies on teaching innovations that develop the student's creative thinking, then considered the selection according to all four criteria, starting from Identification. A total of 826 related studies were found, and six duplicate studies were removed. According to Screening, 24 unavailable items and 154 articles were removed, and Eligibility revealed there were 206 non-experimental studies and 36 studies with incomplete statistics for calculating effects size. Finally, 426 studies did not qualify for meta-analysis and were excluded. Thus, there were only 400 studies left as the appropriate research for this study.

Research Reliability

This meta-analysis examined the reliability of evaluators in the coding and recording processes of the research. The codebook and coding manual was prepared. Data recording of research characteristics was divided into four areas, namely (a) research background data, (b) research content data, (c) research methodological data, and (d) research results for which such information was recorded by the Cohen's Kappa statistical assessor (Lipsey & Wilson, 2001) had a confidence value of 0.98. It indicated that the records had good consistency (Card, 2012).

Research Validity

Since the research has undergone a selection process based on criteria considered the appropriateness and validity of the research (Petticrew & Roberts, 2006), the researcher conducted a research quality assessment and used the 5-level research quality assessment form setting 20 items rubric criteria for assessment. There were seven parts of the assessment content: (a) background and significance of research problems, (b) documents and related research, (c) research methods, (d) data analysis results, (e) conclusions, discussions, and recommendations, (f) presentation of the research report, and (g) benefits of the research.

The researchers examined the rubric's quality, and then applied the results of two recorders independently. Moreover, Cohen's Kappa statistic analyzed the confidence among the assessors (Lipsey & Wilson, 2001). The reliability value showed as 0.97; therefore, it indicated that rubrics were objective and precise. Consequently, it was suitable for research assessments (Card, 2012).

Analyzing of Data

For the statistical analysis of this research, the analysis was divided into four issues as follows:

1. Publication Bias, studied from 1.1) Funnel Plot, the principle of testing is to create a scatter plot between the values representing the magnitude of influence on the x-axis and the value representing the sample size on the y-axis considering the symmetry of the Funnel Plot. If the data is free of publication bias, the effect size values in small studies will be highly distributed and evenly distributed around the mean effect size. The conclusion will be a publication bias problem if the dispersion data is asymmetric from the mean effect size values; 1.2) If the Egger's Test and Kendall's Tau Coefficient have static significance ($p < .05$), it indicates publication bias.

2. Analysis of effect sizes (d) by the computational method of Cohen (1988) and interpretation of the effect size according to Cohen's classification (1988), d = 0.20-0.50 means low effect level, 0.50-0.80 refers to medium effect level; and d above 0.80 means high effect level. As the classification of effect of Thalheimer and Cook (2002), $-0.15 < d < 0.15$ is as interpreted as insignificant level, $0.15 < d < 0.40$ refers to minor level, $0.40 < d < 0.75$ is as medium level, $0.75 < d < 1.10$ is as broad level, $1.10 < d < 1.45$ refers to very broad-level, and $1.45 < d$ is interpreted as perfect level.

3. A meta-analysis from testing the difference in the effect size of the research is applied by the random effect model. In cases where the research effect size values are different and the fixed effect model in the case that the research effect size values with no difference can be studied from 3.1) Omnibus test of model coefficients (Q_a), If the test results show that the Q_a is statistically significant ($p \leq .05$), then the mean total effect size is different from zero, but If the value of Q_a has no statistical significance ($p > .05$), then the mean of the total effect size is not different from zero, 3.2) The test of residual heterogeneity (Q_b), a test for the residual value of the effect size estimation is zero. The results are interpreted according to the statistically significant Q_b value ($p \leq .05$) showing as heterogeneity or have a non-zero. There should select a residual value random effect model estimation method so that the estimation result is not biased. However, if Q_b has no statistical significance ($p > .05$), then there is no heterogeneity or if the remainder is zero, the fixed effect model estimation method should be chosen (Hedges & Vevea, 1998), 3.3) The Z statistic indicates the difference from zero after adjustment. Results are interpreted based on a statistically significant Z value ($p \leq .05$), showing that the effect size value differs from zero and tends positively or negatively to the total mean effect size. In case if the Z value is without statistical significance, ($p > .05$), it shows that the effect size value is not different from zero and has no influence on the total mean effect size, and 3.4) The τ^2 statistical values represent the variability of the effect size values (d) of each study. The interpretation can be considered in conjunction with the I^2 statistical values expressed as a percentage variance of the effect size of each research level. For example, interpretation of the S. Cooper et al. (2009) classification is 25% to mean the difference is low or no difference, 50% the difference is moderate, 75% is the difference in the high level (significant).

4. A meta-analysis can be studied from the Forest Plot. It describes the effect of eight instructional management models as the effect size means appearing as a square box and 95% confidence interval. The big square represents high accuracy. This may be due to many samples or the large effect size. In addition, if the confidence interval crosses the solid line (value 0), the study result is not statistically significant by analyzing the mentioned data using JASP Version 0.14.1 program.

Findings / Results

Publication Bias

Publication bias was tested using various methods for the studies in this study. First, the funnel plot revealed that the overall effect size of the research was broadly sampled. As shown in Figure 2, the majority of the effect size values were distributed at the top of the Funnel Plot. According to Figure 2, the funnel plot shows an asymmetric distribution with mean effect size values, which causes publication bias problems in this study. The cause of publication bias could be that each study has a different effect size (Borenstein, 2009). Furthermore, the Egger's test was 8.246 ($p < .05$), and Kendall's Tau Coefficient was 0.374 ($p < .05$), indicating that the findings of this study had a significant impact on publication bias in each study (Borenstein, 2009; H. Cooper et al., 2009; Egger et al., 1997; Rosenthal, 1979).

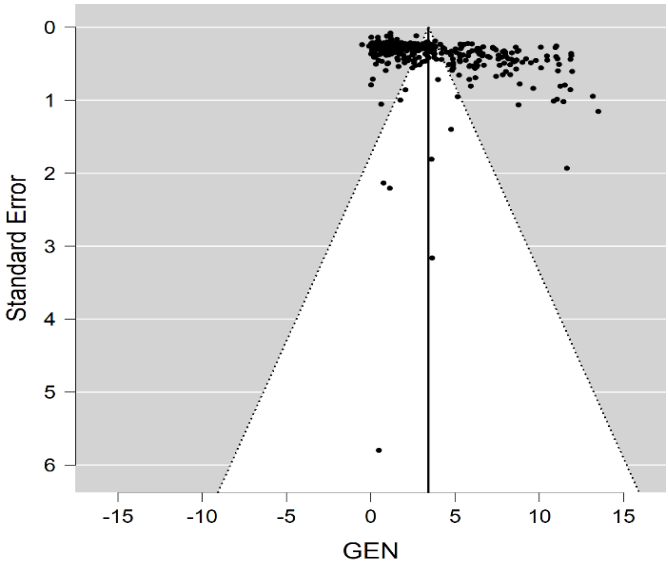

Figure 2. Funnel Plot

Findings of Effect Sizes Combined by Fixed and Random Effects Model and Heterogeneity Test Results

The results of the random effects model test of 400 studies showed that $\bar{d}$ = 3.430, SE = 0.167, Upper 95% CI = 3.17, and Lower 95% CI = 3.10, and the testing of the Fixed Effects Model revealed that $\bar{d}$ = 2.426, SE = 0.015, Upper 95% CI = 2.46, and Lower 95% CI = 2.40. The above results found the effect size in each study, and the percentage of research variance was relatively high (I^2 = 99.227%). Therefore, the researcher selected the analysis results from the Random Effect Model to estimate the effect sizes in accordance with the research objectives.

As a result, it can be concluded that the meta-analysis results of 400 studies obtained a mean effect size of 3.430 as a high effect size (d > 0.80) and was considered as a perfect level effect size (d > 1.45). When calculating the statistical significance according to the Z test, the Z statistical test result was 20.512. Consequently, the mean difference in the effect size of the research was statistically different from zero (p < .001). The test concluded that the effect size values for each study were different from zero and tended to be positive. The details are shown in Table 2.

Homogeneity Analysis

For the Homogeneity test from Q-statistic, it revealed that Q was equal to 34512.899. To perform this Homogeneity test, the researcher used the chi-squared value from the statistical table at df 401, found that $\chi^2$was 448.692 and df 399 χ^2 showed was 446.575 with the significance level at .05. Because the Q-statistic value exceeded the critical chi-square value, the rejected hull hypothesis showed that the effect values of each study were statistically significantly different. In addition, when considering the I^2 statistical value representing the percentage variance of the effect size value, I^2 = 99.227% indicated that the research effect size value had a high variance (S. Cooper et al., 2009). Thus, homogeneity tests (Q and I^2) pointed out that the effect size of each study was very different. Therefore, it is appropriate to apply the Random Effects Model to reduce outcome bias (Borenstein et al., 2015). The details are shown in Table 2.

Table 2. Findings of the Effect Size Meta-Analysis Combined by Fixed and Random Effects Model and Homogeneity Test

Model	Effects Size			95% CI		Absence Hypothesis		Heterogeneity		
	k	$\bar{d}$	SE	lower	Upper	Z	p	Q	DF	I^2
Random Effects	400	3.430	0.167	3.10	3.17	20.512	<.001	34512.899	399	99.227%
Fixed Effects	400	2.426	0.015	2.40	2.46	166.344	<.001			

Effects of Instructional Management Model

The results of the Random Effects Model analysis revealed that the mean effect size was different from zero (Q_a = 17.294**). Furthermore, it had a non-zero remainder. (Q_b = 33805.294***). The variance of the effect size was high (τ^2 = 10.656). The percentage variance of the effect size was high (I^2 = 99.195%), indicating that each study had a high level of variance with a statistically significant difference.

When studying the effect of the instructional management model on the development of creative thinking, it showed that there were four instructional management model with statistically significant differences. The model with the average effect size in descending order were as follows: Creative Development Theory ($\bar{d}$ = 4.217, SE = 0.458, [3.32, 5.11]), Learning Integration ($\bar{d}$ = 4.061, SE = 0.502, [3.06, 5.06]), Media and Technology ($\bar{d}$ = 3.644, SE = 0.321, [3.01,

4.28]), and Learning Experience ($\bar{d}$ = 2.121, SE = 0.320, [1.49, 2.79]), respectively. The details are shown as in Table 3 and Figure 3.

Table 3. Random Effects Analysis of Instructional Management Models on the Development of Creative Thinking

Instructional Management Models	k	$\bar{d}$	SE	95% CI	Z	Q_a	Q_b	τ^2	I^2
Learning Experience	40	2.121	0.320	[1.49, 2.76]	4.078***	17.294**	33805.294***	10.656	99.195%
Project-Based Learning	36	3.253	0.661	[1.95, 4.56]	1.482				
Media and Technology	107	3.644	0.321	[3.01, 4.28]	2.510*				
Learning Integration	49	4.061	0.502	[3.06, 5.06]	2.703**				
Cooperative Learning	33	2.133	0.410	[1.33, 2.94]	0.031				
Creative Development Theory	64	4.217	0.458	[3.32, 5.11]	3.140**				
Laboratory Method	24	3.737	0.530	[2.70, 4.78]	1.893				
Constructionism	47	3.665	0.566	[2.21, 5.12]	1.677				

Note: Q_a = Omnibus test of model coefficients, Q_b = Test of residual heterogeneity. *p < .05, **p < .01, ***p < .001.

Uncombined Findings of Effect Size Analysis in Accordance With Creative Thinking Variable

Moreover, if considering the forest plot (Figure 3), which is described in the form of the average effect size of each instructional management model shown as square boxes and the confidence intervals of 95% revealed that four models had the effect sizes influencing the total average effect size with statistical significance (p < .05). Suppose considering the effect size according to the instructional management model in descending order, namely creative development theory, learning integration, media and technology, learning experience, respectively. Then, it can be concluded that the four instructional management models affect the creative thinking development of the students.

When considering the dispersion of average effect size value for each model based on the Funnel Plot (Figure 4), it was discovered that eight instructional management models developing students' creative thinking had the effect size value in a positive direction. Furthermore, they are distributed within the triangle and symmetrically near the total average effect size centerline. As a result, it demonstrates that the conclusions from the eight comparison models have a common effect on publication bias.

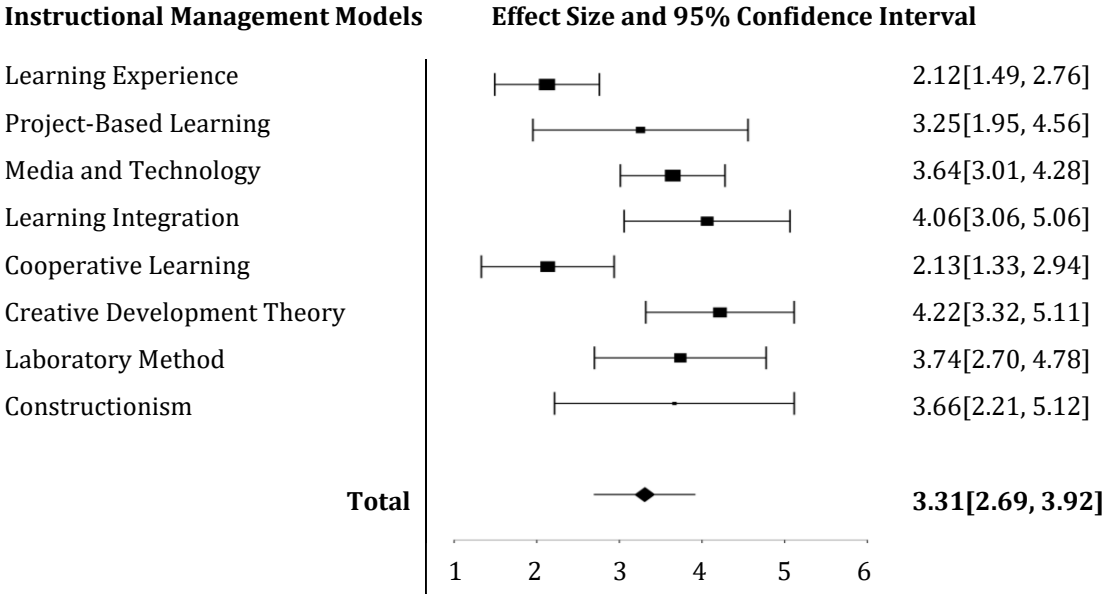

Figure 3. Forest Plot of Effect Sizes of Studies by the Variable of Instructional Management Models

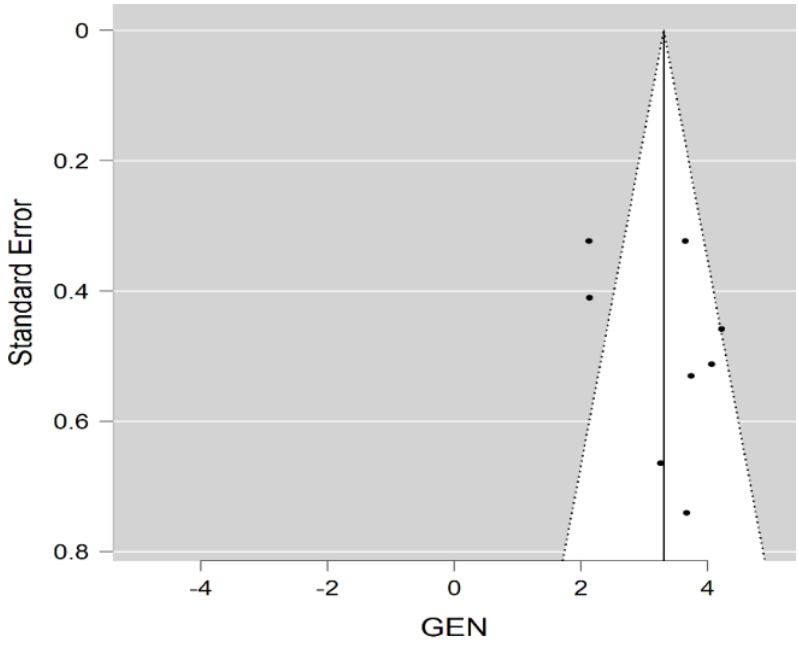

Figure 4. Funnel Plot

Results of the Moderator Analysis According to Creative Thinking Variable

Results of the Categorical moderator's analysis, which was performed to reveal the reasons for heterogeneity occurring due to the instructional management model variable, showed that the average effect size of the instructional management models varied according to the variables categorized by all variables. The level of each variable with the highest average effect size consisted of research qualification published in 2009–2017 ($\bar{d}$ = 4.849) under private schools ($\bar{d}$ = 3.640), conducted within Thai language courses ($\bar{d}$ = 3.311), and applied Torrance's creative thinking theory. The samples were at the preschool level ($\bar{d}$ = 3.311). The teachers used one to six lesson plans ($\bar{d}$ = 3.805), each plan spent less than an hour ($\bar{d}$ = 3.439), spent more than 31 hours ($\bar{d}$ = 4.519), and taught in four weeks ($\bar{d}$ = 3.199). The learning process consisted of six steps: problem identification, hypothesis, design, experimentation, discussion, and conclusion ($\bar{d}$ = 4.109). Evaluation and assessment were done by the test ($\bar{d}$ = 3.630), and there were 30–39 items in the tool ($\bar{d}$ = 4.774). The knowledge sheets were utilized as teaching materials ($\bar{d}$ = 4.333), there was the research design based on one sample group ($\bar{d}$ = 4.948). The sample selection was by the cluster sampling ($\bar{d}$ = 5.193), non/randomized one group pretest-posttest was the research design ($\bar{d}$ = 4.969), quality of tool was determined by only reliability ($\bar{d}$ = 3.275), research statistic applied was t-test dependent ($\bar{d}$ = 5.047). The research's quality was at a moderate level ($\bar{d}$ = 5.708) at a statistically significant level of .05, as shown in Table 4.

Table 4. Categorical Moderator Results Related to the Effect of Instructional Management Models of Creative Thinking

Moderators	k	$\bar{d}$	SE	95% CI	Z	Q_a	Q_b	τ^2	I^2
Year of Publication									
1960 - 1990	44	1.122	0.138	[0.85, 1.39]	2.443*	64.686***	31512.911***	9.475	99.096%
1991 - 2001	74	2.162	0.230	[1.71, 2.61]	1.739				
2002 – 2008	117	3.282	0.260	[2.77, 3.79]	3.896***				
2009 – 2017	129	4.849	0.377	[4.11, 5.59]	6.723***				
2018 – 2020	36	4.443	0.558	[3.35, 5.54]	4.727***				
Schools									
Private	221	3.640	0.215	[3.22, 4.06]	16.196***	1.989	34013.346***	10.910	99.223%
Government	179	3.176	0.264	[2.66, 3.69]	-1.410				
Courses									
Thai Language	23	3.311	0.616	[2.10, 4.52]	4.801***	10.536	33473.602***	10.861	99.213%
Mathematics	53	3.196	0.396	[2.42, 3.97]	-0.150				
Science	100	2.759	0.295	[2.18, 3.34]	-0.726				
Social Science	13	2.136	0.521	[1.11, 3.16]	-1.030				
Art	69	3.920	0.413	[3.11, 4.73]	0.745				
Home Economics	19	4.186	1.369	[1.50, 6.87]	0.402				
Foreign Languages	12	4.182	0.966	[2.29, 6.08]	0.726				
Creative Skill Enhancement	111	3.882	0.351	[3.19, 4.57]	0.733				

Table 4. Continued

Moderators	k	$\bar{d}$	SE	95% CI	z	Q_a	Q_b	τ^2	I^2
Creative Thinking Theory									
Torrance	217	3.199	0.223	[2.76, 3.64]	14.176***	7.934	33901.829***	10.858	99.219%
Gilford	90	3.954	0.414	[3.14, 4.77]	1.713				
William	34	3.875	0.519	[2.86, 4.89]	1.093				
Jellen and Urban	33	4.087	0.590	[2.93, 5.24]	1.430				
Wallach and Kogan	26	2.275	0.341	[1.61, 2.94]	-1.327				
Level									
Primary School	61	4.034	0.409	[3.23, 4.84]	9.417***	6.267	33294.186***	10.859	99.217%
Elementary School	35	4.138	0.570	[3.02, 5.26]	0.144				
Secondary School	125	3.335	0.283	[2.78, 3.89]	-1.340				
Junior High School	126	2.965	0.298	[2.38, 3.55]	-2.055*				
Senior High School	53	3.598	0.520	[2.58, 4.62]	-0.712				
No. of Lesson Plans									
1 – 6 plans	169	3.805	0.271	[3.27, 4.34]	14.739***	4.603	34438.004***	10.922	99.221%
7 – 12 plans	94	3.083	0.324	[2.45, 3.72]	-1.663				
13 – 19 plans	83	2.985	0.321	[2.36, 3.61]	-1.807				
More than 20 plans	54	3.574	0.510	[2.57, 4.57]	-0.426				
Hours per Plan									
Less than 1 hour	66	3.439	0.339	[2.77, 4.10]	8.319***	0.778	34474.870***	11.014	99.223%
1 hour	222	3.332	0.238	[2.87, 3.80]	-0.253				
2 hours	82	3.546	0.364	[2.83, 4.26]	0.185				
More than3 hours	30	3.843	0.598	[2.67, 5.02]	0.542				
Total Teaching Hours									
Less than 10 hours	73	2.786	0.327	[2.15, 3.43]	7.223***	12.775**	33784.303***	10.649	99.198%
11 – 20 hours	215	3.593	0.229	[3.14, 4.04]	1.791				
21 – 30 hours	57	2.521	0.344	[1.85, 3.20]	-0.352				
More than 31 hours	55	4.519	0.544	[3.45, 5.59]	2.902***				
No. of Teaching Weeks									
4 weeks	110	3.223	0.298	[2.64, 3.81]	10.097***	0.992	34211.020***	11.016	99.225%
8 weeks	158	3.620	0.292	[3.05, 4.19]	0.926				
12 weeks	65	3.290	0.395	[2.52, 4.06]	0.131				
More than 13 weeks	67	3.471	0.384	[2.72, 4.22]	0.489				
Learning Process									
Leading, Teaching, Conclusion	141	3.018	0.234	[2.56, 3.48]	10.776***	4.650	34280.014***	10.939	99.218%
Leading, Experiment, Conclusion	123	3.680	0.357	[2.98, 4.38]	1.527				
Leading, Teaching, Measurement, Conclusion	41	3.248	0.503	[2.26, 4.23]	0.376				
Leading, Act, Analysis, Conclusion, Application	49	3.532	0.429	[2.69, 4.37]	0.918				
problem identification, hypothesis, design, experimentation, discussion, and conclusion	46	4.109	0.547	[3.04, 5.18]	1.895*				
Evaluation and Assessment									
Test	333	3.630	0.190	[3.26, 4.00]	19.923***	9.103*	33419.279***	10.778	99.209%
Sheets/Activities	26	2.132	0.423	[1.30, 2.96]	-2.213*				
Exercises	20	1.948	0.621	[0.73, 3.17]	-2.186*				
Observation Forms	21	3.319	0.509	[2.32, 4.32]	-0.387				
No. of Items in Instrument									
≥10 items	123	3.036	0.277	[2.49, 3.58]	10.207***	12.802*	33798.014***	10.755	99.208%
10 – 19 items	91	2.846	0.268	[2.32, 3.37]	-0.416				
20 – 29 items	51	3.549	0.420	[2.73, 4.37]	0.927				
30 – 39 items	52	4.774	0.624	[3.55, 6.00]	2.939**				
≤40 items	83	3.839	0.430	[3.00, 4.68]	1.669				

Table 4. Continued

Moderators	k	$\bar{d}$	SE	95% CI	z	Q_a	Q_b	τ^2	I^2
Teaching Materials									
Textbooks	54	2.577	0.407	[1.78, 3.37]	5.733***	10.209*	33480.042***	10.756	99.211%
Exercises	53	2.970	0.496	[2.00, 3.94]	0.567				
Knowledge Sheets	59	4.333	0.450	[3.45, 5.21]	2.807**				
Sheets/Activities	210	3.584	0.234	[3.13, 4.04]	1.986*				
Internet	24	2.859	0.476	[1.93, 3.79]	0.351				
Research Group									
1 group	217	4.948	0.237	[4.48, 5.41]	24.883***	126.116***	29269.796***	8.241	98.973%
2 groups	166	1.639	0.168	[1.31, 1.97]	-10.942***				
More than 3 groups	17	1.673	0.411	[0.87, 2.48]	-4.434***				
Selection of Samples									
Simple Random Sampling	154	2.405	0.224	[1.97, 2.84]	9.502***	48.360***	30950.138***	9.760	99.124%
Stratified Random Sampling	79	5.193	0.447	[4.32, 6.07]	6.303***				
Multi-stage Sampling	35	2.470	0.519	[1.45, 3.49]	0.086				
Purposive Sampling	99	4.103	0.322	[3.47, 4.73]	4.129***				
Stratified sampling	33	2.924	0.388	[2.16, 3.68]	0.878				
Research Design									
Randomized Control Group Pretest – Posttest	174	1.578	0.126	[1.33, 1.82]	7.276***	130.290***	28630.572***	8.169	98.963
Non/Randomized One Group Pretest – Posttest	216	4.969	0.237	[4.50, 5.43]	11.367***				
Factorial Design	10	2.430	1.876	[-1.25, 6.11]	0.920				
Quality of Tools									
Reliability	220	3.275	0.221	[2.84, 3.71]	14.507***	1.083	34379.625***	10.976	99.226%
Reliability, Discrimination	80	3.546	0.386	[2.79, 4.30]	0.614				
Reliability, Discrimination, Difficulty	100	3.675	0.340	[3.01, 4.34]	0.982				
Research Statistics									
t-test Dependent	211	5.047	0.240	[4.58, 5.52]	25.300***	137.964***	28982.534***	8.053	98.947%
t-test Independent	153	1.688	0.181	[1.33, 2.04]	-10.907				
ANOVA, ANCOVA, MANOVA	36	1.433	0.214	[1.01, 1.85]	-6.929				
Quality of Research									
Moderate Level	11	5.708	1.296	[3.17, 8.25]	5.630***	19.591***	33396.750***	10.456	99.190%
Good Level	343	3.600	0.182	[3.24, 3.96]	-2.069				
Excellent Level	46	1.655	0.325	[1.02, 2.29]	-3.618***				

Note: K = Number of studies, $\bar{d}$ = Mean of effect size, SE = Standard error CI = Confidence interval, Q_a = Omnibus test of model coefficients, Q_b = Test of residual heterogeneity. *p < .05, **p < .01, ***p < .001.

Discussion

According to the findings of this study, the researchers have recognized the importance of developing students' creative thinking over the last five decades, resulting in a list of highly relevant. However, because they did not meet the selection criteria, only half of the total were applicable research papers. Students, teachers, and school administrators were not in the same sample group. They could not be downloaded in their entirety. They were qualitative studies, but there was not enough statistical data to calculate effect sizes for meta-analysis (Aytaç & Kula, 2020; Tarik, 2020; Tufan, 2020). The selected research found that the four instructional management models affected the development of creative thinking. Nevertheless, this conclusion is still based on the effect of many attribute variables, including the effect of Publication Bias. Due to Thailand has had various research developments that develop teaching innovations in many fields, most researchers still lack rigor in research design, incorrect use of research methodology, conducting research with too few samples, control of extraneous variables, and lack of attention to the quality of research tools, and there were also statistically breaking preliminary agreements. This may be an important reason for such Publication Bias (Borenstein, 2009; H. Cooper et al., 2009; Egger et al., 1997; Rosenthal, 1979). This is consistent with Dowdy et al. (2020), who stated that research is still being produced that does not cover a wide range of topics, including research design, research process, and data analysis. Furthermore, most studies lack strict internal validity, including randomization, blinding, protocol adherence, and external validity. The findings are also consistent with the

findings of Alinaghi and Reed (2018), Bom and Rachinger (2019), who stated that the few samples have a high-risk patient, resulting in poor methodological quality. It could be due to a low research budget and a preference for non-strict research methodology; for example, the research of Alacapınar and Uysal (2020), Cakir (2017), Yurt and Polat (2015) studied Publication Bias from the Funnel plot and Rosenthal and Orwin's Fail-Safe N Method found that the meta-analysis results were highly affected by Publication Bias. The Funnel plots' study revealed that the influence sizes distribution was asymmetrical and away from the total mean influence sizes. It reflects that meta-analysis research often faces the same problem: the inability to eliminate Publication Bias.

The meta-analysis of the Random Effects Model found that the average effect size was statistically significant ($\bar{d}$=3.430) at a perfect level. Cohen (1988) and Thalheimer and Cook (2002) present the findings with the consistency of the research constructed by Alacapınar and Uysal (2020), Aytaç and Kula (2020), Er-Türküresin (2020), Ulubey (2018), the findings indicated that the instructional management model is considered as a significant variable on effect toward the creative thinking positively with the statistical significance. After that, when studying to find out which teaching method was most suitable for developing the student's creative thinking, it revealed that there were teaching methods that significantly affected the students' creative thinking development with the statistical significance of four types: creative development theory had the largest effect size, followed by learning integration, media and technology, and learning experience, respectively. The researchers believe this is because creative development theory is a teaching method that focuses on behavioral learning development in the classroom in terms of knowledge, thoughts, and attitudes. To increase the ability to think creatively, the step begins with problem identification, data collection, analysis, use of thought in data selection, thought process, synthesis, and evaluation, for example, creative development theory of Torrance, Guilford, William, Jellen, and Urban, Wallach and Kogan, etc. This theory instructs students to respond to the process of brain development by seeing relationships and connections between things around them, which results in learning and understanding until they become imaginary ideas. It also inspires innovative inventions to meet their daily needs or solve problems (Algahtani, 2017; Dani et al., 2018; Royston & Reiter-Palmon, 2019; Taylor & Kaufman, 2021). The theory is in line with the humanism theory that describes creative thinking as innate in humans. However, it can be expressed through the stimulation originating from learning and experience of one's own. It results in the accumulation of knowledge combined with thinking outside the box until becoming an intellectually creative person (Bush, 1978; Knowles et al., 1998; William, 1979).

These findings are also aligned with the research of Fakhrou and Ghareeb (2020), who described that creative development theory could enhance language creative thinking and supplement teaching strategies by comparing metaphors, telling what is wrong with the truth, and looking at images in different dimensions of the students (Shah & Gustafsson, 2021). According to the research findings, the total effect sizes from all studies had a very high variance. This variation was caused by several attribute variables. As a result, the conclusions regarding the efficacy of each teaching style are not concise. Furthermore, the researchers noted that the number of studies on various variables varied significantly, such as courses variable in the foreign languages research group (n = 12) and creative skill enhancement (n = 111) with a significant number of studies. Therefore, it can affect the chances of being statistically significant. It was also shown that research assessed at moderate quality tended to have a small effect size, while the research with low-quality assessments showed very high effect levels. Examples include studies using two or more sample groups, randomized control group pretest-posttest, instrument validation for reliability, discrimination, difficulty, and statistics used in research, t-test independent, ANOVA, etc. These elements should result in the research's quality at a reasonable level and tend to affect the development of creative thinking positively. On the other hand, these studies did not have a statistically significant effect on creative thinking development. As a result, differences caused by attribute variables that directly affect research findings must be managed in order for the conclusions to be valid and appropriately applicable to those involved (Austin, 2011; Hong & Raudenbush, 2005; Thoemmes & Kim, 2011). As a result, the researchers propose that the effect of variables be eliminated before conducting the meta-analysis in order to more accurately identify the effect of the instructional management model on creative thinking development. The international research reviews revealed that the propensity score matching method (PSM) has been used since 1983 and has started to attract attention for eliminating the variance caused by extraneous variables in research such as the research by Hong and Raudenbush (2005), Itzhak et al. (2005) and Stuart et al. (2011); PSM is important and has been widely applied in various research fields to help eliminate differences of moderator variables. This ensures that the results of the study are truly experimental results.

Conclusion

It can be concluded that all instructional management models have a meaningful effect in a positive direction. Of these, only four instructional management models had a statistically significant effect on the student's creative thinking development, particularly instructional models based on the creative development theory, followed by learning integration, media and technology, and learning experience, respectively. However, the conclusions of the above research were drawn from the effect of the attributed variables. which relates to differences in research methodology as well as the process of using different instructional management models, consisting of (a) language content, (b) student's level, (c) application of creative thinking theory, (d) instructional time, (e) number of hours in each instruction, (f) duration of instruction throughout the process, (g) number of instructional weeks, (h) instructional

management procedures, (i) measuring and evaluation tools, (j) the number of evaluation items, and (k) learning materials for students. As a result, when developing students' creative thinking in various school contexts and student groups, teachers should select an instructional management model that best suits the students' creative thinking development. It can also stimulate students' learning by facilitating instruction with modern media and technology. As a result, the students' creative thinking will be fully developed.

Recommendations

The above research results recommend three important innovation development issues to promote students' creative thinking. First, the teachers should apply creative development theory as an instructional management method. There should be media and technology to use and organize the situation creatively to encourage the students to practice thinking and creative expression. Second, the teachers should apply the results of categorical variables affecting the instructional management model that develops the students' creative thinking as a guideline for their teaching design since it can increase teaching efficiency. Third, those interested should study the control methods, which cause less publication bias since it will result in complete research results. There were recommendations for further research with three issues: First, meta-analysis research should be conducted on other essential variables such as critical thinking, communication, collaboration, etc.; Second, the scope of research should include aspects of the students' creative thinking development process, such as instructional design, instructional process, measurement, and evaluation, and so on. Furthermore, the scope of research should be related to creative thinking development because it may cause high discrepancies in the research results; third, PSM should be controlled or eliminated before testing the differences in the effectiveness of students' creative thinking development from different instructional methods to achieve better results. Furthermore, new meta-analysis research will be conducted in the future.

Limitations

The limitations have arisen in the conclusion because the research selection still has inaccessible researches, so the researchers could not collect all important data. In addition, the research characteristics used in the analysis are graduate thesis in Thailand from various disciplines with a variety of research methods. However, most researchers (54.00%) still applied a research model with little control over the effect of variables and preferred to use only one sample number in the experiment. Therefore, there often had problems with the quality of research tools, including research of good quality tends to have lower effect size values. In contrast, when the research quality is lower, the effect size tends to be higher. Therefore, it may be an essential reason for such research findings.

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Authorship Contribution Statement

Itsarangkul Na Ayutthaya: Conceptualization, design, data acquisition, data analysis/interpretation, statistical analysis, drafting manuscript, critical revision of manuscript, and writing. Damrongpanit: Consulting research, data analysis, statistical analysis, editing/reviewing, supervision, final approval, technical or material support, and securing funding.

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