Integration of STEAM With Local Context for Enhancing Early Childhood Students' Creativity

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Abstract
This article aims to: a) review, analyze and synthesize the literature related to Science, Technology, Engineering, Art and Mathematics (STEAM) education and Context-based Learning (CBL); and b) developing the Context-based STEAM instructional model for enhancing creative skills in early childhood. The authors analyzed the STEAM instruction from the national and international contexts by using content analysis. Then, the researchers synthesized the teaching steps of STEAM Integrated with Local Context (L-STEAM) for enhancing early childhood students' creative thinking. The teaching steps from these literatures were analyzed. From the analysis, the authors synthesized the L-STEAM teaching model consisted of six teaching steps: a) Introduce STEAM problem, b) Investigate, c) Act, d) Share, e) Apply and Extend and f) Self-assessment. At final, the authors raised one example of L-STEAM lesson plan for teaching the Toys and Accessories topic for early childhood students. This example may guide other early childhood teachers in applying local context in teaching with STEAM in any subject they assigned to teach.

Keywords: STEAM Education, Local Context, Creative Thinking, Early Childhood

Introduction

Thailand places importance on delivering education with quality and equity for all Thai citizens. As evident in the 2017 Constitution of the Kingdom of Thailand, Section 5 Article 54, "The state shall ensure that every child receives twelve years of education, from pre-school to the end of compulsory education, with quality and without charge" (Office of the Secretary-General of the House of Representatives, 2540, p. 14). Additionally, the 1999 National Education Act, as amended in 2002 (2nd edition), Article 10: Rights and Responsibilities in Education, specifies that "Education management must provide individuals with equal rights and opportunities for basic education without charge, not less than 12 years" (Office of the National Education Commission, 2545, p. 7).

Quality education is crucial for the development of the country, as emphasized in the National education plan B.E. 2560-2579 (A.D. 2017-2036) (Office of the Education Council, 2017):

> Education is a fundamental right of all Thai citizens that the state must provide to foster the holistic development of individuals at every stage of life. It aims to cultivate intellectual capital crucial for developing skills, qualities, and competencies necessary for professions and leading a fulfilling life in harmony with others in society. (p. 10)

In the Early Childhood Curriculum B.E. 2560 (A.D. 2017), early childhood education concentrates primarily on fostering the holistic development of children from birth to the age of six. The overarching goal of early childhood education is to provide a comprehensive and nurturing learning environment that supports the physical, emotional, social, and cognitive growth of young learners (Ministry of Education Thailand, 2017). Early childhood education encompasses the deliberate cultivation of caregiving skills and the facilitation of learning processes that seamlessly correspond with the natural and age-appropriate development of every child. This approach is designed to unlock each child's fullest potential within the unique framework of their social and cultural environment.

Early childhood education plays a pivotal role in shaping children into well-rounded adults, particularly in the context of the substantial societal and economic shifts witnessed in the 21st century. With rapid advancements in science and technology defining this era, fostering early learning in science, technology, and mathematics becomes imperative. By emphasizing these foundational skills during the formative years, we equip children with the essential tools needed for both current learning and future life challenges. This approach empowers them to lead a high-quality life that aligns seamlessly with the dynamics of both the contemporary world and upcoming transformations (Ministry of Education Thailand, 2017).

Early childhood is crucial for the development of cognitive abilities and the nurturing of creativity. Introducing STEAM concepts during this period sets a solid foundation for a lifelong love of learning and exploration. Hands-on, experiential activities delivered through STEAM education can engage children minds, making learning a joyful and memorable experience. STEAM education embodies an integrated teaching approach that seamlessly combines Science, Technology, Engineering, Arts, and Mathematics into a cohesive and unified pedagogical framework. STEAM education goes beyond the conventional boundaries of subjects, encouraging a holistic approach to learning. By seamlessly integrating science, technology, engineering, arts, and mathematics, educators aim to cultivate a multidimensional

skill set that empowers students to solve complex problems, think creatively, and adapt to an ever-changing global landscape (Loapideht, 2013; Ministry of Education, Thailand, 2017).

Context-based Learning (CBL) is recognized as a constructivist teaching method that places strong emphasis on and leverages the local context surrounding children throughout the learning process. Integrating local context with STEAM education elevates the significance of cultural and contextual relevance in early childhood learning, adding an extra layer of importance to the educational process. By infusing lessons with elements from students' cultural backgrounds, educators not only boost engagement but also nurture a sense of identity and pride. This approach acknowledges the diversity among learners, ensuring that education remains relatable and meaningful for each student (Crawford, 2001; Bennett, Grasel, Parchmann and Waddington, 2005; Gilbert, 2006; Potter and Overton, 2006; Boonmaton, Supap and Wiriyapong, 2018; Tungkawasakul 2017; Tippang, 2019; Gudhom, 2017).

Integrating the local context can significantly enhance student engagement in learning. Students are more likely to be engaged and motivated when learning experiences resonate with their daily lives and cultural backgrounds. The fusion of STEAM with the local context not only encourages students to think creatively but also facilitates the connection of theoretical concepts with real-world applications within their own cultural framework. However, upon a thorough examination of the literature pertaining to education in the Thai context, it becomes evident that there is a gap in research regarding the current situation, problems, and needs regarding the integration of local context in STEAM education for teaching early childhood.

Research Questions

The research questions were: a) What are the current situation, problems, and needs related to STEAM education and CBL in the context of early childhood education; and b) What are the desirable characteristics of a new learning model integrated STEAM education and CBL.

Research Objectives

The research objectives were two folds: a) to investigate the current situation, problems, and needs of STEAM education and CBL in early childhood education; and b) to develop a new learning model integrated STEAM education and CBL for early childhood education.

Literature Review

This section presents the literature review about CBL and STEAM education as follows.

Context-Based Learning (CBL)

The transformations in the learning landscape of the 21st century have given rise to teaching approaches that underscore the significance of context, notably termed as Context-based Learning (CBL). Within CBL, learners engage in educational experiences intertwined with real-life situations encountered in their daily lives. The integration of context in teaching proves advantageous in cultivating students' skills and fostering a profound comprehension of knowledge. CBL serves as a pedagogical strategy that prioritizes delivering learning content within a context closely tied to students' everyday realities. This principle is dedicated to

advancing learning experiences that resonate with various situations in learners' daily lives, facilitating the connection of acquired knowledge with real-life experiences.

CBL underscores the importance of integrating contexts aligned with real-life situations, fostering engaging and meaningful learning experiences for students. The successful implementation of CBL in educational settings necessitates support from educational organizations and teachers alike. Schools should actively create an environment conducive to the incorporation of context in teaching, while teachers should undergo training to enhance their skills in crafting and delivering contextually rich lessons.

Hence, CBL emerges as a teaching strategy that accentuates the creation of meaningful learning experiences closely aligned with real-life situations in learners' day-to-day existence. By employing context as the foundation for learning, this approach involves linking the learning content to the experiences and situations in the actual lives of students. This connection ensures that the learning is not only meaningful within its immediate context but also applicable and transferable to diverse situations, enriching the overall educational experience (Crawford, 2001; Bennett, 2005; Gilbert, 2006; Potter and Overton, 2006; Boonmatan, 2016; Tungkawasakul 2017; Tippang, 2019; Kuadhom, 2017).

STEAM Education

STEAM Education, an innovative educational approach seamlessly integrating Science, Technology, Engineering, Arts, and Mathematics into the learning process. Martinez and Stager (2013) underscored the significance of providing students with opportunities to creatively produce their own work through engaging science and engineering activities through STEAM education. Mae Jemison (2019), a renowned astronaut and physician, advocates for the fusion of science and art, actively supporting STEAM Education as a means to cultivate creativity in students. Mitch Resnick (2018), is an executive and researcher, who leads the Scratch project, which is a creative programming learning platform used to promote collaboration with technology in creative production. Andrea Beaty (2013) is the author of the book "Rosie Revere, Engineer" and other works that focus on encouraging children's interest in experimentation and creative work in various STEAM fields. The scholars emphasize the importance of STEAM Education in developing essential skills for the future e.g., fostering creativity, and collaborating with technology and innovation in a rapidly changing society (Martinez and Stager, 2013; Beaty, 2013).

Research Methodology

This research employs a mixed-method research design. Specifically, the quantitative research utilizes survey research, while the qualitative research involves Focus Group Discussions (FGD).

Quantitative Research

The quantitative research was a survey of teachers’ and parents’ perspectives on the current situation, problems and needs regarding STEAM education and CBL.

Data Collection

The research instrument was a questionnaire incorporating a five-scale rating (5 = Very high, 4 = High, 3 = Moderate, 2 = Low, and 1 = Very low). For collecting data from teachers, the researchers utilized an instrument called "Problems and Needs in Teaching with STEAM and CBL Questionnaire," which was structured into three distinct parts: Part 1: Background of respondents (5 items); Part 2: Problems and needs in in teaching with STEAM and CBL (20 items); and Part 3: Suggestions for further developing STEAM and CBL (1 open-ended item).

For collecting data from parents, the researchers utilized an instrument called "Problems and Needs in Teaching with STEAM and CBL Questionnaire," which was structured into three parts: Part 1 background information. Part 2 problems and needs of teaching with STEAM and CBL (16 items) and Part 3 suggestions.

Data Analysis

The background data from Part 1 was analyzed for frequencies and percentages. The data from Part 2 was analyzed by calculating for mean and standard deviation (SD). The interpretation of mean ranges of each item in Part 2 (Wongratana, 2007) was as: mean 4.50 - 5.00 was interpreted as a Very High level of problems and needs; while mean 3.50 - 4.49, 2.50 – 3.49, 1.50 – 2.49, and1.00 – 1.49 were interpreted as the problems and needs were at a High, Moderate, Low and Very Low levelsm respectively. Furthermore, the qualitative data from Part 3 was analyzed by content analysis.

Qualitative Research

Focus group discussion (FGD) were conducted with 35 early childhood teachers (all females), who had experience in teaching with STEAM education and CBL more than five years.

Data Collection

The FGD with teachers about current situation, problems, and needs in STEAM education and CBL was a semi-structured interview: three, one and three questions focusing on the current situation, problems and needs of STEAM education and CBL, respectively.

Data Analysis

The researchers using five steps in analyzing qualitative data from FGDs Preparing, Segmenting, Coding, Categorizing and Thematizing (Buaraphan, 2017).

Results and Discussion

The results and discussion will be presented according to the research questions as follows.

Teachers' Perspectives on Current Situation, Problems and Needs in Teaching With STEAM Education and CBL

All responding teachers were female. Most of them aged 41-45 years old (34.30%), followed by 46-50 years old (31.40%), and 51-55 years old (11.40%). A majority of respondents was fallen in a Professional Level (K2) (68.60%), followed by Practitioner Level (K1) (14.30%) and Others (14.30%). A majority of respondents have teaching experience ranging from 21 to 25 years (37.10%), followed by 16 to 20 years (20.00%) and less than 6 years (14.30%).

Of 35 respondents, the teachers' perspectives on the problems and needs in implementing STEAM education and CBL can be presented as Table 1.

Statement		Mean	SD	Interpretation
Problems				
	School			
1.	STEAM education is not suitable for the local community context.	3.17	1.12	Moderate
2.	STEAM education is not suitable for the school context.	3.14	1.12	Moderate
3.	School administrator does not support STEAM education.	3.26	1.07	Moderate
4.	Teachers do not support STEAM education.	3.09	1.17	Moderate
	Curriculum			
1.	School lacks a STEAM education curriculum.	3.31	1.03	Moderate
2.	School lacks the STEAM education lesson plans.	3.43	1.04	Moderate
3.	Implementation of STEAM education is not widespread in the school.	3.51	0.98	High
	Teacher			
1.	Teachers are not yet ready for STEAM education.	3.43	0.98	Moderate
2.	Teachers lack knowledge and understanding of STEAM education.	3.03	0.89	Moderate
3.	Teachers lack awareness of the importance of STEAM education.	3.26	1.01	Moderate
4.	Teachers lack skills in teaching with STEAM education.	3.14	0.97	Moderate
5.	Teachers have not sufficiently utilized local contexts in teaching with STEAM education.	3.29	1.07	Moderate
	Student			
1.	Kindergarten students are not yet ready for STEAM education.	3.34	1.11	Moderate
2.	Kindergarten students are not yet ready in learning with context-based learning.	2.94	0.94	Moderate
3.	Students have not yet developed problem-solving skills to a satisfactory level.	3.09	1.01	Moderate
4.	Students have not yet developed creative thinking skills to a satisfactory level.	3.23	0.94	Moderate

5.	Students have not yet developed sufficient awareness of local context conservation.	3.26	0.78	Moderate
	Overall problems	**3.23**	**1.02**	**Moderate**
Needs				
	School			
1.	The local community needs STEAM education.	3.23	0.84	Moderate
2.	Schools need STEAM education.	3.83	0.89	High
3.	School administrators should support the implementation of STEAM education.	3.86	0.88	High
4.	School administrators should support the use of local context into teachers' teaching.	3.91	0.92	High
	Curriculum			
1.	Schools should develop a STEAM education-based curriculum.	4.03	0.89	High
2.	Schools should promote teachers to design STEAM education-based lesson plans.	3.83	0.71	High
3.	Schools should encourage the implementation of STEAM education across all levels within schools.	3.94	0.64	High
	Teacher			
1.	Teachers should be ready prepared for implementation of STEAM education.	3.94	0.68	High
2.	Teachers should improve their knowledge and understanding of STEAM education.	4.17	0.75	High
3.	Teachers should raise their awareness of the importance of STEAM education.	4.26	0.78	High
4.	Teachers should develop skills in teaching with STEAM education.	4.23	0.77	High
5.	Teachers should utilize local contexts in teaching STEAM education.	4.23	0.81	High
	Students			
1.	Kindergarten students should be ready prepared for learning with STEAM education.	4.31	0.76	High
2.	Kindergarten students should be ready for context-based learning.	3.97	0.75	High
3.	Students should be developed problem-solving skills to a satisfactory level.	3.89	0.76	High
4.	Students should be developed creative thinking skills to a satisfactory level.	3.94	0.80	High
5.	Students should be developed awareness of local context conservation.	4.06	0.80	High
	Overall needs	**3.98**	**0.79**	**High**

Table 1: Teachers' perspectives on the problems and needs in implementing STEAM education and CBL

In overall, the responding teachers perceived a moderate level (mean = 3.2, SD = 1.02) of problems in implementation of STEAM education and CBL. The top three problems were:

Implementation of STEAM education is not widespread in the school (mean = 3.51, SD = 0.98), followed by the school lacks the STEAM education lesson plans (mean = 3.43, SD = 1.04) and Teachers are not yet ready for STEAM education (mean = 3.43, SD = 0.98).

The responding teachers reflected a high level (Mena = 3.98, SD = 0.79) of needs in teaching with STEAM education and CBL. The top three needs were: Kindergarten students should be ready prepared for learning with STEAM education (mean = 4.31, SD = 0.76), followed by Teachers should raise their awareness of the importance of STEAM education (mean = 4.26, SD = 0.78), Teachers should develop skills in teaching with STEAM education (mean = 4.23, SD = 0.77), and Teachers should utilize local contexts in teaching STEAM education (mean = 4.23, SD = 0.81).

Parents' Perspectives on Current Situation, Problems and Needs in Teaching With STEAM Education and CBL

From the survey of 21 parents regarding the current situation, problems and need in learning with STEAM education and CBL, a majority of respondents were female (66.70%) with their age range between 56 to 60 years old (81.00%).

	Statement	Mean	SD	Interpretation
Problems				
1.	School are not ready yet for implementing STEAM education.	1.81	0.93	Low
2.	Teachers are not yet ready for STEAM education.	1.62	0.74	Low
3.	Teachers lack skills in teaching with STEAM education.	2.05	0.92	Low
4.	Teachers have not sufficiently utilized local contexts in teaching with STEAM education.	2.14	0.72	Low
5.	Kindergarten students are not yet ready for STEAM education.	1.86	0.65	Low
6.	Students have not yet developed problem-solving skills to a satisfactory level.	1.67	0.73	Low
7.	Students have not yet developed creative thinking skills to a satisfactory level.	1.48	0.75	Low
8.	Students have not yet developed sufficient awareness of local context conservation.	1.86	0.65	Low
	Overall problems	**1.81**	**0.76**	**Low**
Needs				
1.	The school needs to be developed to be ready to implement STEAM education.	2.81	1.12	Moderate
2.	Teachers should be ready prepared for implementation of STEAM education.	3.43	0.98	Moderate
3.	Teachers should raise their awareness of the importance of STEAM education.	3.48	0.51	Moderate
4.	Teachers should utilize more local contexts when teaching with STEAM education.	3.90	1.04	High

5.	Kindergarten students should be ready prepared for learning with STEAM education.	3.81	0.75	High
6.	Students should be developed problem-solving skills to a satisfactory level.	4.00	0.84	High
7.	Students should be developed creative thinking skills to a satisfactory level.	4.38	0.81	High
8.	Students should be developed awareness of local context conservation.	4.28	0.78	High
	Overall needs	**3.76**	**0.85**	**High**

Table 2: Parents' perspectives on the problems, and needs in implementing STEAM education and CBL

In overall, the responding parents perceived a low level (mean = 1.81, SD = 0.76) of problems in teaching with STEAM education and CBL. Three top problems were: Teachers have not sufficiently utilized local contexts in teaching with STEAM education (mean = 2.14, SD = 0.72), followed by Teachers lack skills in teaching with STEAM education (mean = 2.05, SD = 0.92), and Students have not yet developed sufficient awareness of local context conservation (mean = 1.81, SD = 0.86).

In addition, the parents reflected a high level of needs in STEAM education and CBL (mean = 3.76, SD = 0.85). The top three needs were: Students should be developed their creative thinking skills to a satisfactory level (mean = 4.38, SD = 0.81), followed by Students should be developed their awareness of local context conservation (mean = 4.28, SD = 0.78), and Students should be developed their problem-solving skills to a satisfactory level (mean = 4.00, SD = 0.84).

From FGD, the participating teachers reflected their perspectives on the current situation in teaching with STEAM education and CBL in three main points.

Current situation 1: Teachers were not yet ready prepared for integrating local contexts with STEAM education

The teachers stated that though they implemented STEAM with their students, they still lacked an ability to apply local contexts in STEAM teaching. They reflected the issues like: Integrating local contexts with STEAM education was a novel idea; They tried to emphasize integration of STEAM in various contexts; they tried to integrate STEAM disciplines; STEAM education provided students with the opportunity for developing problem-solving skills.

> In STEAM education, children were tasked with collecting leaves to craft into boats. Before embarking on the actual creation, the children were encouraged to plan and draw pictures, and then they floated their boats to observe whether they sank or floated. The children were joyful, and there was significant collaboration in organizing the activity. (Teacher 01*, FGD)
> *Note: T01 representing Teacher no. 1 in FGD

Current situation 2: Teachers reflected positive attitudes towards STEAM education

The participating teachers reflected their positive attitudes towards STEAM education as: STEAM education was a new pedagogy for kindergarten level; Students learned with STEAM could apply knowledge in real situations and develop creativity; Students enjoy STEAM education through practice and design; STEAM education could facilitate the holistic development in children. However, teachers mentioned obstacles like: Teaching with STEAM education took too much time and Some children need more encouragement to work collaboratively in team.

Current situation 3: Appropriateness in integrating local contexts with STEAM education

The participating teachers stated that integrating various local contexts with STEAM education was suitable for kindergarten students and school contexts. In addition, the teachers mentioned their problems in teaching with STEAM education. The teachers stated the difficulty in managing student learning in STEAM education. Many parents and children did not understand the multiple steps of STEAM education.

The participating teachers agreed that teaching with STEAM education was an innovative idea and they stated their needs in teaching with STEAM education: more learning resources, more support from schools, more trainings on knowledge and skills being essential for successful implementation of STEAM education in kindergarten level. In overall, STEAM education could promote continuous development in children.

Development of a New Learning Model Integrated Local Contexts in STEAM Education for Teaching Early Childhood Education

The authors reviewed the literature related to STEAM education and CBL (CORD, 1999; Bennett, 2005; Gilbert, 2006; De Jong and den Hartog, 2008; University of Southern California, 2009; Thanakwong, 2016; Sa-nguansak, 2019; Plodpluang, 2020) Subsequently, they synthesized the steps of Local Context-based STEAM Education (L-STEAM) into six steps, as outlined in Table 3.

Key Characteristics of CBL	**Key Characteristics of STEAM Education**	**Summary of key characteristics of Context-based STEAM Education**
Learning emphasizing contexts being relevant to learners' diverse real-life experiences	Learning is organized in an integrative manner of STEAM	Engaging learners by introducing a STEAM problem integrated diverse and appropriate local contexts being relevant to students' real-life experiences
	A teacher presents problem situations that exist in the real-life context of the learners	A teacher presents problem situations that exist in students' real-life contexts.
	Students gather information and ideas related to the problem	Students gather information and ideas related to the problem
	Students choose an appropriate problem-solving method and create art-embedded product	Students choose an appropriate problem-solving method and create art-embedded product

Learning through hands-on and problem-solving activities Learning collaboratively	Students test and evaluate the created product and seek ways to improve it	Students work collaboratively to test and evaluate the created product and seek ways to improve it
Presentation of learned knowledge	Students present products and process and get feedbacks from a teacher and peers	Students present products and process and receive feedbacks from a teacher and peers for further improvement
Applying learned knowledge meaningfully to other contexts Transferring learned knowledge to different situations		Students apply and transfer learned knowledge and experience meaningfully to other contexts
Self-assessment of learning	Students gain positive attitudes towards learning process and outcome	Students conduct self-assessment and cultivate positive attitudes towards learning with STEAM education

Table 3: Summary of key characteristics of Context-based STEAM Education

STEAM stands for Science (S), Technology (T), Engineering (E), Arts (A), and Mathematics (M). STEAM education is rooted in STEM education emphasizing learner-centered pedagogy that begins with problem-solving in the context of students' real lives.

The teaching steps of components Context-based STEAM Education can be described as: **Step 1: Introduce STEAM problem:** The teacher presents real-life problem situations in the context of students' lives, connecting Science (S), Technology (T), Engineering (E), Arts (A), and Mathematics (M); **Step 2: Investigate:** Students gather information about the problem, choose problem-solving methods, and design integrated artistic works: **Step 3: Act** Students collaboratively engage in hands-on testing and evaluate their works; **Step 4: Presentation:** Students present their problem-solving methods and integrated artistic works; **Step 5: Apply and Extend:** Application and extension of knowledge, where students apply what they have learned to different situations; and **Step 6: Self-assessment:** Students assess their own learning, review their work, and identify areas for improvement after each session.

Conclusion

The teachers in this study reflected a moderate level of problems in implementing STEAM education and CBL in kindergarten level. They also mention that the school lacks STEAM education lesson plans and kindergarten teachers are not yet ready for STEAM education. The teachers reflected a high level of needs in teaching with STEAM education and CBL. The teachers state that the kindergarten students should be ready prepared for learning with STEAM education. In addition, kindergarten teachers should raise an awareness of STEAM education and further develop skills in integrating local contexts with STEAM education.

The parents in this study perceived a low level of problems in teaching with STEAM education and CBL. They mention that teachers lack STEAM teaching skills and have not sufficiently utilized local contexts in teaching. Students have not yet developed sufficient awareness of local context conservation. Also, the parents reflected a high level of needs in teaching with STEAM education and CBL. They need their child to further develop problem-solving skills, creative thinking skills and awareness of local context conservation.

Early childhood teadhers can effectively utilize the L-STEAM model outlined in this study. Additionally, they have the option to employ the guidelines provided in this research to craft a new learning model tailored to their specific classroom and school settings. Successful integration of the L-STEAM model hinges on increased support from both school administrators and local communities. Administrators play a pivotal role in fostering an environment conducive to the implementation of the L-STEAM model, urging educators to adopt it and facilitating the exchange of insights acquired from real-world applications in kindergarten classrooms through Professional Learning Communities (PLCs). To further enhance the competence of teachers interested in implementing the L-STEAM model, comprehensive training is essential, encompassing a deep understanding, enhanced abilities, and heightened awareness of the model's effective implementation.

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