



Professional Development of Science and Mathematics Teachers through a Facilitative Coaching Process

Wirin Wansomsakul¹*, Sutthikan Tipayakesorn², and Peeraphat Gatephan³

¹Department of Science Education, Faculty of Education, Chiangmai University, Chaing Mai 50300, Thailand

²Department of Curriculum Teaching and Learning, Faculty of Education, Chiang Mai University, Chaing Mai 50300, Thailand

³Department of Mathematics, Faculty of Science, Naresuan University, Phitsanulok 65000, Thailand

Email: wirinvisory@gmail.com

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Abstract. This research aimed to clarify the Facilitative Coaching Process (FCP) in the workshop of teacher professional development. The FCP included the need for professional development of teachers, and teaching design of the FCP Science and Mathematics Teacher Professional Development Project. The subjects consist of the becoming a Facilitative Coach (FC) including 36 science and mathematics teachers who were working in the Chiang Mai Primary Educational Service Area Office 4 (CMPESAO 4), and 27 science and mathematics teachers who were working in science and math teachers under the Chiang Mai Primary Educational Service Area Office 1 (CMPESAO 1). The obtained information, then, was used as a database for teaching professional development training. This is one of the policies related to the promotion and development of teachers and educational personnel to provide quality learning management. The research method was carried during the workshop activities that were designed to examine utilizing worksheets on instructional design based on FCP principles and through observation and recording of participants' responses while engaging in the activities. The findings showed that this workshop's training approach assisted in preparing teachers to create lessons that would increase students' enthusiasm for learning and close the age gap between them and their students. Interestingly, the top three areas of professional knowledge that participants sought to develop the most were new information, innovative teaching techniques, and integrated teaching. The CMPESAO1 teachers concentrated on reinforcement strategies, whereas the CMPESAO4 teachers concentrated on using teaching aids.

Keywords: Professional Development of Science and Mathematics Teachers (PDSMT), Facilitative Coaching Process (FCP), Facilitative Coach (FC)

1. Introduction

Professional Development of Science and Mathematics Teachers (PDSMT)

Education in mathematics and science today is essential to the way of life. Mathematics was considered very important and useful subject in everyday life and playing an extremely important role in the development of human thought. Mathematics make human beings creative, think logically. It's a methodical system. It has a pattern that can analyze problems and situations carefully, making them possible to predict and plan to determine problem solving, and apply them in everyday life correctly and appropriately. In addition, mathematics is a tool for the study of science, technology, and other related sciences. Therefore, the Ministry of Education has designated mathematics as a course included in the curriculum from elementary to high school, both basic and additional subjects (Ministry of Education, 2009). As well as science, which plays a vital role in today and future global societies and involves everyone both in everyday life and careers. As well as the technologies, tools, appliances and productivity that human beings use to facilitate life and work. Combined with creativity and other sciences, science helps human beings develop ways of thinking, including rational thinking, creativity, critical thinking, criticism, and critical skills. Ability to solve problems systematically. Decision-making can be made by using a variety data and verifiable evidence. Science is the culture of the modern world, a knowledge-based society. Therefore, everyone needs to be developed to know science to understand nature and the technologies created by human beings. (Office of the Basic Education Commission, 2008). The last two decades since the world entered the 21st century. It's a time of rapid change and change in the world. The changes are the result of the drive of the 3 mainstreams consist of 1) globalization that fuses the whole world into one society and connecting the whole world, people can communicate or travel around the world in no time, 2) the big bang of technology has evolved by leaps and bounds and 3) the flow of capitalization where money is increasingly playing a role in the modern world globalization and financial technology have made money drives the world in virtually every way, along with the development of more digitized forms (Thanin et al., 2020). The context and environment, both inside and outside the country, are likely to change rapidly. It is highly dynamic and has a wide range of complex dimensions that will affect the future of the country's development. Therefore, the country needs a comprehensive development strategy in all dimensions and aspects, have knowledge, competencies, and skills that correspond to various changes, be able to be cognizant and adaptable to be able to live life. Especially, in a rapidly changing world where systems and supporting factors are needed along the way, both in terms of teaching and learning systems and developing skills which consistent with the development of people of different ages (National Strategy 20 years, 2018) This twisted and fast-paced change. As a result, social conditions. The politics and economy with which people are accustomed to changing, too. To cope with this volatile global trend, everyone is focused on education, which is the cornerstone of people's development. Therefore, education must be reviewed and adjusted to create learners with the necessary skills and competencies, able to adapt to a rapidly changing global society. It can be twisted, uncertain, complex and ambiguous, and ready for current and future changes. Hence learning in the 21st century, teachers as instructors, should focus on providing learner-centered instruction. At the same time, teachers themselves are important people in different roles. The role of the teachers in the current class must therefore consider the fundamentals of learners with a wide range of differences. In the context of a variety of different classrooms and the development of learners following the circumstances of living in the 21st century. This emphasizes that learners have the competencies they need to work. Problem-solving and livelihoods Build learners with the necessary skills and competencies, able to adapt to a rapidly changing global society (Rajuptook, 2020).

The PISA program asked students about the methods teachers used to teach science from these four methods 1) teacher-directed instruction, where the teacher explains scientific concepts and principles or uses demonstrations, 2) teacher-directed instruction, 3) teacher-directed instruction and 4) quest-based teaching. According to student reports, teachers use a combination of the four methods in their teaching, but some may be more common. Information from Thai students compared within the same school found teachers in all groups of schools use a higher direct teaching-leading approach than others. Thai students reported that teachers use this method the most. (Institute for the Promotion of Teaching Science and Technology, 2018)

Professional Development (PD)

The Office of the Basic Education Commission (2016:7) proposed teachers' professional standards and provided teachers with the appropriate abilities and teaching skills to improve learners' learning as well as being good role models in order to build students' confidence and trust. Therefore, professional development plays a paramount role in education reform and school reform. If the academy has been reformed, then courses and instruction will be developed. Teachers and administrators must also develop. (Ngsawat et al., 2009; Chakraborty, 2014; Cox, 2018) The professional teachers use activity-based teaching through science and arts. Teachers always play the role of parents or mentors (Srisamrithi, 2013; OECD, 2009; Bredeson, 2003). Teacher professional development is the process of continuous and systematic teacher development. It focuses on developing teachers in terms of knowledge, skills, and attributes for teachers to learn and develop performance from thinking, review work and innovate learning. Therefore, (Dictionary of Contemporary Education, 2015:399) says that teaching professional development is the development of educational institutions aimed at learning learners. As Khammani (2017:230) mentioned that the teacher component qualifications of teachers' self-development in teaching preparation and organizing learning activities is developing the learning process to achieve that goal. Teachers are the closest and most directly impactful individuals to learners' learning. Teachers with good teaching are often self-developed teachers. They always been developed to learn in different ways. Schools that want to succeed in developing the learning process need to focus on the teaching arrangements of their teachers and should help and facilitate teachers to prepare quality teaching.

Teacher professional development (PD) is a learning process that teachers should have on a continuous basis throughout the teaching career to be able to ensure that they have knowledge, competencies, and skills suitable for continuous classroom teaching practices, amid rapid changes in society, economy, and technology. Because effective teaching cannot happen by chance, in a short amount of time, it takes new boarding teaching years to acquire the skills and knowledge. They need. the ability to practice teaching effectively or even experienced teachers. Teaching may be problems caused by many factors such as changes in the curriculum, increasing or decreasing content, and advancement of technology or even the cause of individual learners if teachers do not receive effective professional development. It will result in the students lacking the opportunity to learn and Self-Development (Rakwijitkul, 2017). Teacher development needs of modern teachers under the strategy of education reform, an important indicator of development is competencies as a base for professional work in teacher professional development, there are basic competencies that are essential for performance, especially student-centered learning. A study was conducted by Queensland University of Technology, Australia (2002) found important issues that Thai teachers want to develop in a competency-based way. There are seven areas of the profession: a new form of knowledge, a new type of teaching strategy, measurement and evaluation, integrated teaching, information

technology competencies, monitoring and support systems, and operational research (Pahe, 2010)

Desimone (2023) mentioned that rethinking teacher PD must focus on how to improve student learning. The field of professional development has evolved considerably over the past several decades. An abbreviated recent history might highlight the 1970s-1990s, when the much maligned ‘one-shot’ workshop ruled the day. During this time period, the predominant means for evaluating professional development consisted mainly of post-workshop surveys that gauged how much teachers enjoyed the experience. Grounded in previous correlational and case study research, and using national data from the U.S., the field coalesced on five key features necessary for effective professional development – a focus on content or how students learn content, opportunities for active learning, participating collectively with other teachers, ensuring coherence with school and organizational-level mandates and teacher beliefs, and learning activities of sufficient duration to allow practice and feedback. Did teachers think the novel approach had potential to help their students learn? Each of these factors – principal support, individualization and teacher buy-in – was found to play a critical role in the uptake of ideas and practices targeted in PD. Perhaps the most important idea generated from the review and reflection on rigorous causal studies in PD is that we need to distinguish between our ability to change what teachers know and do (does PD work to support productive teacher change?) from the ability of those new practices to improve student learning (If teachers change in the ways supported by the PD, will student learning grow?) The work published in *Professional Development in Education*, as well as many other international education journals, has shown that we absolutely know how to change what teachers know and do. Unequivocally. We know how to do it virtually, and we know how to do it in person. We can do it with coaches, or with collaborative teams. We can do it with system (e.g., district) level PD, and we can do it with school-level PD. We can do it in math, and we can do it in science, literacy, and technology. We know what it takes. A focus on content or how students learn content. Provision of active learning opportunities, so teachers can analyze, ask questions, share experiences, get feedback – practice. Ensuring coherence with district and school mandates, curriculum, beliefs. Providing sufficient time for teachers to engage with their learning, and to try it out in their classrooms and integrate it into their instructional routines. Providing coaches or instructional leaders who are experienced and have relevant content-area expertise and know how to calibrate learning to the teachers’ needs. Supporting teachers in adapting the new ideas and practices. As we continue on our journey to understand more about professional development – for example, in this issue, unpacking its complexity, identifying the role of leadership, mentoring and coaching, the evolution of teacher needs over time, the interaction of beliefs and behavior’s, the role of dialogue, team-based approaches, morality, mindfulness, context, relevance and efficacy – I urge us all to keep in mind the ‘what’ of professional development-what are we seeking to get teachers to believe, know, and do, and to what extent do we have evidence that will bolster student understanding and learning? I hope the next generation of professional development studies will be grounded in a conception that acknowledges that we are not just studying if and how we get teachers to change – we are studying whether those changes matter for student learning.

According to Thailand National Strategy 20 years (2018: 34, 37) The development of a learning system that responds to changes in the 21st century involves designing a new learning system. by rebranding the role 'Teacher' as a new generation teacher by adjusting the role from "teacher" to "coach" or "facilitator" acting to motivate inspire, introducing how to learn and how to organize, building knowledge to design activities and create learning innovations for students, and researcher development to learning process for student achievement Including adjusting the production and development system of

teachers starting from attracting, selecting high-caliber people to become quality teachers. There is a continuous development system for teachers' potential and competency. This is therefore a guideline that the researcher considers as the main principle in carrying out. The project of professional development of science and mathematics teachers through a facilitative coaching process.

Approaches to Coaching

Instructional coaches implementing the impact cycle take a dialogical approach to coaching. As the table below illustrates, the dialogical approach represents one of the three most common approaches to coaching, the other being facilitative and directive coaching. Each approach has its unique strengths and weaknesses, and I have summarized each. (Jim Knight, 2021)

Table 1 Three Models for Approaching Coaching

Facilitative	Dialogical	Directive
Coach does not share expertise	Coach share expertise dialogically when appropriate	Coach's expertise is the focus of the coaching session
Teacher does most of the thinking	Coach and teacher think together	Coach does most the thinking
Teacher- focused goal	Strategy- focused goal	Student- focused goal

Facilitative Coaching

Facilitative coaches, like dialogical coaches, see collaborating teachers as equals who make most if not all decisions during coaching. As Sir John Whitmore (2002) has written in his influential book *Coaching for Performance: GROWing People, Performance, and Purpose*, "the relationship between the coach and coachees must be one of partnership in the endeavor, or trust, of safety and of minimal pressure" Facilitative coaches encourage coachees to share their ideas openly by listening with empathy, paraphrasing, and asking powerful questions. Additionally, facilitative coaches do not share their expertise or suggestions with respect to what a teacher can do to get better. They keep their ideas and knowledge to themselves because they assume that:

- Coachees already have the knowledge they need to improve, so a coach's role is to help them unpack what they already know.
- Coaches who share their expertise with coachees could inhibit progress by keeping coachees from coming up with their own solutions.

Facilitative coaching can be used in all kinds of situations, so it has the potential to address issues that dialogical and directive coaching are not able to address. For example, facilitative coaching could be used to help a teacher get along with a difficult team member, a principal lead culture change in her school, or a student use his time more effectively. In the classroom, facilitative coaching works best when the teachers being coached already have the knowledge they need to improve. However, it is less effective when teachers do not have the knowledge they need to address issues in the classroom. A teacher who is struggling to create a learner-friendly classroom culture and who has not learned effective strategies for classroom management will likely need an instructional coach to help him master teaching behavioral expectations, reinforcing appropriate behavior, and correcting inappropriate behavior. Facilitative coaching, because it asks coaches not to share their expertise, is not an appropriate vehicle for schools or districts intending to use coaching to share instructional practices.

Directive coaching

In many ways, directive coaching is the opposite of facilitative coaching. The directive coach's goal is to help coachees master some skill or set of skills. The directive coach/coachee relationship is like a master/apprenticeship relationship. The directive coach has special knowledge, and his job is to transfer that knowledge to the coachee. The relationship between the directive coach and teacher is respectful, but not equal. In contrast to facilitative coaches who set their expertise aside, the directive coach's expertise is at the heart of this coaching approach. The job of the directive coach is to make sure teachers learn the correct way to do something, so directive coaches tell teachers what to do, model practices, observe teachers, and provide constructive feedback to teachers until they can implement the new practice with fidelity. Directive coaches work from the assumption that the teachers they are coaching do not know how to use the practices they are learning, which is why they are being coached. Secondly, they also assume that teaching strategies should be implemented with fidelity, which is to say in the same way in each classroom. The goal of the directive coach is to ensure fidelity to a proven model, not adaptation of the model to the unique needs of children or strengths of a teacher. The best directive coaches are excellent communicators, who listen to their coachees, confirm understanding with effective questions, and sensitively read their coachee's understanding or lack of understanding. They need to especially be effective at explaining, modeling, and providing constructive feedback. When teachers are committed to learning a teaching strategy or program, directive coaching can be effective. However, directive coaching, deprofessionalizes teaching by minimizing teacher expertise and autonomy and therefore frequently engenders resistance. Teachers mentioned that they had to do something a certain way treats teachers more like laborers than professionals, and it often leads to resistance more than change.

The directive approach to coaching also often fails because it over simplifies the rich, complex world of the classroom. The unique, young human beings who attend our schools are too complex for one-size fits all approaches to learning. What teachers and students need are an approach to coaching that combines the facilitative coach's respect for the professionalism of teachers with the directive coach's ability to identify and describe effective strategies that can help teachers move forward. That approach is the dialogical approach.

Dialogical coaching

The facilitative coach focuses on inquiry, using questions, listening, and conversational moves to help a teacher become aware of answers he already has inside himself. The directive coach focuses on advocacy, using expertise, clear explanations, modeling, and constructive feedback to teach a teacher how to use a new teaching strategy or program with fidelity. The dialogical coach balances advocacy with inquiry. Like a facilitative coach, a dialogical coach embraces inquiry, asking questions that empower a collaborating teacher to identify goals, strategies, and adaptations that will have an unmistakable impact on students' achievement and wellbeing. Dialogical coaches ask powerful questions, listen, and think with teachers, and collaborate with them to set powerful goals that will have a powerful impact on student's lives. They employ a coaching cycle, like The Impact Cycle, that is driven by back-and-forth conversations about the current reality and a teacher's desired reality in the classroom. Like a facilitative coach, a dialogical coach embraces inquiry, asking questions that empower a collaborating teacher to identify goals, strategies, and adaptations that will have an unmistakable impact on students' achievement and wellbeing. Dialogical coaches ask powerful questions, listen, and think with teachers, and collaborate with them to set powerful goals that will have a powerful impact on student's classroom.

Dialogical coaches do not give advice; they share possible strategies with teachers and let teachers decide if which strategy they will use to try to meet their goals. Dialogical coaches partner with teachers to identify goals and teaching strategies, and then describe strategies precisely, while also asking teachers how they want to modify the strategies to better meet students' needs. Then they help the teachers implement the strategies and gather data on whether they lead to students hitting their goals. Dialogical coaches don't keep their ideas to themselves, but they realize that sometimes strategies have to be modified to meet student's needs and to align with teachers' strengths. They also understand that student-focused goals that matter to teachers are essential for effective coaching. During dialogical coaching, the standard for excellent implementation—in contrast to directive coaching—is not the coach's opinion but the goal itself. If a teacher implements a strategy in a way that is radically different from how it was designed to be used, the coach doesn't take a top-down approach and tell the teacher how to teach the strategy with fidelity. The coach simply says, "Let's see if we can hit the goal." If the goal isn't reached, then the teacher and coach can go back to the description and consider whether or not the strategy should be taught with greater fidelity.

Facilitative and directive coaching both involve conversation, but they do not involve dialogue. A dialogue is a meeting of the minds, two or more people sharing ideas with each other. It is not a dialogue if I withhold my ideas, and it is not a dialogue when I tell you what you should do. It is a dialogue when I share my ideas in a way that makes it very easy for others to share their ideas. A dialogue is thinking with someone (Jarusombat, 2018). It is believed that both the facilitator style and coaching style roles share key skills. Especially building relationships, listening, asking and facilitate learning so that people or groups of people can find the answers themselves, so Courage to Coach calls their own coaching and facilitating process Facilitative Coaching.

Facilitative coaches encourage coaches to share their ideas openly by listening with empathy, paraphrasing, and asking powerful questions. Additionally, facilitative coaches do share their expertise or suggestions concerning what a teacher can do to get better.

Inner world factors that drive external behavior inner potential, real elements, or being the principles of Personality and Human Relations International (PRH), were born in the 1970s based on the research of Luo Wong Father Andre Rochais to make sure everyone understands what they want to know, such as being perceived as "Who am I", to discover the potential for growth in individuals and to become fully who we are. The "true element" (Being) is the foundation upon which we are all, from the source of personality to the foundation of aptitude and abilities to the center of individual goodness. True elements, like the seeds of plants in us. It's been with us since birth. As we get older, these seeds sprout and grow at the same time, and growth depends largely on their upbringing and environment. Discovering one's self, inner potential, or being, is like finding the best qualities in us. It gives us the capacity, talent, ability, and inspiration to accomplish many things according to the mission we were born human beings. When we see treasures or resources within ourselves, it increases self-understanding. Discover the potential in yourself, that there is so much and enough to live and work, such as being responsible, committed, compassionate, and sharing, etc. (Jarusombat, 2018; Knight, 2021).

Facilitative Coaching Process

Jarusombat (2018) said that "I live my life through Jimi the Coach Group and Courage to Coach, they crystallized their thinking and lifestyle skills and a tool for happiness and success called the Facilitative Coaching Process," Group Coaching and Team Coaching Process (6C MODEL) as see in the Figure 1

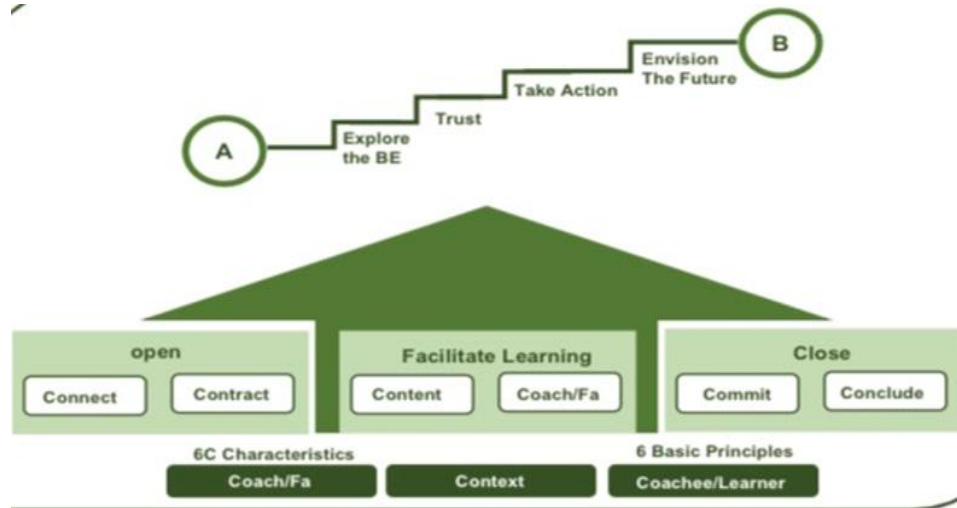


Figure 1: 6C Model (Jarusombat, 2018)

Table 2 Coaching individuals in a group setting or coaching team process.

Phase	Parts	Steps
Open	The Open is the beginning of group coaching and team coaching, creating a dignified and safe space for learning, talking, growing, and changing for group members. There are different styles. Have different learning intentions. There are different souls.	Connect
		Contract
Facilitate Learning	Coaching individuals in a group setting or coaching team Learning Sessions This step is at the heart of coaching a team that will spend as much time together as possible. This is when coaches invite important topics to start talking about and open up spaces for group members to exchange ideas. Opinions, hands-on experiences, shares, concerns. Jammed barriers Get coached and come up with some discoveries called Insights.	Content
		Coaching individuals in a group setting or coaching a team
Close	Closed range This is a period of encouragement to act. Group coaching and team coaching are like individual coaching that emphasizes responsibility. A sense of belonging, and commitment. Act on your findings, new choices, new activities, and specific activities to create positive change and growth in different areas of life.	Commit
		Conclude

Based on the experiences in the work of coaches and literatures (Capello, 2017 cited in Jarusombat, 2018), the executive coaching and ICE core competencies could be categorized into 4 topics and 11 core competencies. Four topics included setting the foundation, co-creating the relationship, communicating effectively, and facilitating learning and results. The topic of setting the foundation consists of 2 core competencies including 1) meeting ethical guidelines and professional standards, and 2) establishing the coaching agreement. The topic of co-creating the relationship consists of 2 core competencies including 1) establishing trust and intimacy with the client, and 2) coaching presence. The topic of communicating effectively consists of 3 core competencies including 1) active listening, 2) powerful questioning, and 3) direct communication. The topic of facilitating learning and results consist of 4 core competencies including creating awareness, 2) designing actions, 3) planning and goal setting, and 4) managing progress and accountability.

Six Essential Skills of an Effective Facilitator.

Chander (2014) mentioned that facilitator's responsibility is to make a process easier or facilitate a process through adequate planning. A facilitator acts like a guide to help people move through a process. They guide the participants towards an exploratory journey of learning by helping them to delve into their inner self to realize their strengths and weaknesses, helping them to share their experiences and learning from the experiences of others.

Facilitators achieve this by helping the group to analyze what they wish to accomplish. Good facilitators understand their group and adopt a customized approach while working in the group. They plan, manage, and guide a group event effectively ensuring that objectives are met. A good facilitator keeps away from the real content and maintains a neutral stance.

The question is what does it take to be an effective facilitator? What are the competencies you need to build in order to effectively drive a group towards their objective?

Six competencies given below are the ones. Of-course there are many more. In fact, every facilitator has a unique style that corresponds to a unique competency.



Figure 2: Six Essential Skills of an Effective Facilitator (Chander, 2014).

Communication Skills

A good facilitator encourages open communication. He ensures inclusion whereby each member can participate and scans nonverbal cues through behavioral observations of

the group. He ensures conclusion at the end of meetings and paraphrases for clarification. He also ensures that the group is focused and not deviating from the topic.

Active Listening

Comprehension of the message that the speaker is conveying requires active listening. Statistics reveal that most of us listen to just 25-50% of what we hear and forget almost 46% of what we have heard. The totality of the message being conveyed should not get lost and so effective listening is extremely important. There might be some natural barriers to listening like noises and other barriers could be talking more and listening less, boredom, being engrossed in personal issues, preconceived ideas and assumptions. A facilitator should develop the skill of active listening. They should maintain a body language that makes the group feel assured about his physical presence by facing them squarely, making eye contact, nodding, keeping an open posture and so on. He also should be able to attend to the speaker at a psychological level by understanding what is not being conveyed explicitly and he should be able to pick up from nonverbal cues. Paraphrasing and repeating back what was said and asking questions reflects that he is actively listening.

Rapport Building

A facilitator should be able to connect with the group. Trust and empathy are essential for building a relationship with the group. Building a relationship with a new group requires finding some common goals and interests, shared values and outlook.

Structuring and recording facts and feelings

A facilitator should be able to record precisely the information gathered during the course of the discussion. He can do it himself or assign a note gatherer for it. He could do it using a flip chart for this purpose. Noting key words and accuracy is extremely important.

Developing Synergy

Teamwork is an essential in any workshop or session. A skilled facilitator knows how to bring the participants together based on shared interests and goals. The facilitators should facilitate synergy in the group by removing distractions, by making them sit face to face, in arena type arrangement for open discussions. He should encourage sharing of views, respecting each other's views, reaching consensus and through brainstorming sessions.

Effective Techniques of Questioning

The purpose of questioning is to seek clarification and to check for comprehension. Facilitators ask questions primarily to probe the understanding of the participants and to help them in critical thinking and for evaluating information. Socratic questioning method is a very effective questioning method whereby one just does not raise questions but finds out the answers himself. It helps in developing critical thinking skills. Facilitators often use this technique to unravel the basic issues, identify the problem areas, and develop accuracy, increase creativity and logical thinking. Facilitators should possess good probing skills through open ended and closed ended questions. The manner of questioning in terms of timing and accurate delivery is extremely important. The APPLE technique is often applied. The acronym for APPLE is the following:

A: Asking the question.

P: Pausing for allowing participants to comprehend the question and think of an answer.

P: Picking a member to provide the answer

L: Listening to the answer.

E: Elaborating on the answers obtained

Apart from the above-mentioned skills, a good facilitator should be receptive and should be able to develop new skills as and when required depending on the participating group and should be open to ideas.

Thanetpongtham (2014) talked about acting as a good facilitator, i.e., stimulating the learning process in small groups to create learning. Help the chairman direct group activities. Encourage learners to bring their prior knowledge up for discussion. Encourage groups to set learning objectives that align with the lesson. Assess the skills of the learners and the group process. Giving feedback to learners. A facilitator is a practice in which the learning process takes place in the company. Control of activities the planning of the study was planned. A medium to exchange the knowledge of the people in the company and to share it with the members of the company

Based on the statements mentioned above. The investigators were assigned under NEDA Order No. 271/2018 from the Office of the Basic Education Commission to carry out cognitive building on facilitative coaching to enable teachers to use their knowledge to design learning activities to develop learners to be ready for assessment of students at all levels. Inservice Group Monitor and evaluate the educational activities of the CMPESAO1, therefore, provides a workforce development program to enhance learner quality to student readiness for student evaluation. Mathematics and Science Facilitative Coach to teachers affiliated with CMPESAO1 and according to official letter no. 04050/3214, courtesy of the investigator to be a lecturer in a workshop for teachers affiliated with the CMPESAO4 In the study of the process. Workshops, facilitative coaching processes, and professional development needs of teachers attending workshops, math, and science teacher development projects to become facilitative coaches within the district of responsibility of the CMPESAO1 and CMPESAO4 to provide the results of the study to the school district office. To continue to train teachers for professional development.

2. Research Objectives

1. To study the facilitative coaching process.
2. To study qualitative data to develop assumptions for designing the workshop about enhancing mathematics and science teachers to become facilitative coaches.

3. Methodology

To examine PDSMT, a mixed-methods research approach was employed (Creswell & Clark, 2017). The mixed methods approach was considered appropriate because qualitative data can be used as a supportive set of data to illustrate the quantitative results.

A mixed research study on PDSMT with the FCP. The researcher has divided the research process into 2 steps as follows.

Step 1 A study of procedures and processes in the workshop. The project is to develop mathematics and science teachers to be Facilitative Coach (FC) by using data recording of various activities during the workshop

Step 2: A study of the preparation and application of knowledge of teachers attending the workshop. Mathematics and science teacher development project to become a facilitator and the needs of teachers who attended the training on the needs of professional development in 7 areas using a questionnaire, and a study of instructional design for being a facilitator by using a classroom instructional design exercise based on 6C principles

Subjects

The subjects consist of the 27 CMPESAO 1 and 36 CMPESAO 4 science and mathematics teachers. These subjects were obtained by voluntary sampling.

Research Tools

Research tools included questionnaires for FCP and FC. The questionnaire for Teacher Development Program for Mathematics and Science in the FCP of the CMPESAO1 and CMPESAO4 included 3 parts. These included 1) general information of the training

recipients, 2) preparing for training by 3 sets of shares assembled to prepare for training, 3) teachers' preferences for professional development in 7 issues and the design of classroom instruction based on the FCP (6C Model)

The tools for Teacher Development Program for Mathematics and Science in the FC program of the CMPESAO1 and CMPESAO4 included participant observation and informal interview that could be carried out during the workshop.

Data analysis

The mixed methods approach was considered appropriate because qualitative data can be used as a supportive set of data to illustrate the quantitative results. The researcher analyzed the data by collecting the records and draw conclusions about the same and the difference between CMPESAO1 and CMPESAO4 teachers were gathered to achieve the objectives of the study.

1. To take the questionnaire about teacher participation in the workshop.

2. The questionnaire on teacher needs for professional development of teachers participating in the workshop was taken. Mathematics and Science Teacher Development Project for FC check the score. The score was given according to the A rubric with a rating scale was used by (Sri Sa-at. 1989: 103) as follows:

Table 3 Rating Scale

Rating	Equivalent
5	most agree
4	very agree
3	moderately agree
2	less agree
1	least agree

3. To bring a questionnaire about promotion support the teaching of attending workshops. The project mathematics and science teacher development for FC to collect results and summarize the differences between of teachers under CMPESAO1 and CMPESAO4 (Content Analysis).

4. To take the questionnaire about participation in the project and the questionnaire about the needs of teacher professional development of attending workshops. The project mathematics and science teacher development for FC and analyzing the mean by setting 5 levels to interpret the criteria as follows:

Table 4 Rating Scale

Rating	Equivalent
4.21-5.00	Excellent
3.41-4.20	Very Good
2.61-3.40	Good
2.61-3.40	Fair
1.00-1.80	Poor

4. Research and Discussion

A study of professional development of science teachers and mathematics this time. The researcher was conducted by regular science and mathematics teachers who had attended the workshop. Developing mathematics and science teachers to be FC by taking notes during the event. The questionnaires use on classroom problems to support learning in the classroom, and teachers need to develop their professions in various fields. The results of operations are as follows:

4.1 Part 1 Results of the FCP study

The organizing workshops of FCP showed teachers' competencies in teacher development projects and mathematics and science in FC. These could be viewed as the Table 4.

Table 4 Displays the recording of the teacher's activities during the inquiry.

Activity	CMPEAO 1	CMPEAO 4	Comparison(6C)
Check-in Teacher's preferences Regular Science and Mathematics Training	Techniques, teaching methods, and other opportunities to be used for classroom instruction, how to inspire students to learn important activities. Applying the surroundings to the classroom and exchanging technical techniques with other teachers.	Apply what you receive from your training to your own teaching. It can be more appealing to students. Reduce the age gap between students and teachers to adapt to changes in the dynamics that occur and to adjust the attitudes of children studying both science subjects and mathematics.	Connect /Contract When the school was born. Requirements for Learn by force. Inspiration or adjustment Attitudes of students Contents
Self-knowledge activities using being	Teachers will apply, namely, applying Being to work in groups by dividing duties according to being to be compatible and most suitable for children. The use of being born in children and children. Students find their own beings with their teachers, supplements, and support and use of activities in subjects Guidance to observe children's behavior and use reinforcement techniques with being.	It is to look at schoolchildren from a more individualized perspective and use individual reinforcement methods. Being's an approach to career development, leading students to find potential and passion, and to adjust the attitudes of teachers who have the ability to appreciate Being.	Content being used by students, for students Harness your potential Come out as much as possible to explore the subject of classes and guidelines in Development to bring to the table Career
Sound activity in the head	Thinking back to yourself whether you're a good listener or not, and after this listen to students more and give advice on solving problems, not acting approach to problem solving for students.	Teachers do not receive enough information and guidance from schoolchildren, including guiding the methods of communication rather than receiving enough information from schoolchildren, considering the reasons.	Conversations Adaptation of teachers to Good stuntman Get a baby More students

Table 4 (Cont')

Activity	CMPEAO 1	CMPEAO 4	Comparison(6C)
Check Out Events	Teachers received from coming to this workshop is learning to live together with other teachers in the school and reflecting on themselves come out to understand more, able to access feelings, and the needs of children more techniques for making classroom activities more interesting and look at students in a more positive light.	The teachers received from this workshop to be more open and listen to students, how to bring interesting lessons changing attitudes toward students thus reducing the age gap between teachers and students were changing perspectives to better understand what the students want to express.	Commit/Conclude Teachers gain a greater understanding of student identity and adaptation. Perspectives on students and methods for organizing classroom activities to be more suitable and interesting

According to Table 4, it showed what the science and mathematics teachers of the CMPEAO1 and CMPEAO4 want to learn from the same workshop is to apply the knowledge from this workshop to the amount for teaching in one's own classrooms and to use it for teaching in one's own classes. Inspiring and optimistic perspectives between students and their studies in science and math courses. What teachers are doing in science and math at CMPEAO1 and CMPEAO4 The same applies to the concept of being to the student by using the student's findings. Being blessed with support by using reinforcement techniques to guide future careers that teachers do not accept. It's only good to know what schoolchildren are doing to the media and to propose guidelines for solving problems rather than helping students find ways to curb principles and reasons. Getting more exposure to the students and what students are doing is important. Changing students' perspectives, ideas, and attitudes, and how activities and lessons are organized, is more interesting and engaging.

Quantitative information about the project

Table 5 Promotion data display table Support the classroom teaching of the participants of the workshop.

List of inquiries	CMPEAO1		CMPEAO4	
	Rating	Description	Rating	Description
1. See the importance of this project.	4.14	Very good	4.15	Very good
2. Be prepared to receive training.	4.14	Very good	4.15	Very good
3. Meeting the students from the classroom	3.29	Good	3.26	Good
4. Expectation to receive the guidelines of solving problem from the training	4.11	Very good	4.33	Excellent
5. Become more self-conscious.	4.18	Very good	4.03	Very good
6. In term of teaching condition, there is greater distress.	4.21	Very good	4.05	Very good
7. There is more frustration from schools	4.29	Excellent	4.00	Very good
8. Receive guidance on how to improve classroom management	4.43	Excellent	4.26	Excellent
9. Learn additional teaching skills from this training.	4.39	Excellent	4.26	Excellent

Table 5 (Cont')

List of inquiries	CMPESAO1		CMPESAO4	
	Rating	Description	Rating	Description
10. Have a more positive attitude toward teaching.	4.21	Very good	4.13	Very good
11. Have a more positive attitude toward students	4.32	Excellent	4.23	Excellent
12. There is satisfaction with this training.	4.14	Very good	4.05	Very good
13. The training will be used in the teaching process.	4.21	Very good	4.10	Very good
14. Training foster me to improve this manner.	4.14	Very good	4.15	Very good
15. You feel that the training provides you worthiness.	3.29	Good	3.26	Good

Table 5 showed that techniques was used to promote supporting learning that teachers under the CMPESAO1 use the most of reinforcement techniques and techniques used to promote supporting learning that teachers under the CMPESAO4 use the most are creation of media used in teaching.

Qualitative data on supplementary methods to support classroom instruction (Content Analysis)

Table 6: Frequency of CMPESAO 1 and CMPESAO 4 used teaching methods or techniques to support classroom instruction

information	CMPESAO1 Frequency (Person)	CMPESAO4 Frequency (Person)
1. Use of reinforcement techniques	4	3
2. Studying based on individual interests	3	3
3. Complementary science experiments	2	-
4. Use of technology and internet access in information processing	2	-
5. Buddy's ditch-catching the rest of the way.	1	-
6. Project enhancement	1	-
7. Teaching materials	1	4
8. Individual analysis	-	2
9. Conceptualization	-	2
10. Arrange the angle of the hole.	-	1
11. Integration of content with school grounds	-	1
12. On-site education	-	1
13. Story Analysis	-	1
total	14	18

Table 6 showed how frequency of teachers' techniques used to promote supporting learning. It found that most of CMPESAO1 teachers under used the reinforcement techniques and techniques to promote supporting learning. However, most of the CMPESAO 4 teachers used the creation of media in teaching.

4.2 Part 2: the development of mathematics and science teachers to be FC

The effect of qualitative and quantitative data for preparing, the project for the development of mathematics and science teachers to be FC by using data from questionnaires for the workshop.

Qualitative information on the needs of teachers' professional development

Table 7: the details of professional development requirements.

Issues of PD requirements	CMPESAO 1		CMPESAO 2	
	Mean	Level	Mean	Level
1. Need for new knowledge.	4.32	Excellent	4.05	Very good
2. Need for new teaching strategies.	4.11	Very good	4.05	Very good
3. Measurement and evaluation	3.71	Very good	3.77	Very good
4. Integrated teaching	4.07	Very good	3.87	Very good
5. Information technology competencies	3.93	Very good	3.82	Very good
6. In the in-service system, follow up on the remaining information.	3.93	Very good	3.82	Very good
7. Organizing research	3.93	Very good	3.72	Very good

According to the table 7, it indicated that the top 3 most common are the same: in the form of new teaching strategies and integrated teaching strategies, which are the same as the two most common, and the most common things of CMPESAO1 are measurement and evaluation, and of CMPESAO 4 is the organizing research.

4.3 Part 3: Developing assumptions for designing the workshop about enhancing mathematics and science teachers to become facilitative coaches

This section will clarify some information that could be generated in order to develop assumptions for designing the workshop about enhancing mathematics and science teachers to become facilitative coaches. The CMPESAO1 teachers listed some issues about teaching and learning. The frequency of the issues may suggest the ideas of designing the workshop. The table 8 showed what 11 science and 10 mathematics CMPESAO 1 gave the information. According to table 8, it showed a link to what math and science teachers have led FCP. The top 3 most common and accurate teaching methods are to add Q&A, workshops, and presentations to classroom activities.

Table 8: the frequency of FCP used in teaching design.

Information	Number of Science teachers	\bar{X}	Number of math teachers	\bar{X}	Number of all teachers	\bar{X}
Q&A	5	45.45	4	40	9	42.86
Doing the work	5	45.45	5	50	10	47.62
Presentation of skepticism	5	45.45	4	40	9	42.56
Discussion	4	36.36	3	30	7	35
Surveying	4	36.36	2	20	6	28.57
Critique	1	9.09	-	-	1	4.76
Exchange of opinions	2	18.18	1	10	3	14.29
Analysis	2	18.18	-	-	2	9.52
Connection to everyday life	-	-	1	10	1	4.76

5. Conclusion

It could be viewed that facilitative coaching process workshop has implication for science and mathematics teacher development in term of becoming facilitative coach. The study clarified teacher development that teachers could gain their knowledge from the workshop. There are a lot of difference and complexity in the professional development of both CMPESAO1 and CMPESAO4, the largest 3 issues are same true in the form of a new verticality. New teaching strategies and integrated teaching practices and the differentiation of complementary methods. Support the classroom teaching of teachers affiliated with the CMPESAO1 is the use of reinforcement techniques for teachers affiliated with the CMPESAO4 is the use of teaching materials. Teachers can behave following the guidelines of the facilitator as a facilitative coach. The teachers, who become facilitative coach, considered with children's learning and hands on practice, reinforcement techniques, what and how to do for improving students, pedagogical designing, psychology for children, and strategies for student motivation. The literatures also suggested these issues for enhancing teachers becoming facilitative coach (Boonploy, 2009; Jaff and Scott, 1988; Queensland University of Technology, 2002).

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