

Teachers and Participatory Action Research for Developing Learning Environments

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Abstract

This research aims to develop learning environments through *Participatory Action Research (PAR)* methodology in a specific context of the Department of Electronics, Nong Han Industrial and Community Education College. Three development outcomes are expected: (1) changes in expected and non-expected outcomes of action; (2) action-based learning in the researchers, research participants and the institute and (3) knowledge from the grounded theory. The results are as the followings: 1) there are positive changes in both expected and unanticipated outcomes consisting of the implementation of the co-designated development approaches and the nature of the expected learning environments, 2) the researchers, research participants, and the institute learn about the efficiency of working together, which makes everyone realize how inefficient working alone was in the past, and 3) a body of knowledge gained from practice describes the relationship between the expected changes, and the driving force and resistances to change as well as ways to overcome the resistances.

Keywords: learning environment, industrial and community education college, participatory action research, action-based learning, knowledge from action

1. Introduction

Thai education management strives to establish a quality and efficient education management system and process under the National Education Plan 2017-2036 to develop Thai people into excellent citizens with qualities, abilities, and competencies congruent with the Kingdom of Thailand Constitution. Moreover, the principles of vocational education management as the management of professional education mean to produce and develop workforce at skill level (vocational certificate), technical level (high vocational certificate), and technology level (bachelor of technology). The management strategy consists of the philosophy of vocational education, the national vocational education qualifications framework, and each level's standards. The values of vocational education management have four main goals: *Merit, Quality, Collaboration, and Professionalism*. The education management aims to produce and develop learners and qualified graduates covering three following aspects. The first aspect is *the desirable characteristics*, namely morality, ethics, professional ethics, behaviour, character and intellectual skills. The second aspect is *the core and general competencies* that consists of knowledge, communication and information technology skills, learning development, performance, working with others, scientific processes, application skills, and work development. Lastly, *the professional competence*, including the ability to apply knowledge and skills in the professional field into practice and use in the profession (Office of the Vocational Education Commission, 2017).

To achieve the goal of education management, the teachers need to be knowledgeable in the learning environment that improves student learning. Studies indicate that students reach a higher level of achievement when teachers manage effective learning environments. Therefore, teachers must understand how to operate the learning environment in modern society to improve their professional abilities and their students' achievement (Solheim, n.d.).

The traditional learning environment where students sit in rows of tables while the teacher stands in front of a room with a blackboard or whiteboard has become obsolete. A specific design environment should replace the old-school classroom (Verma, 2019). Several studies indicate that a well-designed and managed learning environment have a

positive impact making students be more open and want to involve in learning if the learning environment is properly operated (Rylands, 2016).

According to Cox (2019), Sieberer-Nagler (2016), Western Governors University (2021), and Movchan (2018) the definition of a learning environment is surrounding things that directly and indirectly affect human learning. There are two types of environments: 1) *Physical Environment* or man-made conditions and things that are naturally occurring and affect people's learning consisting consist of (1) the classroom environment such as desks, chairs, materials, equipment or media within the classroom (2) the environment outside the classroom, such as light, color, sound, and various buildings within the educational institution; 2) *Psychological Environment* or teaching and learning activities inside and outside the classroom that encourages learners to learn and ultimately develop themselves in every aspect, consisting of (1) characteristics of teachers or behaviors expressed by teachers to students; (2) teaching and learning processes inside and outside the classroom; and (3) relationships between teachers, parents and the community.

According to Dancker (n.d.), Kelly (2019), Life Skills Group (2020), Loveless (n.d.), Milrad (1999), Movchan (2018), Patterson (2016), and Stoller (2016), we can synthesize 37 approaches for teachers in developing a learning environment for modern society or education for the 21st century as follow.

1. Improve collaboration and increase student engagement
2. Enable quick shifts in focus and attention
3. Learning improves
4. Assess students' understanding before and after presenting a lesson
5. Provide hands-on practice opportunities
6. Get students involved in the process
7. Establish a supportive learning culture
8. Value of the teacher
9. Capture student interest by activating prior knowledge
10. Promote self-efficacy for teachers and students
11. Make it feel like home
12. Let them collaborate
13. Make it relatable
14. Spin the class seats: they can rotate from left to right or another way round
15. Stand: make them change their learning posture from sitting to standing
16. Charge: provide ready-to-use technology equipment. Everyone can access a charging point.
17. Move: allow different patterns for seating arrangement.
18. Rock: provide rocking chairs or armchairs for relaxing.
19. Share: provide and share information through the internet and communication technology
20. Keep it Green: use digital technology and online communication to promote paperless activities.
21. Lounge: use simple teaching technics to make a relaxing classroom.
22. Address Learners' Needs
23. Keep it Positive
24. Safety
25. Employ interactive games and activities
26. Allow student choices
27. Bring music into your classroom
28. Provide beneficial feedback
29. Share some stories from the summer
30. Get to know each student

31. Plan for the future, live in the moment
32. Create a classroom newsletter
33. Be enthusiastic
34. Treat each student as if they were your own child
35. Review the basics
36. Use online social media to connect teachers, parents, and the community
37. Establish positive parent relationships

All in all, the researchers aim to develop learning environments using Participatory Action Research (PAR) in the Department of Electronics, Nong Han Industrial and Community Education College, under the Office of Vocational Education Commission Ministry of Education, located in Nong Han Sub-district, Nong Han District, Udon Thani Province, Thailand. This research methodology focuses on collaborations and democratization in the actions and consequences that cause change, learning, and knowledge from the action. It consists of bottom-up, collaboration, and equally planning, acting, observing, and reflecting in a spiral cycle manner that operates endless moves. In addition, it focuses on the expected change in sustainable development supported by the commitments from participation at all stages (Sanrattana, 2018).

2. Objectives

This research aims to develop learning environments through Participatory Action Research (PAR) methodology in a specific context of the Department of Electronics, Nong Han Industrial and Community Education College. Three development outcomes are expected: (1) changes in expected and non-expected outcomes of practice; (2) action-based learning in the researcher, research participants, and the institute and (3) knowledge from the grounded theory.

3. Methodology

3.1 Types of Action Research

Sanrattana (2018) synthesized the action research from the views of Arhar, Holly and Kasten (2001), Carr and Kemmis (1992), Coghlan and Brannick (2007), Creswell (2008), James, Milenkiewicz, and Bucknam (2008), Kemmis and McTaggart (1992), McTaggart (1991), McTaggart (2010), and Mills (2007) found that the action research was first developed in 1952 by the scholar, Kurt Lewin. Several additional researchers, including David Kolb in 1984 and Wilfred Carr and Stephen Kemmis in 1986, later adopted this notion. Carr and Kemmis (1992) classified action research into three levels: (1) technical action research, in which a critical idea is an outside expert or the researcher acts as an outside expert who creates a plan or project and has the co-researchers carry it out, (2) practical action research, has an important idea that the researcher is more involved with the co-researcher. A researcher does not apply all of his or her own ideas, plans, or projects but acts as a consultant who motivates, raises issues, brainstorm, act, observe and reflect on the results, (3) emancipatory action research or participatory action research, in which collaboration and equality are essential concepts. This research adopts a participatory action research methodology that relates to critical social theory and theories of postmodernism and focuses on collaborations and democratization in the actions and consequences that cause change, learning, and knowledge from the action. It consists of bottom-up, collaboration, and equally planning, acting, observing, and reflecting in a spiral cycle manner that operates endless moves. In addition, it places a focus on the expected change in sustainable development supported by the commitments from participation at all stages.

3.2 Cycles Steps and Ethics of the Study

This study used a participatory action research method and was conducted in the manner of a spiral cycle that is carried out in an endless sequence of planning, acting, observing, and reflecting results. Due to a limit on the course duration, the researchers had to establish two cycles for this study, one semester each in the academic year 2021. Ten teachers voluntarily participated in the research, and 60 students were the targets for development. The details of each cycle are as follows.

3.3 Cycle 1

3.3.1 Step 1 Preparation. It included three activities as follows: 1) clarify research methods for the research participants so that they can decide to participate voluntarily according to the followings code of conduct, "*The researcher must*

initially demonstrate the nature of the research process and its interests to the research participants, and “those who do not wish to participate must be respected for their rights.”, 2) design ethical collaboration: “(1) engage participants in the design of the research process, and (2) create joint consultation and common approval between all parties” and 3) conduct an after-action review “(1) analyze, critique, and assess oneself; and (2) learn from action both successful and unsuccessful under the systematic joint learning process.”

3.3.2 Step 2 Planning. It included four activities: 1) conduct brainstorming among research participants to find out what and how to improve the learning environments in the Department of Electronics, Nong Han Industrial and Community Education College considering the potential expertise and being a stakeholder from within the community 2) the researchers present the theoretical development guidelines from the results of the relevant literature studies to the study participants so that they can access various information equally, and 3) make an action plan by brainstorming to integrate the co-designated development approaches and theoretical developments from the relevant literature studies based on all parties’ opinions and create joint consultation and formal approval between all parties (**Note:** the action plan resulted in 43 development guidelines as shown in Table 1), and 4) conduct an after-action review.

3.3.3 Step 3 Acting. It included four activities: 1) create the evaluation form for the co-designated development approaches implementation, 2) create the evaluation form for the expected learning environment for three phases; pre-action and post-action in Cycle 1 and post-action in Cycle 2 based on the concept of research direction and expected outcomes resulted by joint decisions, 3) evaluate the current condition of pre-action in Cycle 1 by using the evaluation form for the co-designated development approaches implementation and the evaluation form for the expected learning environment, and 3) follow the joint action plan considering “(1) in a specific context, (2) diversified skills, (3) change-oriented, (4) action-oriented, and (5) sustainable development.” and “each research participant influences work”, and 4) conduct an after-action review.

3.3.4 Step 4 Observing. It was a phase of data collection from every activity and action by using an observation form, an in-depth interview, and group discussion, examining/record or journal, maps, audiotapes and videotapes, artefacts, and field notes based on the concept of “There is a record of all research participants’ activities and actions”, and ethical considerations “(1) any observation or review of documents for any other purpose must be authorized, and (2) no copyright infringement of the writings is required. or the views of others without negotiating before publication”

3.3.5 Step 5 Reflecting. It included three activities: 1) evaluate the current condition of pre-action in Cycle 1 by using the evaluation form for the co-designated development approaches implementation and the evaluation form for the expected learning environment, 2) reflect on performance by brainstorming to reflect on the results of every step of Cycle 1 using the concepts of “(1) analyze, critique, and assess oneself; and (2) learn from action both successful and unsuccessful under the systematic joint learning process.” and “the results will remain visible and allow others to give feedback.”, and 3) conduct an after-action review.

Kurt Lewin's Force-Field Analysis (Lunenburg & Ornstein, 2000) was applied in this step. The analysis covered the following aspects: a) What are the current conditions?; b) What are the desired conditions?; c) What is the force for change?; d) What are the resistances to change?; and e) What are suggestions to increase the force and reduce the force resistance?. The findings were used for making an action plan in step 6. The plan might either improve the original force's efficacy or replace it with a more effective force, or both.

3.4 Cycle 2

3.4.1 Step 6 Planning. It included two activities: 1) action plan and 2) after-action review.

3.4.2 Step 7 Acting. It included two activities: 1) follow the joint action plan made in step 6, and 2) after-action review.

3.4.3 Step 8 Observing. It included data collection from activities using an observation form, an in-depth interview or group discussion, examining/record as used in Cycle 1.

3.4.4 Step 9 Reflecting. It included three activities: 1) evaluate the current condition of post-action in Cycle 2 using the evaluation form for the co-designated development approaches implementation and the evaluation form for the expected learning environment, 2) reflect on performance by brainstorming to reflect on the results of every step of Cycle 2, and 3) conduct an after-action review.

3.4.5 Step 10 Research result conclusion. The researchers and research participants attended the workshop to summarize the data collected from the above steps. The conclusion was drawn upon the principles of “(1) specific context, (2) recognize every research participant’s opinion, (3) analyze, critique, and assess oneself; and (4) learn from action both successful and unsuccessful under the systematic joint learning process”, and “(1) create joint consultation and common approval between all parties and (2) the results will remain visible and allow others to give

feedback.”

3.5 Research Site and Research Participants

The Department of Electronics, Nong Han Industrial and Community Education College was the research site. It was selected explicitly considering its convenience, the potential of the researchers and the possibility of obtaining cooperation from the research participants. It is an educational institution under the Office of Vocational Education Commission, Ministry of Education, located at Nong Han Subdistrict, Nong Han District, Udon Thani Province, Thailand. Ten teachers who voluntarily participated after hearing the research method and 60 students were the targets for development.

3.6 Research Tools

1) The data collection form was selected according to the circumstances of the activities and actions as suggested in the concept of Mills (2007) as follows: 1) an observation form, 2) an in-depth interview and group discussion, and 3) examining/record or journal, maps, audiotapes and videotapes, artefacts, field notes, etc.

2) The evaluation form for the co-designated development approaches implementation was used to evaluate the 3-phase current condition (pre-action, post-action in Cycle 1 and post-action in Cycle 2). The research participants' self-assessment with a 5-rating scale: *the most, very, neutral, a little and the least*. Because the questions in the form were related to the co-designated development approaches and theoretical developments from relevant literature studies synthesized by the researchers and research participants in Cycle 1 (Action Plan), this assessment was not examined by experts for validity and item-objective congruence indexes, nor was it used in a try-out with the sample group for its alpha coefficient of reliability.

3) The evaluation form for the expected learning environment created by the researchers and research participants from the findings in the learning environment studies of Heick (n.d.), Human Kinetics (n.d.), Kelly (2019), and Zacarian, Alvarez-Ortiz and Haynes (2018), Borglund et al (2016), Cleveland and Fisher (2014), and Murcia, Silveira and Belando (2015). It was a self-assessment form for students who were a developed target. It was characterized by a rating scale of 5 levels: *the most, very, neutral, a little and the least*, with a total of 30 questions.

This assessment was reviewed for the Indexes of Item-Objective Congruence (IOC) based on Rovinelli and Hambleton's (1977) by five educational administration and measurement experts. The results showed that all questions have an IOC value above the 0.50 threshold. Therefore all items indicated that this assessment had content validity (Chaichanawirote & Vantum, 2017). The findings in a try-out with 30 students in the Department of Electronics, Udon Thani Technical College, showed an alpha coefficient of reliability value of .97. When classified by aspects, it was found that the college environment was .93, the classroom environment was .94, and the learning environment was .95, which was higher than the specified threshold (equal to or higher than 0.70) (UCLA: Statistical Consulting Group, 2016).

3.7 Data Collection and Analysis

The researchers and research participants played a role in collecting data at every step by using the tools mentioned above, following the principles *“There is a record of all study participants of their activities and actions.”*

Quantitative data from the assessing characteristics of the expected learning environment form were analyzed using descriptive statistics, i.e. mean and standard deviation. Qualitative data, which was actual data obtained through observations, interviews and recordings, were analyzed in the followings process: 1) Checking the integrity of the data to determine whether it is entirely objective or not, 2) Checking the reliability of the data to see if it meets the actual conditions, and 3) Presenting information in a critical description factually and neutrally with evidence of subtitles such as numbers, statistics, statistics, and objectives, graphic, table, direct quotes/verbatim or the informant's unadjusted dialogue pointing to a wide range of thoughts on the same issue that may support or contradict each other.

4. Research Results

The findings in the learning environments investigation in the Department of Electronics, Nong Han Industrial and Community Education College are discussed in three aspects as follows: (1) changes in expected and non-expected outcomes of action; (2) action-based learning in the researcher, co-researchers and educational institution and (3) knowledge from the grounded theory.

4.1 Changes in Expected and Non-Expected Outcomes of Action

4.1.1 Changes in expected outcomes. There were two phases of changes as follows: 1) Changes in the level of

implementation of the development approaches comparing averages and standard deviations derived from self-assessment of 10 participants in three phases: pre-action and post-action in Cycle 1 and post-action in Cycle 2, and 2) Changes in the expected learning environment comparing the mean and standard deviation obtained from the self-assessment of 60 students who were the development targets in three phases: pre-action and post-action in Cycle 1 and post-action in Cycle 2, as shown in Table 1 and Table 2, respectively.

Table 1. Changes in the Level of Implementation of the Development Approaches Comparing Averages and Standard Deviations Derived from Self-Assessment of 10 Participants in Three Phases: Pre-Action and Post-Action in Cycle 1 and Post-Action in Cycle 2

	Co-designated Development Approaches	Assessment Results from pre-action in Cycle 1		Assessment Results from post-action in Cycle 1		Assessment Results from post-action in Cycle 2	
		\bar{X}	S.D.	\bar{X}	S.D.	\bar{X}	S.D.
		1.	Teachers allow students to practice solving immediate problems to create a variety of learning.	2.40	0.52	3.60	0.52
2.	Teachers allow students to practice analytical, synthetic and creative thinking in different situations.	2.60	0.52	3.80	0.42	4.80	0.42
3.	Teachers train students to be skillful in many areas according to the student's aptitude.	2.50	0.53	3.70	0.48	4.70	0.48
4.	Teachers allow students to learn by exploring their own needs and experiences.	2.70	0.48	3.80	0.42	4.80	0.42
5.	Teachers allow students to participate in teaching activities and answer questions in class.	2.50	0.53	3.80	0.42	4.80	0.42
6.	Teachers allow students to use communication devices for extensive learning worldwide.	2.50	0.53	3.70	0.48	4.80	0.42
7.	Teachers improve collaboration and increase student engagement.	2.30	0.67	3.40	0.52	5.00	0.00
8.	Teachers can quickly shift focus and attention.	2.50	0.71	3.60	0.52	4.80	0.42
9.	Teachers improve learning	2.30	0.67	3.30	0.67	4.70	0.48
10.	Teachers assess students' understanding before and after you present a lesson	2.40	0.70	3.50	0.53	4.80	0.42
11.	Teachers provide students with hands-on practice opportunities.	2.60	0.52	3.60	0.52	4.90	0.32
12.	Teachers get students involved in the process.	2.70	0.48	3.80	0.42	4.60	0.52
13.	Teachers establish a supportive learning culture.	2.40	0.52	3.60	0.52	4.60	0.52
14.	Teachers play an essential role and show their value related to learning.	2.40	0.52	3.70	0.48	4.50	0.53
15.	Teachers capture student interest by activating prior knowledge.	2.50	0.53	3.60	0.52	4.70	0.48
16.	Teachers promote self-efficacy for teachers and students.	2.70	0.48	3.90	0.32	4.50	0.53
17.	Teachers make students feel at home when they are in class.	2.70	0.67	3.80	0.42	4.40	0.52
18.	Teachers let students collaborate.	2.40	0.52	3.70	0.48	4.60	0.52
19.	Teachers make it relatable.	2.40	0.52	3.70	0.48	4.40	0.52
20.	Teachers spin the class seats: students can rotate from left to right or round.	2.40	0.70	3.70	0.48	4.50	0.53
21.	Teachers make students change learning posture from sitting to standing to stimulate their enthusiasm.	2.60	0.52	3.60	0.52	4.60	0.52
22.	Teachers provide ready-to-use technology equipment. Everyone can access a charging point.	2.50	0.71	3.70	0.48	4.80	0.42
23.	The classes allow different patterns for seating arrangement.	2.40	0.70	3.70	0.48	4.60	0.52
24.	Teachers provide rocking chairs or armchairs for relaxing and body movement.	2.30	0.67	3.50	0.53	4.70	0.48
25.	Teachers provide and share information through the internet and communication technology.	2.70	0.48	3.70	0.48	4.60	0.52
26.	Teachers use digital technology and online communication to promote paperless activities.	2.60	0.52	3.80	0.42	4.90	0.32
27.	Teachers use simple teaching technics to make a relaxing classroom.	2.60	0.52	3.60	0.52	4.80	0.42
28.	Teachers address learners' needs.	2.60	0.52	3.70	0.48	4.70	0.48
29.	Teachers keep it positive.	2.40	0.52	3.80	0.42	4.70	0.48
30.	Teachers establish a safety learning environment for learners.	2.70	0.48	3.70	0.48	4.70	0.48
31.	Teachers employ interactive games and activities.	2.40	0.52	3.70	0.48	4.60	0.52
32.	Teachers allow student choices.	2.60	0.52	3.60	0.52	4.70	0.48
33.	Teachers bring music into the classroom.	2.20	0.42	3.70	0.48	4.70	0.48
34.	Teachers provide beneficial feedback.	2.30	0.48	3.50	0.53	4.50	0.53
35.	Teachers share some stories from the summer.	2.30	0.67	3.70	0.48	4.70	0.48
36.	Teachers get to know each student.	2.50	0.71	3.80	0.42	4.80	0.42
37.	Teachers plan for the future and live in the moment.	2.30	0.48	3.60	0.52	4.60	0.52
38.	Teachers create a classroom newsletter.	2.30	0.67	3.60	0.52	4.70	0.48
39.	Teachers encourage being enthusiastic in the learning environment.	2.40	0.70	3.80	0.42	4.80	0.42
40.	Teachers treat each student as if they were their own children.	2.70	0.48	3.70	0.48	4.70	0.48
41.	Teachers review the basics.	2.50	0.53	3.50	0.53	4.70	0.48
42.	Teachers, students and parents are connected by using social media.	2.50	0.53	3.60	0.52	4.60	0.52
43.	Teachers establish positive parent relationships and do house visits.	2.40	0.70	3.80	0.42	4.70	0.48
	Total	2.49	0.38	3.68	0.20	4.68	0.21

Table 2. Changes in the Expected Learning Environments Comparing the Mean and Standard Deviation Obtained from the Self-Assessment of 60 Students Who Were the Development Targets in Three Phases: Pre-Action and Post-Action in Cycle 1 and Post-Action in Cycle 2

The expected learning environments	Assessment Results from pre-action in Cycle 1		Assessment Results from post-action in Cycle 1		Assessment Results from post-action in Cycle 2	
	\bar{X}	S.D.	\bar{X}	S.D.	\bar{X}	S.D.
Inside the college environment						
1. My college has enough buildings for the number of classes and the number of students in each class.	2.88	0.64	3.88	0.64	4.23	0.43
2. My college has adequate and appropriate buildings or areas for extra learning activity	2.66	0.65	3.60	0.76	4.20	0.40
3. My college has a library with a wide variety of catalogues, journals, and books, and they are up-to-date.	2.76	0.69	3.75	0.72	4.27	0.45
4. My college has adequate Internet accessibility computing facilities.	2.58	0.74	3.41	0.94	4.33	0.48
5. My college has well-equipped classrooms and areas to facilitate Internet learning.	2.65	0.73	3.63	0.75	4.28	0.45
6. My college has no boundaries in using modern communication devices for the student.	3.03	0.68	4.03	0.68	4.32	0.47
7. My college promotes a learning environment that keeps pace with the learning society for the 21st century.	2.91	0.71	3.88	0.78	4.25	0.44
8. My college encourages students to build 21st century skills such as creativity s, critical thinking, communication and technology skills, etc.	2.98	0.70	3.95	0.76	4.28	0.45
9. My college has a modern environmental protection movement.	2.93	0.70	3.88	0.80	4.25	0.44
10. My college has enough sports fields.	2.51	0.81	3.36	1.02	4.27	0.45
Classroom environment						
11. I feel involved with others in all courses.	2.95	0.64	3.95	0.64	4.25	0.44
12. I can learn by trial and error in natural or experimental situations.	3.08	0.69	4.05	0.76	4.37	0.49
13. I can learn from exploring my needs and experiences.	2.98	0.65	3.96	0.68	4.38	0.49
14. Students can participate in learning material handling activities.	2.95	0.62	3.90	0.72	4.20	0.40
15. Students can use communication devices for worldwide learning purposes.	2.93	0.66	3.91	0.69	4.30	0.46
16. Students can express their opinions and actions independently.	2.78	0.73	3.71	0.88	4.38	0.49
17. Teachers participated in teaching activities and answered questions in class clearly.	3.00	0.78	3.95	0.87	4.40	0.49
18. Teachers presented content on topics tailored to students' knowledge.	3.06	0.70	4.01	0.81	4.40	0.49
19. Teachers focus on thinking, analyzing, synthesizing and creating more than memorization.	3.11	0.69	4.10	0.72	4.38	0.49
20. Teachers organize teaching activities for students to learn from actions rather than teaching by lecture	3.01	0.65	3.98	0.72	4.45	0.50
21. Teachers promote student expression based on democratic principles	2.85	0.70	3.80	0.81	4.35	0.52
22. Teachers promote the development of 21st-century learning skills, such as creative thinking, critical thinking, communication and technology skills, etc.	2.96	0.66	3.95	0.69	4.42	0.53
Psychological environment for learning						
23. I receive feedback regularly, which helps me see my progress.	2.86	0.74	3.81	0.89	4.40	0.53
24. Teachers foster student interest and motivation to learn.	2.91	0.61	3.90	0.70	4.35	0.52
25. Teachers encourage research and important spirituality in students.	2.90	0.68	3.88	0.80	4.45	0.53
26. Teachers encourage individual work and encourage student participation through teamwork.	2.98	0.62	4.00	0.63	4.48	0.54
27. Teachers start lessons effectively by encouraging students' interest.	2.85	0.65	3.88	0.73	4.50	0.54
28. I have the opportunity to choose how to work with others.	2.95	0.62	4.00	0.66	4.33	0.48
29. I can learn by collaborating and discussing with others.	3.00	0.66	4.03	0.73	4.40	0.49
30. Teachers focus on different learning activities, and have respectful attitude towards students	3.01	0.65	4.03	0.71	4.48	0.50
Total	2.90	0.50	3.87	0.57	4.35	0.27

Table 1 reveals the assessment of the implementation level of the co-designated development approaches in 3 phases had an overall mean of 2.49, 3.68, and 4.68, respectively. It represents an improvement after the implementation of the co-designated development approaches. Furthermore, considering the low overall standard deviation of 0.38, 0.20 and 0.21, respectively, the variance of the respondents' opinions was low.

From Table 2, the evaluation results of the expected learning environment characteristics in the 3 phases had an overall

mean of 2.90, 3.87 and 4.35, respectively, improve the expected learning environment. Considering the overall low standard deviation of 0.50, 0.57 and 0.27, respectively, the variance of the respondents' opinions was low.

Based on the findings presented in Table 1 and Table 2, the change in expected outcomes has improved both in the implementing of the co-defined development approaches and in the expected learning environment.

4.1.2 Changes in Unexpected Outcomes

The findings reveal several unexpected changes in outcomes. However, we focus only on significant changes occurred. The research participants realized that the development of the learning environment did not always imply physical progress, as had previously been assumed. It also entailed creating a psychologically conducive learning atmosphere for students. Furthermore, the decrease in the number of students who did not attend class resulted in a change in the unexpected outcomes. Because of the improvement of the learning environments, students have more opportunities to participate and offer their thoughts. The changes result in a more conducive learning environment.

4.2 Action-based Learning

According to the findings, the researchers, research participants, and educational institution all benefited in various ways from this participatory action research. However, an essential lesson that we shared was understanding the benefits of collaboration. In addition, the PAR methodology used in this study permits all parties to perceive the inefficiencies of the uncoordinated work we had conducted in the past.

4.3 Knowledge from Action

A body of knowledge gained from practice describes the relationship between the expected changes and the driving force and change resistance and ways to overcome the resistance in the specific context of the Department of Electronics, Nong Han Industrial and Community Education College.

In the expected change, there are two aspects: 1) there was a positive change based on mean and standard deviation in the expectation of the co-designated development approaches implementation in three phases (pre-action and post-action in Cycle 1 and post-action in Cycle 2), and 2) the mean and standard deviation showed the improvement in the learning environment in 3 phases (pre-action and post-action in Cycle 1 and post-action in Cycle 2)

The driving forces that caused the expected changes in this study are called “*Six driving forces that affect the development of a successful learning environment*”, consisting of three main driving forces and three supporting driving forces, as discussed below.

Three main driving forces

- 1) A participatory action research methodology allows the researchers and the research participants collaboratively participate in the research; everyone has equal status in planning, acting, Observing, and reflecting in a spiral cycle pattern.
- 2) Buddhist dharma principles that are used as reminders for working with quality and success, namely a) *Four Sangahavatta* or a dharma principle that promotes unity; b) *Khanti* or teaching of patience, tolerance, and endurance for goodness and the proper purpose achievement, c) *Four Iddhipada* or the principle that teaches us to love, diligently, pay attention and work with wisdom, d) *Kalyanamittata*, the dharma principle that teaches us the benefits that will be gained from having good friends or from acting as good friends, and e) *Seven Sappuris Dhamma*, the principle that teaches us to aware of the truth, purpose, self-awareness, time, community, and individual differences.
- 3) An action plan that outlines 43 development approaches arising from the brainstorming of the research participants and the theoretical development approaches from the researcher's related literature studies based on the principle of “*listening to the opinions of all participants*” and according to the code of conduct “*The consultation and the suggestions were agreed by all parties.*”

4.3.1 Three Supporting Driving Forces

- 1) The eight-collaboration principle; a) Make teamwork a priority, b) Clarify roles, Responsibilities and accountabilities, c) Set clear goals, d) Communicate with each other, e) Make decisions together, f) Build trust and get to know each other better, g) Celebrate differences/ diversity, and h) Examine and improve teamwork processes and practices.
- 2) The five-collaboration strategy; a) Common purpose, b) Develop diversity within team, c) Group problem-solving, d) Reinforce collaborative behavior, and e) Relaxation towards ideas implementation.

3) The steps of the development approaches implementation; (a) Deep understanding of the development approach (b) Implementing the development approaches in the class and the work (c) Conducting a group discussion every 15 days about the result of the implementation (d) Attending a workshop at the end of each development cycle, and (e) Summarizing the results and write a performance report.

The following are the primary change resistance factors and ways to overcome them: 1) The majority of the participants had no prior experience with Participatory Action Research, so the researcher needs to create step-by-step manual guidelines for the research participant to study while participating in the study. 2) The research participants cannot connect their personal experiences with academic notions, so more information from the researcher is required to encourage active participation. 3) The research participants cannot evaluate courses and summarize learning outcomes from practice. 4) The research participants have a routine activity to complete. As a result, teachers have limited time to participate in the various activities of the research process. Therefore, periodic stimulation and motivation must be applied.

5. Discussion

The research findings reveal that the six driving forces adopted in this study significantly improved the expected and unexpected changes. Moreover, the researchers, researcher participants and educational institution learned from the action. There were resistances to change arisen. However, there were ways to overcome those resistances to change. The researchers believes that the cause-and-effect relationship components are the key to this success. Firstly, this research challenging objectives (effect) or SMART goals were the expected changes focusing on learning and cognitive development from practice. Secondly, the Participatory Action Research focusing on the principle of rationalism and democracy is used in this study. This method led to various development approaches. In addition, the concept of Buddhist doctrine was also used to determine the success strategy of the work and the development approaches in the specific context. The combination of those principles results in achieving results according to SMART Goals. It is consistent with other studies that use Participatory Action Research methods and have similar research results, for example: "Participatory Practice "Teach Less, Learn More": A Case of Srikruanwittayakom School" by Roobtam and Sanrattana (2021), "Development of Learning by E-Learning System: A Case of Mahamakut Buddhist University, Mahavajiralongkorn Rajaviyalaya Campus" by Phramaha Pajit Uttamadhammo (Sakhong) and Phrakrusutheejariyawattana (2021), and "Cooperative practices to enhance the quality of work-integrated learning at Nong Khai Technical College" by Sarapoom and Phrakrudhammapissamai (2021).

Nevertheless, it is the nature of any work, especially requiring innovative initiatives; change resistance is often related to time constraints and the lack of knowledge and skills in research methodology and subject matters. As Ladimeji (2022) stated, "Learning new tools and methods can look like a steep uphill battle, especially when entering a new field". Another study revealed that teachers burdened with multitasking often report not having enough time for action research (Volk, 2010; Zhou, 2013). This finding is consistent with the findings by Norasmah and Chia (2016) accepted that the challenge in action research conduction is teachers' workload, time constraints, and a lack of research methods. The possible solution for this problem is action research training for teachers.

6. Recommendations

The findings of this Participatory Action Research in the learning environments development lead to action-based knowledge, which is regarded as a model for creating a learning environment in the specific context of the Department of Electronics, Nong Han Industrial and Community Education College only. Therefore, according to the research principles, it may not be published or quoted in other contexts. However, Coghlan and Brannick (2007), and James, Milenkiewicz and Bucknam (2008) state that *"Although the results of an action research have limitations in terms of dissemination or reference, they can be used as a recommendation for a point of view or an important event that can be implemented in other similar situations or that are attempting to achieve a similar change."* Therefore, this research recommendation is to present the knowledge from practice as a model for developing in a learning environment where other agencies can adjust or apply it in their unit. As shown below, the schematic presentation or a prototype model describes the relationship between the expected change and the driving forces, resistances to change and how to overcome them.

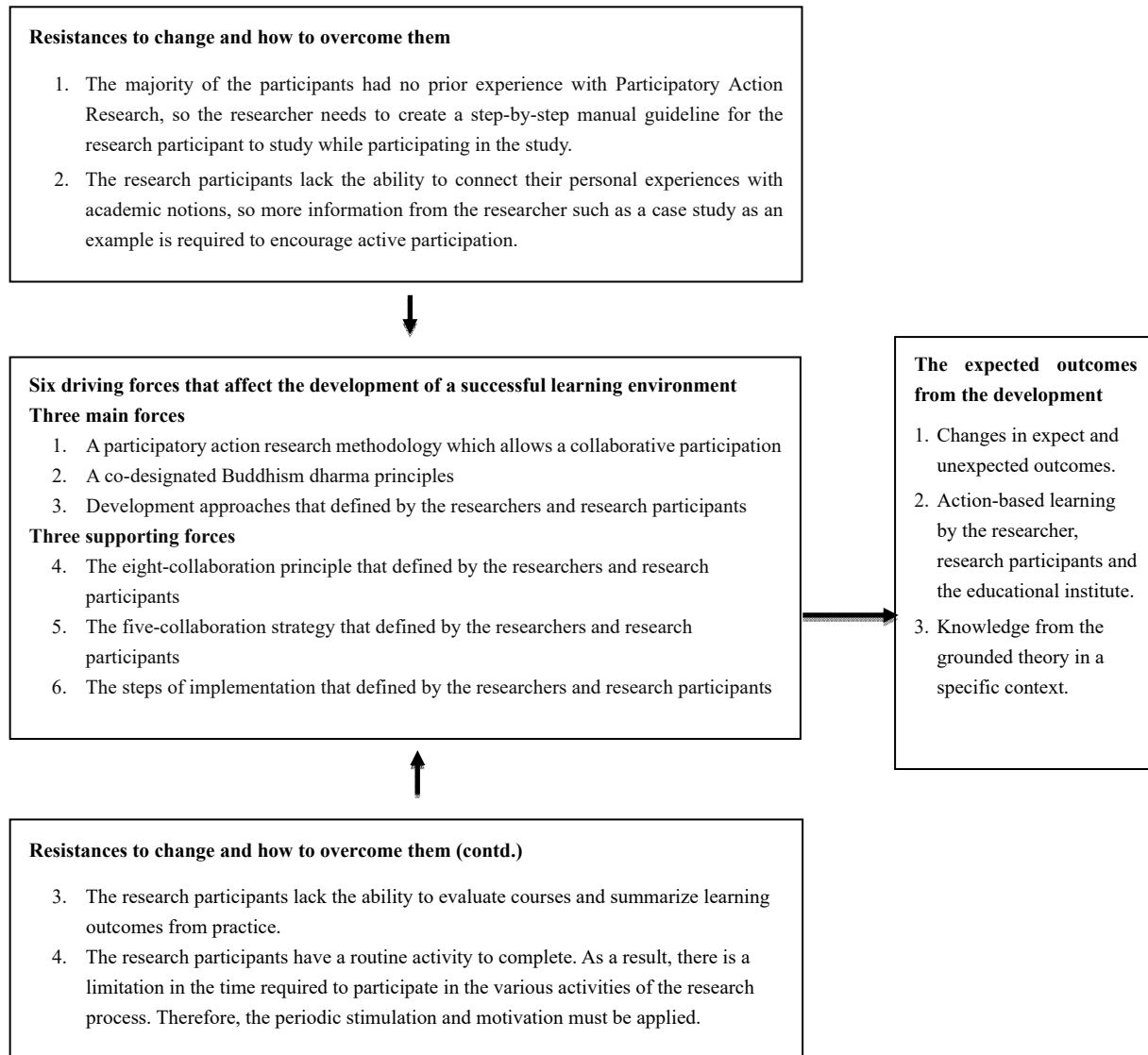


Figure 1. Prototype Model for the Development of Learning Environments: Theoretical Knowledge Based on Participatory Action Research in the Department of Electronics, Nong Han Industrial and Community Education College

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