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Problem-Based Blended Training via Chatbot to Enhance the Problem-Solving Skill in the Workplace

Waristha Saengrith [1], Chantana Viriyavejakul [1*], Paitoon Pimdee [1]

[1] *School of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand.*

Abstract

Problem-solving skill is one of the soft skills that has become essential for employees in various organizations. Training model and educational technology were considered key success factors in delivering knowledge for personnel in the workplace to develop this skill. Problem-Based Learning (PBL) is a key driver for learning activities, which has been increasingly adopted for workplace training and has proven to be one of the best approaches to helping learners improve their problem-solving skills in the organization. Hence, this research aims to synthesize problem-based blended training via chatbot to enhance problem-solving skills in the workplace. Literature review, document analysis, and focus group technique were used as the main procedures for the first phase of model synthesis. The effectiveness of the training model was examined in the second phase by applying it to 20 employees of the flexible lamination manufacturers in Thailand from purposive sampling. The training was held for four weeks and examined with a problem-solving skill test. In addition, a follow-up test has been conducted to monitor retention skills after a four-week training period. Data analysis used the repeated-measures ANOVA test with normality and homogeneity as a prerequisite test. This study shows that the problem-based blended training model via chatbot to enhance problem-solving skills in the workplace comprises six main steps: (1) Group identification; (2) Problem identification; (3) Idea creation; (4) Learning; (5) Implementation; (6) Evaluation. The results on the implemented training model showed that problem-solving skills after training were significantly higher than those before training, and the retention of skill remained higher than that before training and did not significantly change after finishing training at a statistical significance of 0.5. As a result, the developed model is highly appropriate for implementation, particularly because the chatbot platform is involved in almost every step of this training model to accommodate learners who can easily access the training platform, repeat the training content, and feel motivated to explore new information to improve their problem-solving skills. In a post-COVID-19 period with distancing required in the workplace, this model is applicable to deliver efficiency in workplace training.

Keywords:

Training;
Problem-Based Learning;
Blended Learning;
Chabot;
Workplace Learning;
Problem-Solving Skill.

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1- Introduction

With the rapid changes in technology in today's world, self-learning has become more important in the workplace instead of learning from traditional teaching content, and learning is therefore being transformed into helping workplace learners think creatively to identify solutions to problems. Problem-solving is generally regarded as the most important cognitive activity in everyday and professional contexts in the workplace. Recently, problem-solving skill has been considered an important workplace skill; that is, about 30% of the personnel in the workplace have this skill to assess problems and find solutions at work [1, 2]. Therefore, problem-solving, communication, entrepreneurship, and digital

* **CONTACT**: chantana.vi@kmitl.ac.th

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skills have become essential skills for employees in organizations to adapt quickly to more complex digital work environments, as all those skills are core competencies for future establishments [1, 3, 4].

Several instructional and educational strategies have been adopted to enhance problem-solving skills in the workplace, such as project-based, service-learning, and PBL [5]. Problem-based learning (PBL) is an instructional learner-centered approach that has been successful for decades. It is an effective way to empower learners to create knowledge, integrate theory, and practice and apply skills to conduct solutions to further defined problems. Moreover, PBL is also a famous learning model in every facet of corporate training, and it can be used to manage learning to develop problem-solving skills in many organizations [6]. The popularity of PBL has been shown in many organizational and educational settings [7, 8], with the rising number of studies examining the effectiveness of learning quality in developing problem-solving skills, self-directed learning habits, and deep disciplinary knowledge [9, 10], achieving its intended result. Therefore, many organizations have started to adopt the PBL approach in their training courses, and instruction has been developed to enhance personnel skills in the workplace [6]. The learning takes place from the learners seeking knowledge to solve the assigned problems through a process and procedure with group classes available [11]. Nevertheless, the reality is that learners in the workplace are new to PBL and require attractive instruction training to support the development and enhance their problem-solving skills. In addition, one of the factors limiting the efficacy of workplace training is the instructional media that would require integration between authentic and instructional experiences to guide the development of robust cognitive structures in the workplace [12].

Blended Learning (*BL*) is one of the effective educational technologies widely applied in workplace training. Moreover, the knowledge of content, the abilities, and skills of both problem-solving skills and analytical thinking of learners are simultaneously developed [13]. There are several types of blended education approaches, including the combination of methods for transferring knowledge, the combination of theory or principles of learning or teaching, the integration of teaching technology, or the combination of teaching and learning technology with practical tasks [14]. Chatbots are conversational agent platforms incorporated within learning platforms that are used to supplement training through BL. They are based on the features of computer programs that can simulate human conversations and communicate via text or voice prompts, using artificial intelligence technology to interact with the interlocutor. Over the past decade, chatbots have been utilized for educational teaching and learning contexts with training [15] to enhance various skills, such as collaborative learning [16], personalized learning [17], and fostering knowledge creation and dissipation effectively [18]. The application of training based on chatbot functions that is appropriate for the context is also considered when designing the training model with chatbot technology.

From the above-mentioned causes, the authors are interested in studying and synthesizing the problem-based blended training model via chatbot to enhance the problem-solving skills in the workplace. The final training management model will be advantageous to apply in various firms to enhance the problem-solving skill within their organizations.

2- Theoretical Review

2-1- Problem-Based Learning (PBL)

Problem-Based Leaning (PBL) is a teaching and learning method that empowers learners to work through a process of actively learning where they gain knowledge from learning and work together in groups to find solutions by integrating the knowledge they need [19]. This learning process usually introduces the problem to the learners for study first and then assigns the learners to search for more knowledge to find a solution to solve the problem. The problems used were related to daily life and the learners, and they focused on developing learners in terms of learning skills rather than the knowledge that learners would acquire, and they developed learners through self-directed learning. For this reason, PBL is a suitable teaching strategy to encourage students to create a systematic thinking process enabling learners to gain knowledge resulting from active learning, with the teacher being the supporter and facilitator of learning to enhance analytical thinking and problem-solving skills [20]. Moreover, this approach has been defined as an effective learning strategy to encourage learners to become self-directed learners and develop transferable skills such as critical-thinking skills, teamwork skills, and problem-solving skills [21-23]. The workplace is one of the contexts considering the PBL process, which is crucial as it helps in integrating the work responsibilities and learning within a constantly changing environment [24]. Once the problem is understood and analyzed to know how to fix it, then if this problem occurs again in the next scenario, there will be a way to solve the recurring problems in a timely manner with a system to develop the problem-solving skills of personnel in the workplace. PBL in the workplace had been proposed in various points, which can be synthesized as follows (Table 1).

Table 1. The synthesis of the problem-based learning process in the workplace

Compositions	Details	Schmidt (1993)	Delisle (1997)	Wee & Kek (2003)	Diana (2003)	Yeo (2008)	Emma (2019)
1. Group assignment	To identify the duties of the members in the learning group, including a facilitator to guide learners in the learning process and in finding answers.	x	x	x	x		x
2. Problem identification	Problem identification, situational analysis to generate ideas, analysis to find solutions from brainstorming and define and identify what needs to be known.	x	x	x	x	x	x
3. Idea creation	Creating ideas by combining possible ideas to understand and find solutions to problems and brainstorming solutions by presenting solutions from multiple perspectives.		x	x	x	x	
4. Learning	To organize ideas that need to be learned systematically by creating topics that we will learn by ourselves with the knowledge that can be used to deal with problems to analyze the root causes of problems.	x	x	x	x		x
5. Implementation	The process of synthesis and application to create tangible experiences.		x	x		x	x
6. Evaluation	Giving feedback from themselves and the members of the learning group that is a problem-solving process. Acquiring knowledge or solutions to problems.	x	x	x		x	x

From the above table, PBL process was analyzed in the context of workplace from the concepts of Schmidt (1993) [25], Delisle (1997) [26], Wee and Kek (2003) [27], Diana (2003) [28], Yeo (2008) [29], and Emma (2019) [30]. The coherent principles of the PBL process from the above educators have been summarized as follows: group assignment, problem identification, idea creation, learning, implementation, and evaluation. From this synthesis, outcomes will be applied as the core PBL process to create an effective learning model for further steps accordingly.

2-2- Workplace Learning

Workplace learning is a learning process to develop skills and efficiency based on job responsibility leading to the most effective way of learning in an organization. Workplace learning is based on the concept of adult education philosophy and informal learning. It is classified as a nonformal education to enhance knowledge for personnel in organizations that focus on learning, which primarily involves interaction with the work environment, and there are various mixed learning styles involved in the practice. As multiple researchers put it, workplace learning most occurs unconsciously or in an informal way [31]. Moreover, various evidence shows that informal learning is the most important type of learning for enhancing skills and competencies in the workplace, whereas formal learning (such as classroom-based learning or training) is of minor importance [29, 32-34]. The composition of workplace learning is synthesized in the Table 2 to understand the elements of workplace learning to develop the effectiveness training model in the workplace.

Table 2. The synthesis of the elements of workplace learning

Elements	Details	Marsick & Watkins (1996)	Hanse et al. (1999)	Fuller & Unwin (2002)	Hase & Kenyon (2000)	Blaschke (2012)	Cliffore & Thorpe (2007)
1. Formal learning	Continuous learning through formal skill teaching focuses on processes from knowledge transfer by organizational experience.	x	x	x	x		
2. Informal learning	Bespoke learning and fostering a culture of questioning by imparting knowledge from individual experiences. Custom learning.	x	x	x	x	x	
3. Group learning	Social and collective learning is team learning and learning from that cooperation.	x		x	x	x	
4. Enhance skill	Principles for competence development of learners by raising the level of ability to develop skills in accordance with their obligations.	x		x	x		x
5. Activity	Learning more than the content and having activities to promote learning and social activities to make learning interesting.			x	x		x

The content analysis of principles, including the concept of composition and nature of learning in the workplace, is applied following the concepts of Marsick & Watkins (1996) [35], Hansen et al. (1999) [36], Martínez & Muñoz (2021)

[37], Fuller and Unwin (2002) [38], Cliffore and Thorpe (2007) [39], and Blaschke (2012) [40] to define the elements of workplace learning. Five key elements are found as follows: formal learning, informal learning, group learning, enhancing skills, and activities. All the components of workplace learning will be considered for integration with the PBL core process to come up with the training model in the workplace as the final step.

2-3- Blended Learning (BL)

Blended learning (BL) is one of the educational technologies, mostly applied for education in various contexts. Moreover, it was rapidly expanded to organizations' training that differs from the traditional in the past [41]. Traditional learning in the workplace requires employees to learn and participate in classrooms; there are concerns about attending classes. BL can help solve this problem very effectively by combining learning and work to provide knowledge and support to complete the learning tasks within the classroom. Many works of literature defined the concept of BL as a combination of instructions in terms of methods and delivery media, referred to at different times as flexible, hybrid, or distributed learning. In addition, the use of electronic learning tools such as software, email, video, and/or audio streaming, and chatbot with traditional face-to-face classroom teaching techniques also supports personnel learning to achieve the highest learning efficiency [42]. Therefore, BL is highly adopted as a tool for delivering knowledge in the workplace training that integrates formal and informal learning, face-to-face and online learning, direct pathways and self-paced learning, and digital references and collegial connections to achieve organized learning goal. In addition, the workplace personnel can choose and manage their learning at their own convenience and are able to repeat their learning in different parts of the program [43]. From the workplace context, it was found that BL in the workplace consisted of three components: classroom learning, online learning, and activities [44, 45]. Therefore, the developing training model to be applied in the orgnization would consider combining all these three parts as a proper portion to define the most efficient training model for personnel in the workplace.

2-4- Chatbots

Chatbots are computer programs that simulate human conversations and can communicate via text or voice prompts using artificial intelligence technology in interactions with the interlocutor. They have been under development since 1966 and aim to imitate a human being in a natural conversation with the capability of meeting the user's expectations [46]. Since the early 1970s, chatbots have been developed as pedagogical agents within digital learning environments and are known as Intelligent Tutoring Systems [47]. Recently, Jeya (2021) has investigated educational chatbots that can facilitate team-based projects on collaboration among team members to improve learning performance and teamwork [48]. Therefore, the incorporation of chatbots into the educational field over the last decade implies an increase in interest in the ways in which chatbots might be implemented for teaching and learning. In addition, chatbots can create easygoing interactions with users so that they can be leveraged to support engagement and set out goals, strategies, and outcomes of learning and training [49]. For a company, chatbot is an economic tool that could show the best in personalized training in the workplace. The learning activity is more attractive and not boring than the traditional way [50]. It could support the employee for a given activity; an e-learning chatbot could effectively guide them towards a specific training path [51]. The function of chatbots in the education field is also applicable in training, such as acting as a teaching assistant in sending messages to welcome the learners, giving advice on the media used in teaching, introducing the steps in teaching, and coordinating cooperative learning by responding to the questions asked by learners. In addition, they can guide learners through various steps to achieve their learning objectives and provide advice to improve their learning. They can also provide personalized offers to help analyze individual learning and provide guidance for supplemental teaching [52]. A chatbot framework has been highlighted, aiming to be an innovative solution in employee training in industry 4.0. This application suggests important implications for both the company and the employee from the experimental results. The experimental results were obtained on a group of new employees who could learn the latest training processes through chatbot with promising results[53]. In the context of personal learning, chatbots will be responsible for providing personal assistance to learners, including scheduling or handling notifications of assignments or assessments to learners. This variety of personalized services aims to increase service delivery to learners more quickly [54].

2-5- Problem-Solving Skill

The problem-solving skill is an essential soft skill necessary in the 21st century and involves a process that focuses on solving problems from a starting point of encountering a problem until reaching an answer and then considers how it meets the conditions of the problem and how it can be solved. Problem-solving is often considered a soft skill rather than a hard skill acquired through training and education. This skill is critical in the workplace to support employees deal with challenges and innovation in the organization. These challenges require them to become a professional content master and a skillful problem solver [55]. Problem-solving skills can be developed with common problems in each industry and learning from other more experienced employees in the company. Information technology has also come to play an important role in the current work environment; therefore, soft skills, including communication skills, creative

thinking, and problem-solving skills, are becoming increasingly important in today's workforce. Although problem-solving models were used from the 1960s until the mid-1980s to teach the problem-solving process directly, it was found that proficiency in general problem-solving skills was ineffective, and it was not possible to differentiate between good and bad problem solvers. In fact, the knowledge of problem context is the most important quality of problem-solving skills. Therefore, problem-solving is a situational and contextual process that also depends on the depth of the structure of the person's knowledge and experience [56]. Theories include concepts about problem-solving skills to be used as information in determining guidelines to examine the problem-solving skills of personnel in the workplace using the concept of Weir (1974) [57]: (1) problem identification; (2) analysis of the problem; (3) finding solutions; (4) proofing the answer.

2-6- Objective

- This study synthesizes a problem-based blended training model via chatbot to enhance the problem-solving skills in the workplace.
- It also evaluates the effectiveness of the problem-based blended training model via chatbot to improve the problem-solving skills in the workplace.

3- Methodology

The used Research and Development (R&D) approach consists of two phases. The first phase was to study and develop a conceptual training model. A comprehensive literature review was conducted to find the components of training models in the workplace with the different phrases and keywords from the relevant studies, including PBL, workplace learning, BL, chatbot, and problem-solving skill elements for developing the training model. Content analysis and frequency were used to analyze the data collected to synthesize the model. The record synthesis form was used as the tool and was verified by the experts. The researcher drafted the blended training model with details of each step to create a graphic model. The focus group technique was adopted for evaluation to improve the model. Purposive sampling was used to identify seven experts who had expertise in the two fields of education technology and workplace training, who could attend group discussions.

The second phase was to study the effectiveness of the developed training model with a sample set to study the problem-solving skill outcome. The skill was examined before and after the applied training model with the problem-solving skill testing tool developed and verified by the experts. Moreover, the retention of problem-solving skills after a four-week training period was also examined. The training course provided to the sample group was for four weeks and the variance of problem-solving skills in one group was analyzed using statistic repeated-measures ANOVA test with normality and homogeneity test as prerequisite tests.

3-1- Research Sample

Phase 1: the training model is validated by seven experts, where the expert assesses the model that has been developed through a given questionnaire. These seven experts were selected based on their experience and skill and were from two related fields: five experts from education technology and two experts from workplace training.

Phase 2: twenty employees from a flexible packaging manufacturer in Thailand were selected through purposive sampling as the sample group to study the effectiveness of the training model.

3-2- Research Instruments

Three instruments were used in the study. The first was the literature review table to synthesize content analysis of the elements of the training model. The second is the suitability model assessment form from the seven experts on the focus group technique. Five experts approved the questionnaire to assess content validity and construct validity with a five-point Likert scale as follows: 5 = strongly agree; 4 = agree; 3 = neither agree nor disagree; 2 = disagree; 1 = strongly disagree. Lastly, the instrument to evaluate the effectiveness of the training model is the problem-solving skill test. They were used to examine the skill before and after training and in the retention period after four weeks. All the instruments were applied to five experts to analyze the Index of Item Objective Congruence (IOC) with the criteria considered to be good content validity (IOC > 0.50).

4- Results and Discussion

The results from this research are presented in two phases are as follows.

4-1- Phase 1: Training Model Development

The synthesis of the problem-based blended training model via chatbot to enhance the problem-solving skills of personnel in the workplace was developed from the content analysis of all documents with key variables including PBL,

workplace learning, BL, and problem-solving skill. The core concept of PBL consisted of six steps: (1) group assignment; (2) problem identification; (3) idea creation; (4) learning; (5) implementation; (6) evaluation. Since the model was conducted through the workplace context, workplace learning theory was applied based on the composition of formal learning, nonformal learning, group learning, enhancing skills, and activities. In addition, to facilitate trainees in becoming more comfortable accessing the training course, education technology is applied with BL, involving both classroom and online learning via the LINE chatbot platform and activities during the training. Lastly, the process of examining the problem-solving skills consisted of problem identification, problem analysis, finding solutions, and proofing the answers. All components are integrated into this training model to enhance the problem-solving skills of personnel in the workplace. The first draft graphic of the model is proposed to discuss its suitability in the focus group session. After the focus group technique was applied, the seven experts provided three suggestions for the graphic model as follows: key components of the model are PBL, BL, and problem-solving skills, which should be obvious and seen clearly from the model graphic. The training model should clearly distinguish the roles of facilitator and learner; the chatbot is the key learning platform for BL in this training; the task should be clearly defined in terms of how the chatbot is involved in each online training stage.

From the above recommendations, the researcher adjusted the graphic model to deliver the final model, as shown in Figure 1, and the suitability of the problem-based blended training model via chatbot to enhance the problem-solving skills in the workplace was examined (Figure 2).

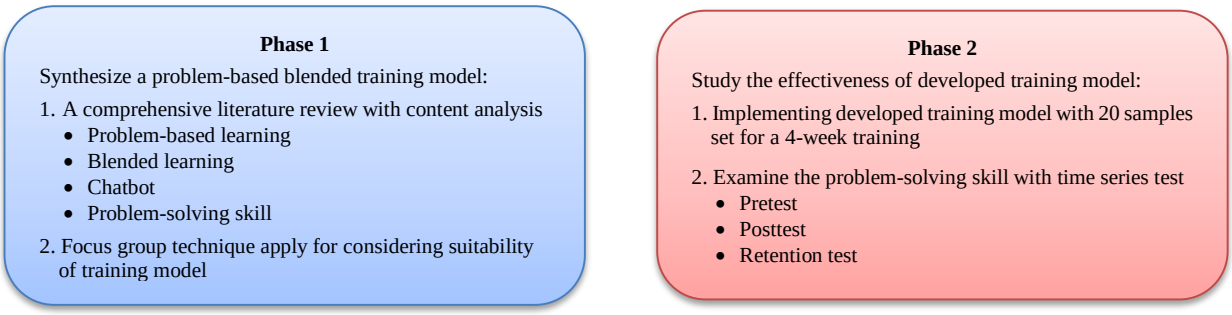

Figure 1. Research framework of problem-based blended training via chatbot to enhance problem-solving skills in the workplace

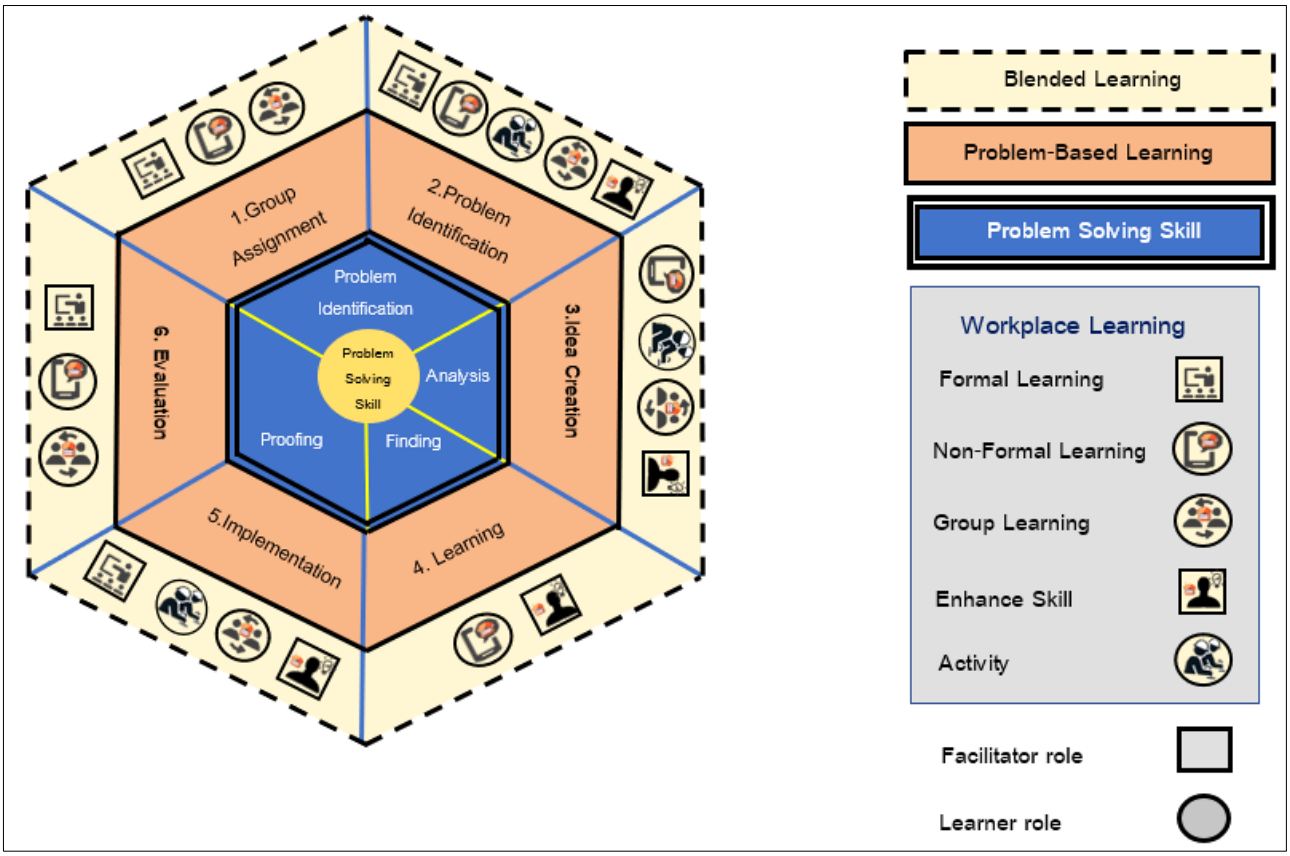

Figure 2. The problem-based blended training model via chatbot to enhance problem-solving skills in the workplace

The suitability of the problem-based blended training model via chatbot to enhance the problem-solving skills in the workplace was divided into three parts (Table 3). In terms of the model's overview, all experts strongly agreed with an average score of 4.51, including several parts such as the principles and basic concepts in the development of the model, the objective, components, process, and evaluation method. For the activity part, all experts strongly agreed with an average score of 4.71 for activities before and during the training process. Lastly, in the model implementation section, all experts also strongly agreed with an average score of 4.78 that the developed training model is suitable for promoting problem-solving skills and is possible to use for practical applications.

Table 3. The suitability of the training model from experts' assessment with the focus group technique

Scope	Mean	Std. Deviation	Level
1. The model's overview	4.51	0.32	Strongly agree
2. Activity	4.71	0.39	Strongly agree
3. Model implementation	4.78	0.39	Strongly agree

The training model was developed together with a chatbot operating on the LINE platform; the main menu is shown in Figure 3. The function on the menu was designed based on elements and processes of the training model in order to accommodate both trainer and trainees during the training program and the instruction process will be provided in the second phase.

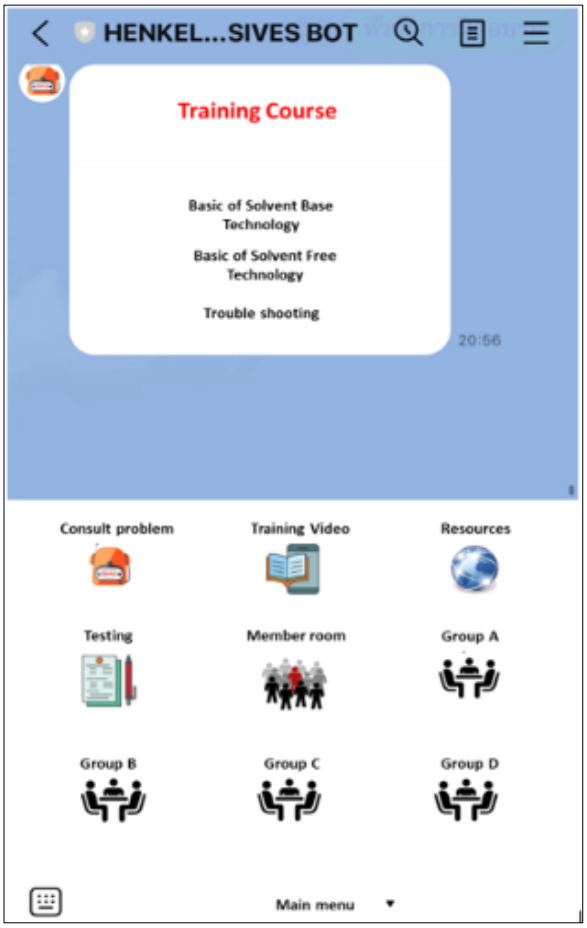

Figure 3. Main menu of chatbot LINE application on personal mobile platform

4-2- Phase 2: The Effectiveness of the Developed Training Model

The second phase of this research aimed to find out the implementation results of a problem-based blended training model developed and approved in the first phase. Twenty trainees from a flexible packaging manufacturer in Thailand were selected from purposive sampling to attend the training. The problem-solving skill before training was examined with a problem-solving skill test. Then, trainees applied for the training course for four weeks following the instructions in Table 4.

Table 4. The instruction process of a problem-based blended training model to enhance problem-solving skill in the workplace

Process	Details
Step 1: Group assignment to identify group members and duties among training groups. The facilitator provides an outline of the training process, including activities during the training course. This stage is applied through a classroom learning session.	1. The trainees are divided into groups of 4-6 people with mixed task backgrounds. The roles of the facilitator and participants are explained. 2. The trainees have access to participate with the chatbot operating system and utilize the group function to support group training. 3. The group targets are set and the roles and responsibilities of team members are assigned. The information is shared and kept via the online chatbot platform.
Step 2: Problem identification to indicate a problem and gain ideas from brainstorming activities among the group and define and explain what needs to be known. This process and activities are applied via the classroom learning session.	1. The facilitator provides the first training topic to give a broad description of the problems that arise and to stimulate ideas before the trainees start the activity. 2. The first activity is assigned for trainees to enhance their analytical thinking to identify problems arising from situations. 3. Members summarized the information they learned from classroom training together with the chatbot interactive session. Problems ideas are identified to choose the best ideas to propose through group chatbots. 4. The facilitator assesses the ability of each group to identify a given problem.
Step 3: Idea Creation to generate ideas of concepts via the online chatbot platform by collecting possible ideas to understand, finding solutions to problems, and brainstorming with group members by presenting a solution to the problem from various perspectives. Process and activities are applied via the online learning session.	1. The chatbot operating system informs about the objective of the second training scenario and provides learning guidelines for this stage. 2. The trainees prepare to participate in second activities by receiving the situation through the chatbot system. 3. The trainees find the right solution and summarize the information learned from the chatbot and choose the best ideas through the group chatbot. 4. Assessing the ability to create concepts and ideas from a given training scenario.
Step 4: Learning to organize the thoughts and deal with what we want to learn systematically through the creation of topics that learners can learn by themselves This stage is conducted via online sessions.	1. Chatbot provides new learning content from the recorded video and from chatbot responsive text. 2. Assess the knowledge that arises in the learning process by using the learning achievement assessment via the chatbot platform.
Step 5: Implementation to synthesize and create concrete experiences to solve the problem with a classroom session.	1. Provide the third activity to incentivize thinking, action, and problem-solving by simulating real problems. 2. Members share their roles in problem analysis and brainstorming ideas, then discuss and select the most appropriate solution project approach for further presentation. 3. The facilitator assesses the ability of each group to propose the solution.
Step 6: Evaluation to evaluate the performance of the method and whether a specified problem can be solved or not. The results are used to improve work to be more effective in solving problems. This stage is still conducted in classroom sessions.	1. Each team proposes the solution from the third activity to share among other groups and discussion. 2. The facilitator provides assessment results, recommendations, and guidance to participants in the training room. 3. Examine the posttest problem-solving skill after completing the training course.

The training program was conducted for four weeks; individual problem-solving skills were examined with a problem-solving skill test. In addition, to understand the efficiency of this training model, retention's skill was examined after 4-week training. The variance in one group in problem-solving skills was analyzed using statistic repeated-measures ANOVA test with normality and homogeneity test as prerequisite tests and the results are as follows (Table 5).

Table 5. The comparison of problem-solving skills of trainees in the implementation of the training model with repeated-measures ANOVA analysis

Time	Mean	Std. deviation	*p*
1. Before training	43.7	4.06	0.000
2. After training	56.2	3.66	
3. Before training	43.7	4.06	0.000
4. After training, 1 month	54.8	2.93	
5. After training	56.2	3.66	0.269
6. After training, 1 month	54.8	4.06	

The results from the above table demonstrated the efficiency of the developed training model with 20 people from the sample group of problem-solving skills examined. The score of problem-solving skills from 80 points after training was significantly higher than that before training from 43.7 to 56.2, and the retention had a higher score than that before training from 43.7 to 54.8. The test hypothesis using repeated-measures ANOVA statistics was used to compare the variance of the independent variable for one group between time series, before and after training and follow-up period;

it was found that the p values of before and after training and the p values of before and after one-month training were 0.000 and 0.000, respectively. Both p values were less than statistically significant at 0.5, which means both hypotheses were accepted. The problem-solving skills of personnel in the workplace before and after training and before and after the follow-up period increased, with a statistically significant level at 0.5. Furthermore, a comparison of the variance after training and the follow-up period after one-month training shows a p value of 0.269, which is higher than the statistical significance level of 0.5. This means that the hypothesis was rejected. The problem-solving skills of personnel in the workplace after training and the follow-up period after training for one month did not change at a statistically significant level of 0.5.

The research result showed that the training model was developed with PBL as the core of the training model, which was examined to understand the efficiency of this training model in the workplace context with a good result. That was related to prior studies indicating that PBL helps the employees in the organization to approach daily problems more confidently with the lessons drawn from problem-solving activities and can enhance the learning capacity of personnel in the workplace. Its success depends on the complexity of learning networks supported by system, process, and organization settings [58]. BL is one of the key trends in corporate training [45, 59] that was proved to be efficient in delivering knowledge to the employee. The organization could initiate and implement the use of educational technology platforms such as e-learning, mobile learning, and chatbot learning for their staff as this is the basic knowledge that allows their employees to study by themselves. The types of chatbots that are applied in this research are simple chatbots or rule-based bots with task-specific functions, whereby the bot poses questions based on predetermined options. It would be interesting to further develop appropriate content with greater flexibility in learning structure and effective communication channels between people in the organization.

5- Conclusion

The results of this research are as follows: The first phase applied content analysis of documents to synthesize a blended training model via chatbot to enhance the problem-solving skills in the workplace. PBL is defined as a core training process with the following steps: group assignment, problem identification, idea creation, learning, implementation, and evaluation. With the integration of key elements for a workplace training context, the composition was considered to enhance efficiency in the training process through formal learning, informal learning, group learning, enhancing skills, and activities. In addition, to eliminate the time limitation during working hours, the BL method was applied to help trainees access the training class, which comprised three components: classroom learning, online learning, and activities. The online training platform chosen to facilitate trainees is the LINE chatbot, which is involved in almost every step of the PBL process in the training model. The key functions of the chatbot are to guide learners through the various steps to achieve their learning objectives and to provide advice to improve their learning through the interactive real-time response function. The focus group technique was applied to examine the suitability of the training model; the result showed that all experts strongly agreed with this developed model, with scores of 4.51, 4.71, and 4.78 in the overview, activity, and implementation parts of the training model.

In the second phase to study the effectiveness of the training model with 20 trainees from flexible packaging manufacturer firms in Thailand, the problem-solving skills were examined. The four criteria are problem identification; problem analysis; problem-solving ability; finding solutions; and verifying the answers. The results found this training model can enhance problem-solving skills in the workplace, with the variance before and after training showing a p value of 0.000 and the score after training increasing from 43.7 to 56.2. Moreover, the retention of skills also remained the same after one month of training. The variances after the training and follow-up periods show a p value of 0.269, which is higher than the statistically significant level of 0.5 with the scores of 56.2 to 54.8. The mean of the problem-solving skills of personnel in the workplace after the training and follow-up period did not change at a statistically significant level of 0.5. Therefore, the developed model is highly suitable to implement, especially the chatbot platform that is involved in almost every step of this training model to help the learners access the training platform easily, repeat the training content, and feel motivated to explore new information to enhance their problem-solving skills in the workplace.

6- Declarations

6-1- Author Contributions

Conceptualization, W.S. and C.V.; methodology, W.S. and P.P.; software, W.S.; validation, W.S., C.V. and P.P.; formal analysis, W.S. and C.V.; investigation, W.S., C.V. and P.P; resources, W.S. and C.V.; data curation, W.S. and P.P.; writing—original draft preparation, W.S.; writing—review and editing, C.V. and P.P.; visualization, W.S.; supervision, W.S., C.V. and P.P.; project administration, P.P.; funding acquisition, C.V. All authors have read and agreed to the published version of the manuscript.

6-2- Data Availability Statement

The data presented in the study are available in article.

6-3- Funding

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6-4- Acknowledgements

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6-5- Institutional Review Board Statement

Not applicable.

6-6- Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

6-7- Conflicts of Interest

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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