



# Learner's Ill- Structures Problem Solving with a Constructivist Web-Based Learning Environment Model

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**Abstract.** The purposes of this research were: 1) To study the process of problem-solving with a complex structure of learners using the learning environment model. 2) To study the EEG and the position of the learners while performing the problem-solving task. The Model Research Phase II: model validation was employed in this research. The sample for phase II: external validation were 30 diploma students of Rajamangala University of Technology Isan, Khon Kaen campus. 2. The results of the comparison of solving problems between before and after learning with the model revealed that Before learning, students cannot solve the problem by using ill-structured problem solving process. After learning, students can solve the problem by using ill-structure problem-solving process as follow: 1) Articulate problem space 2) Identify and clarify problem 3) Generate possible problem solutions 4) Assess and select alternative solutions 5) Monitor the problem space and solution options 6) Implement and monitor the solution and 7) adapt the solution and the problem solving after was significantly higher than before at 0.05 level. The learners' Bain electric wave as perform ill-structured problem solving task in laboratory revealed that while learner performed ill-structured problem solving task found Alpha (7–13 Hz) in all area such that AF3, AF4, F3, F4, F7, F8. This result may believe that the learner had cognitive process, problem solving.

**Keywords:** Ill- structures problems solving · Learning environment model · Bain electric wave

## 1 Introduction

Due to the change of technology and information technology, information has continuously and rapidly increased. Such changes have resulted in a shift in cultural, economic, social, and political problems. The problem to be more intense and ill- structures problems in life and that arise in the operation, especially in the electrical and electronic professions in the design and installation of electrical systems, which are complex of subject matter and the impact of design and installation, there will be a nature of impact problems, for example, if the design is incorrect and the equipment is used may cause damage such as a short circuit, fire. Cause damage to life, property. There must be problem-solving skills in operation. It is necessary to promote skills in seeking knowledge. Solving problems to solve problems for efficiency and safety. From the above

reasons, the researcher is aware of the importance of learning design and management that focuses on providing learners with skills to seek knowledge and construct knowledge to solve ill structure problems in electrical and electronic work, Therefore, to be able to create knowledge to keep up with changes information and can apply knowledge to solve problems effectively create safety in life and property, as well as apply previous knowledge and experience to solve problems in the future.

## 2 Research Purpose

1. To study the process of problem-solving with a complex structure of learners using the learning environment model.
2. To study the EEG and the position of the learners while performing the problem-solving task.

## 3 Research Methodology

This research uses the Model Research in Phase 2, Model Validation.

## 4 Research Instruments

1. The learning environment Constructivism that promotes problem-solving and learning transfer with improvements in the study, Phase 1, model development
2. The problem-solving measure used for studying problem-solving of learners Built base on Jonassen (1997) and the content of home electrical installations. There are 5 which are: 1) A measure to solve the problem of a problem situation of installing electrical equipment in the house 2) A measure to solve the problem of a problem situation of choosing the electric wire by calculation. 3) A measure to solve the problem of a problem situation of choosing the protective equipment with calculations 4) A measure to solve the problem of a problem situation choosing the electricity meter with calculations 5) A measure to solve the problem of a problem situation of the electrical equipment connection
3. The problem-solving interview used for studying the problem-solving of learners is built base on Jonassen (1997)
4. Emotive EPOC+ consists of 14 probe connectors arranged by International 10–20 or International 10–20 Systems standards: AF3, AF4, F3, F4, F7, F8, FC5, FC6, P7, P8, T7, T8, O1, O2

## 5 Data Collection

The learning environment Constructivism promotes problem-solving and learning transfer with improvements in the study, Phase 1 model development to manage learning with learners to study the effects of using the model by studying Problem-solving process before and after learning, study methods as follows (Fig. 1).

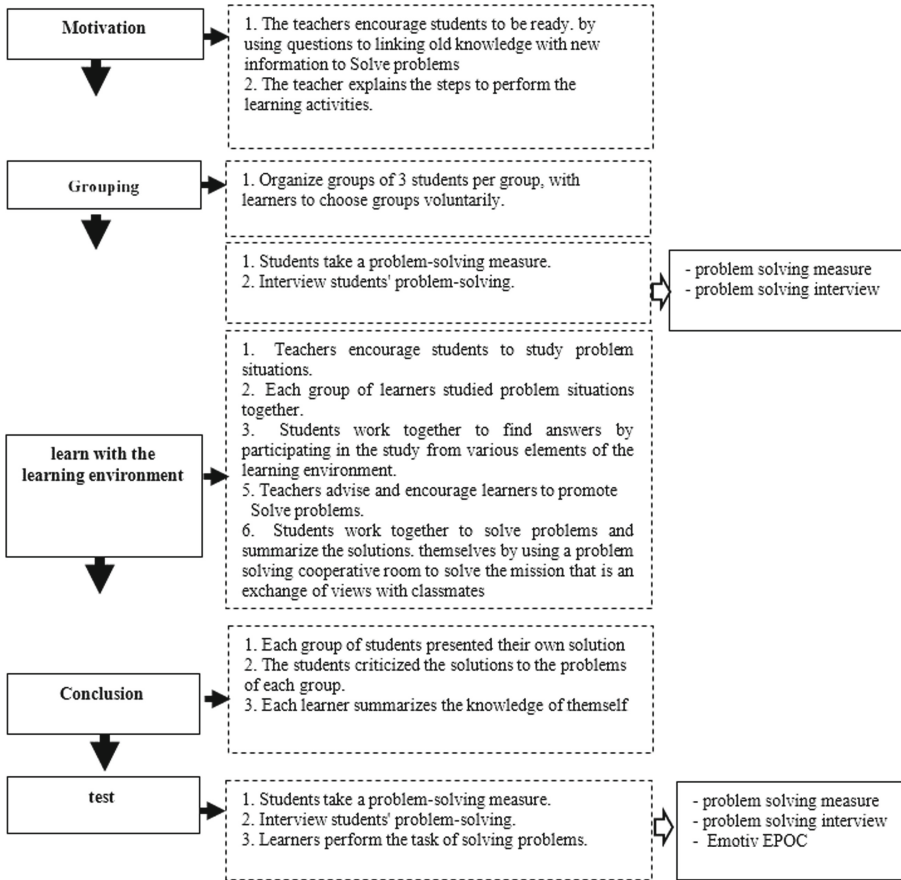


Fig. 1. A data collection process

## 6 Result

### 6.1 Result of Comparison of the Students' Problem Solving from the Interview

The students' problem-solving before and after learning was different. The learners have a three-step problem-solving process: Step 1: Finding the Problem, Step 2: Finding the Cause of the Problem, and Step 3: Solving the Problem. And after learning, it was found that the students used the problem-solving process in order of complex problem-solving processes in 7 steps as follows: 1) Articulate problem space 2) Identify and clarify problem 3) Creating a solution. Step 4) Assess and select alternative solutions Step 5 identifying gaps in problems and solutions) Monitor the problem space and solution options 6) Implement and monitor the solution and 7) adapt the solution as the following details.

Problem-solving of learners before learning, it found that students did not have complex problem-solving processes, according to Jonassen's problem-solving process (1997), but the students had a 3 step problem-solving process. Step 1 Finding the problem,

the students can find the problem by looking the problem by the electrical appliances or the result of the electric pan not working, smelly meat Fridge not cold, the light bulb. Step 2 Identify the cause of the problem. Learners can find the cause by analyzing the results of electrical appliances. What can be the cause? what is involved? and then check for any reason for example, the result of the problem of the electric pan not working Related things include: Electrical wires to be connected and plugs and the body of the electric pan. The students checked by trying to connect the pan to a plug outside the house. If normal, check whether the wires are broken or the size of the wires is too small by calculating the electricity consumption of electrical appliances and comparing them with the size of the wires that are suitable or not. If the wires are normal, check the plug using a multimeter to test if the voltage is normal. Step 3 Problem Solving Learners can solve problems by applying the solutions from previous experiences or try the methods that have been used to solve problems such as the problem of the electric pan not working, the cause of the problem is that the electric wire is small. Learners solved the problem by changing the wires to a larger size.

Problem-solving with ill structures of learners after class, that the students had a ill structure problem-solving process in 7 steps:

Step 1: Articulate problem space, Learners can identify gaps in problems is specified The current problem condition, the refrigerator does not work, the meat smells, the water is not cold. The light in the room is less bright than usual, the lamp flashes when several appliances are turned on at the same time. The electrical cable connected to the plug generates smoke. The electric pan connected to the plug does not work. The desired condition after troubleshooting, the refrigerator is working, odorless meat, chilled water, normal room lighting, the lamp does not flash when several electrical appliances turn on at the same time, the electrical cable connected to the plug does not produce smoke, the electric pan works normally and the limitation to solve the problem is that there is only 1 day to install appliances and electrical equipment and the budget is limited to only 1,500 baht.

Step 2: Identifying the Real Problem, Learners can identify real and pseudo-problems. The real problems learners identified from the goals of the stakeholders were: 1) Chanchai's sister, whose goal is to make Chanchai's home appliances is work normal. 2) Chanchai wants the electrical appliances to work, such as refrigerators, light bulbs, electric pans, and water heaters. Electrical appliances can works when enabled at the same time. and 3) Technicians want to install electrical equipment and electrical appliances successfully and work within the specified time and budget. The goals of stakeholders were common, electrical appliances to work. Therefore, the students Identify Electrical appliances malfunction. It's a real problem.

Step 3: Identify and clarify problem, Learners can create solutions that could reduce or alleviate the root cause by analyzing the cause of problems that cause electrical malfunctions. which is caused by The electrical cable is small, not suitable for electrical appliances. and create a solution to the problem that makes the electric wire to be the right size for electrical appliances. There are 3 ways: 1) Replace every new electrical wire 2) Change some new electrical wires, only the wires connected to the plug for the

refrigerator coffee machine electric pan and in case of other types of electrical appliances and 3) change new electrical appliances to suit the old electrical wires.

Step 4: Assess and select alternative solutions, Learners can assess alternatives and choose solutions, assessing and choosing a solution from the problem constraint such as the cost and time and then choose the most feasible solution. The students evaluate the approach to problem-solving from the following limitations. 1) Time constraints The quickest way is to replace appliances with new ones. The second is replacing some new electrical wires and the slowest is changing all the new electrical wires. 2) Cost Limitation The cheapest way is to Change some new electrical wires, followed by replacing all new electrical wires and the costliest way is to replace the new electrical appliances to suit the old electrical wires. When considering time and cost constraints, learners evaluate the solution of replacing electrical wires as the most feasible solution. Because it doesn't take much time and the price is not high within the time limit and the price set. Therefore, learners choose a solution to the problem. Remove the old power cable and replace some of the power cables in the next solution.

Step 5: Monitor the problem space and solution options, Students will be able to identify gaps in problems and solutions by examining the solution of removing the old wires and replacing some new electrical wires only those that are connected to electrical appliances that use a lot of electricity to be larger can solve the current problem is electrical malfunctions. Because the electric cable is small, it is not suitable for electrical appliances. to the desired condition is that the electrical appliances can work within the limitation of problem-solving, which is limited to 1-day installation time and budget is only 1500 baht and learners formulate strategies for solving problems: 1) Strategies for purchasing electrical equipment are made by contacting multiple stores to compare prices. Promotion and check the model of wires and plugs including rails for wiring. Then consider the store with the lowest prices at The distance that must be purchased to the nearest because it reduces the cost and travel time. to reduce constraints in solving budget problems 2) Wiring strategy by students choosing in-wall wiring in order to reduce the time constraints and for the aesthetics of wiring instead of clip-on and wall-mounted wiring and to be able to improve and repair Therefore, the chosen solution is within the budget and time specified within 1 day and within the budget of 1500 baht.

Step 6: Implement and monitor the solution, The Learners can apply a problem-solving approach, remove the old wires and change some new electrical, which students will start by purchasing electrical equipment according to the calculation and buy it for a price of not more than 1,500 baht. The Learner checks prices, promotions, and distances from many stores. When receive electrical equipment and remove the original equipment first then bring the new device to install in place of the original location but change the wiring from a clip to a walk in the rails on the wall which makes wiring faster. The power socket is floating on the wall instead of the original. it makes it possible to control the installation time not to exceed 1 day and found that learners were able to reflect the results of solving problems. The students indicated that they could buy the sky equipment in a budget of not more than 1500 because of the survey of both prices. Promotion and distance of the shop that sells and choose the shop that sells the cheapest and closest This makes it possible to buy sky equipment at a price that is within the specified budget.

Installing electrical equipment and appliances takes less than a day because choosing the equipment from the nearest store gives you more time to install and choose a way to install the cable in the rail. Floating wall socket Makes it work fast, so it can install within 1 day. Electrical appliances can work because the electrical equipment to be connected has the appropriate size, which calculates and the quality is according to TIS standards. The homeowner is satisfied with the installation and pays the specified wage because the electrical appliances are working and the electrical wiring on the rails. Make the connection beautiful and safe.

Step 7: adapt the solution, Learners can adjust the approach for solving the problem by adjusting the way from removing the old wires and replacing some new electrical wires to removing all the old wires and replacing all new electrical wires. when found that after replacing some new electrical wires, there are still malfunctioning electrical appliances. And to make the solution effective under the limitations of solving problems, students change the way of connecting wires by changing from walking in rails to clipping on the wall because it is cheaper than walking in rails. (Compensation for the purchase of additional electrical equipment to stay within the specified budget) and the distance of the clip will be beaten further to reduce the wiring time but still, maintain strength and beautiful prayer.

## 6.2 Result of Comparison of the Students' Problem Solving from the Problem Solving Measure

Before and after the class the students took a problem-solving measure, after which the scores of both were taken to find the mean and standard deviation. The hypothesis was tested by comparing the mean scores of problem-solving between before and after school with t-test dependent statistics. Comparative results are shown in Table 1.

**Table 1.** Comparison of average problem-solving scores between before and after

Problem solving	<i>n</i>	<i>x</i>	<i>S.D</i>	<i>t</i>	<i>df</i>	<i>sig</i>
Pre-test	30	7.86	1.59	-32.91	29	.000
Post-test	30	15.96	1.44			

From the table in the study of problem-solving of learners from the problem-solving measure, the results showed that the students' problem-solving scores averaged higher after studying than before. (before = 7.86 and after = 15.96) at the statistical significance level of .05 showed that the learning environment model promote problem-solving of learners.

EEG and the location while Learners perform complex problem-solving tasks in the laboratory while taking EEG measurements as perform problem-solving tasks. The results showed that *Delta* (1–4 Hz), *Theta* (4–7 Hz), *Alpha* (7–13 Hz), and *Beta* (13–30 Hz) wavelengths were present at all measurement locations: AF3, AF4, F3, F4, F7 and F8, which are the waves that correspond to problem-solving.

## 7 Discuss

The students' problem-solving before and after learning was different. The learners have a three-step problem-solving process: Step 1: Finding the Problem, Step 2: Finding the Cause of the Problem, and Step 3: Solving the Problem. And after learning, it was found that the students used the problem-solving process in order of complex problem-solving processes in 7 steps as follows: Step 1: Identifying gaps in the problem Step 2: Identifying the real problem Step 2: Creating a solution. Step 4: Evaluating alternatives and choosing a solution, Step 5 identifying gaps in problems and solutions, Step 6 implementing the solution, and Step 7 adjusting the solution as the following Step 1: Identifying the gaps in the problem, the students were able to identify the gaps in the problem by can identify the current problem situation, the after the problem is solved, and the problem constraint. Step 2: Identifying Real Problems, that learners can identify real problems from stakeholder's goal. Step 3 Creating a solution to the problem, that students can create solutions to problems. The students have a process of creating a solution to the problem by analyzing the cause of the problem. and create solutions to reduce or mitigate the root cause of the problem. Step 4: Assessing alternatives and choosing a solution to the problem, learners can assess alternatives and choose a solution by asses the problem constrain and choose the most feasible solution. Step 5, Problem Solving Problems and Ways to Solve Problems, the learners can direct the gaps in the problems. and directing alternative solutions by identifying strategies that can be used for the solution. Step 6 Implementing the problem-solving approach, the students were able to apply the problem-solving approach and reflect the results of applying the approach. Step 7: Adjusting the problem-solving approach, the learners can adjust the problem-solving approach if the problem was not solved. The comparison of the students' problem solving between before and after learning with the model. Obtained from the problem-solving scale, it was found that problem-solving after school was significantly higher than before school at the 0.05 level, consistent with the study of Sumalee et al. (2020), Charuni et al. (2019), Pinyarat Singha and Sumalee Chaicharoen (2019), Seksan Yampinit (2011), Suchart Wattanachai (2010), Chia and Chang et al. (2017), HaeRan and Yeongsuk (2016), Connie and Charlene (2006) studied complex problem-solving base on complex problem solving (Jonassen 1997). Learners have a complex problem-solving process adapted from (Jonassen 1997) because learners are encouraged by the task of learning through situational intelligence. Start from the analysis of the gap in the problem. Identify the real problem Then create all possible solutions. and evaluating alternatives and choosing a solution. Addressing gaps in problems and solutions Implement a problem-solving approach and adjust the approach to problem-solving. In addition to promoting problem-solving processes through learning missions, Students also practice problem-solving with complex structures through the Problem Solving Center. which allows learners to practice the problem-solving process by solving each step by dragging the text or typing in the answers that can be checked. The fact that students have complex problem-solving processes may be a result of learning through the learning environment. created by the researcher.

## 8 Suggestion

1. Should be studied the relationship of complex problem solving with other advanced thinking.
2. Should be studied the brain areas involved in other advanced thinking

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