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The development of training package using the P-PIADA training model: a case study on the usage of GUI – MATLAB program

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Abstract

This paper aims to develop of the training package using the P-PIADA training model on the usage of GUI–MATLAB program. First, we surveyed the need for training content, then analyzed various training courses from related documents and revised related literature. Next, we developed the P-PIADA training model based on STEM education. The P-PIADA training model consists of six processes including 1) Preparation, 2) Pre-learning, 3) Informing, 4) Application, 5) Discussion and 6) Assessment. Then, we constructed a training package on the usage of GUI–MATLAB program. The training package consists of a trainer's manual, PowerPoint presentation, teaching aids and an achievement test. Finally, the quality of the developed P-PIADA training model was evaluated by five experts and was implemented by a sampling group of 25 trainees. The results showed that the quality of the developed P-PIADA training model was appropriate (mean=4.38, S.D. = 0.18) and the P-PIADA based training package was efficient in according to Meguigans's theory.

Keywords: P-PIADA Training model, GUI – MATLAB Program.

1. Introduction

In the 21st century skills consortium (AT21CS), the assessment and teaching of knowledge, attitudes and organizational skills concentrates on four categories, as follows: ways of thinking, ways of working, tools for working, and living in the world. Most of them highlight similar types of complicated thinking, learning, and communication skills. These capabilities are also commonly referred to as higher-order thinking skills, deeper learning outcomes, and complex thinking and communication skills [1]. The training management in the 21st century learning is an important issue by the guidelines of STEM education [2]. Therefore, most courses should integrate available 21st century skills, the STEM fields and their occupations using applicable learning models, where learning and teaching methods are often based through activities, projects, problem, etc. [3,4]. The applications of knowledge to real life situations are emphasized by the STEM education concept in higher education implemented in several research studies [5-8], most of researches are focused on the instructional management and have to use solving teaching problems of the curriculum program in a classroom. However, considering in the training course outside the classroom, it can be seen that the usable training model is diverse, the trainees' background knowledge is not enough and defective to evaluate before training, trainees have to participate a little in the training activities and the training assessment is not appropriate and don't can cover the training behavioral objectives as efficiently. Considering the above problem issues, this paper investigates the

active training methodology based on the STEM education and describes the development of the training package on the usage of GUI–MATLAB program to provide efficiency of training.

2. Materials and methods

2.1 The GUI function of MATLAB Program

MATLAB (matrix laboratory) developed by MathWorks is a numerical computing environment and programming language. The MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with other programs. Although the MATLAB is intended primarily for numerical computing, an optional toolbox, Simulink, GUI (Graphical User Interfaces) that helps the instructor and learner to design a graphical structure and create innovation. Thus, the MATLAB program using GUI function is suitable to develop to be used as a simulator and to solve engineering problems.

2.2 The P-PIADA learning model development

The P- PIADA training model was developed by using several educational theories, as follows: 1) Apperception theory that encourages creating relationships between background knowledge and novel knowledge for applying them to problem solving in new situations and the future.

2) Thorndike's behaviorism, which states that when students are given opportunities to learn through a trial and error method, the appreciated model will be found to respond to most of the students' demands, and linked to stimulus of further learning. As a result, students can solve problems, and better understand how to learn. Moreover, they will have appreciation in what they have solved.

3) Cognitivist theory, which is an important theory of intellectual and cognitive learning skills, where substantial things should be used in teaching to make students understand various natural characteristics. The development of substantial thinking can help the students create their own imagination, and teaching with appropriate equipment will help them understand more [9].

4) STEM education integrates four important subjects: Science, Technology, Engineering and Mathematics, with systematic thinking skills. STEM is used in problems solving and developing innovations in the globalization. The highlight of the STEM education is a learning model that promotes students to have various learning skills, such as complicated thinking, communication skills with technology, problem solving on meaningful lessons in daily life and in actual work, which requires a variety of knowledge. Moreover, the model can also encourage students' ways of thinking to be flexible, creative and innovative in accordance with the change of technologies in present. Thus, the STEM education is a teaching arrangement that supports the 21st century necessary skills [10,11].

In this paper, we have applied these theories as guidance for the design of the training package that supports the 21st century skills and STEM education, as shown in Figure 1.

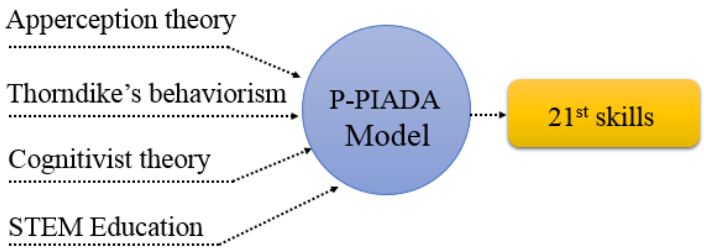

Figure 1 The educational theories used to develop the training model and the training package

The P-PIADA training model, as shown in Figure 2, consists of six steps, as follows:

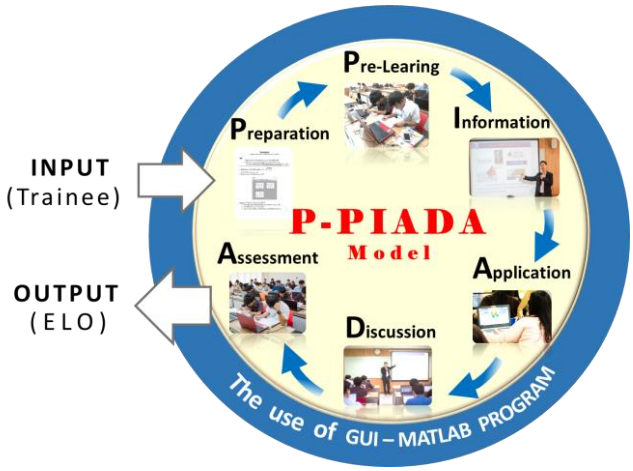

Figure 2 The developed training model

Step 1: Preparation is a process that encourages students to review their required background knowledge and to search and study knowledge necessary for training.

Step 2: Pre-learning is a process that assesses the participants' basic knowledge before attending the classroom. Trainees will review and adapt their knowledge.

Step 3: The Information step provides new lessons using several activities with various teaching aids.

Step 4: Application is a course of action where the participants can practice their learning activities under self-learning modules using worksheets.

Step 5: Discussion is a process in which the participants can analyze and exchange the obtained novel training knowledge in the application step.

Step 6: Assessment is the final process in which the outcomes of the trainees are evaluated in the classroom. All processes of the developed P-PIADA training model will integrate learning and teaching activities to facilitate trainees to have the expected learning outcomes (ELO).

2.3 The research instrument development

To develop the research instrument, as shown in Figure 3, the first step is to survey a need assessment condition for training on the usage of GUI– MATLAB program. Some arguments were found, as follows:

1) The necessity to study new knowledge based on new technology,
2) The applicability of projects and learning modules that required complicated mathematical calculations,
3) The necessity to improve skills for the usage of GUI MATLAB program, and
4) Acquiring new ideas to develop the research.

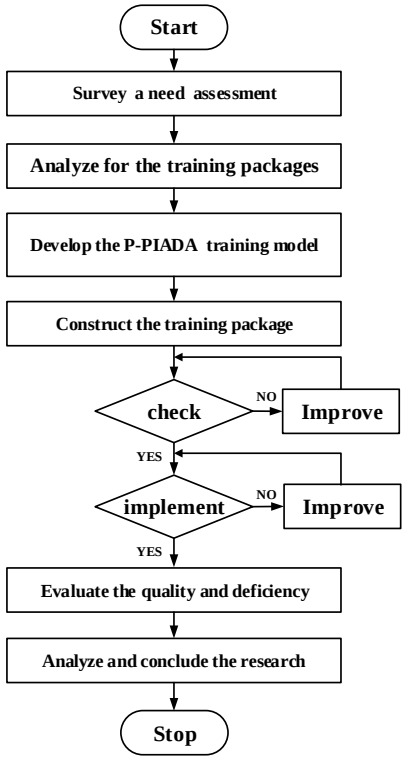

Figure 3 Research methodology

Next, the second step is analyzing and determining topics for the training packages including basic MATLAB command, writing GUI-MATLAB program and application of GUI function. The coral network for the training course, is shown in Figure 4.

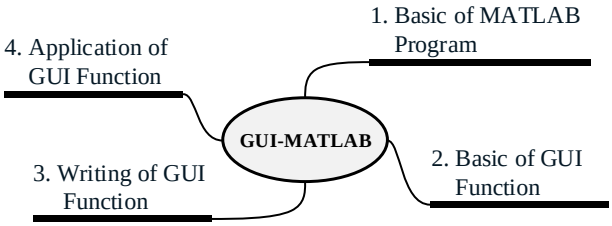

Figure 4 Coral network for the training package

After that, we studied and developed the passive P-PIADA training model based on STEM education. Then, the training package consisting of trainer's manual and PowerPoint presentation as shown in Figure 5, simulation program using GUI function of MATLAB, as shown in Figure 6, achievement tests, and questionnaires for evaluation [12], was constructed and evaluated by five experts.

Figure 5 Developed PowerPoint presentation

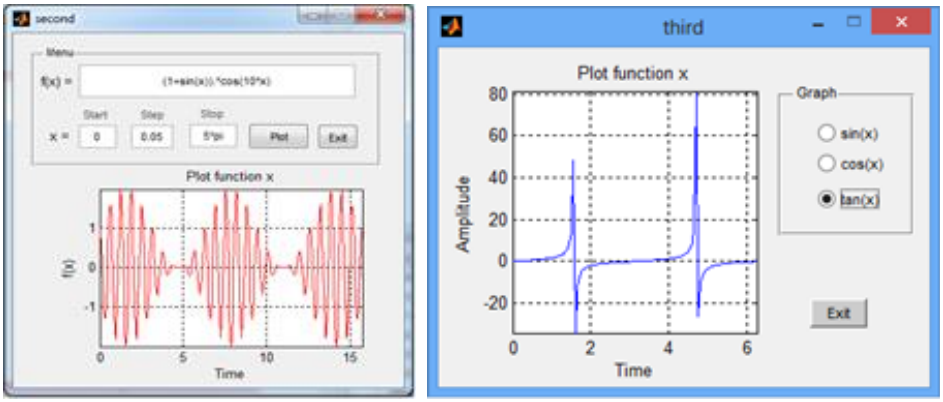

Figure 6 Developed simulation program using GUI function of MATLAB

Finally, the developed training package was implemented by using a sampling group of 25 trainees who registered in a training course of the usage of GUI–MATLAB program, as shown in Figure 7 and 8.

Figure 7 Implementation of information process

The research data was collected from the questionnaire, qualitative data and interview and analyzed for mean value, standard deviation and percentage.

Figure 8 Implementation of Assessment process

3. Results and Discussion

The results of the research includes four aspects of quality: 1) the developed P-PIADA training model, 2) the developed training package including trainer's manual, instructional media, assessment and evaluation, 3) the efficiency of P-PIADA training model, and 4) the trainees' satisfaction for training by using the developed P-PIADA training model as shown in Figure 9.

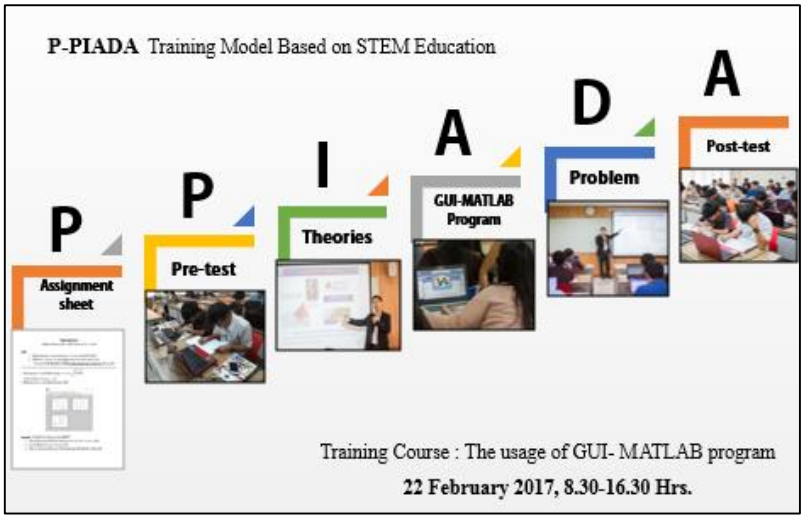

Figure 9 The development of the training package

3.1 The evaluation of the developed P-PIADA model

The results of evaluation by five experts, show that the qualitative data of the developed P-PIADA training model had an average value of 4.38, with the S.D. of 0.18, as shown in Table 1.

Table 1 The evaluation results of the P-PIADA training model from experts

Topics	$\overline{X}$	S.D.	Interpret
The developed P-PIADA training model			
1. Learning process focusing on learner and on 21st Century skills based on STEM Education	4.20	0.45	High
2. Steps of learning process are related	4.60	0.55	High
3. Suitable for training on how to use GUI-MATLAB program	4.00	0.71	High
Total value	4.27	0.28	High
Learning-Teaching Activities			
4. Application of the developed learning activities is practical and in designated time frame	4.20	0.45	High
5. Learners work in team, react according to the objectives	4.40	0.55	High
6. Learners can do research by themselves independently	4.40	0.55	High
Total value	4.33	0.24	High
Instructional Media			
7. Suitable, enough, related to P-PIADA training model	4.20	0.45	High
8. Help student to understand the complicated content easily	4.60	0.55	Very High
Total value	4.40	0.22	High
The assessment and evaluation			
9. Evaluation tools can be used in real situation	4.40	0.55	High
10. Tests are related to learning objectives	4.60	0.55	Very High
Total value	4.50	0.50	Very high
Total average value	4.38	0.18	High

3.2 The evaluation of the training package

The developed training package consists of a trainer's manual on the GUI–MATLAB program, the PowerPoint presentation, instructional media, and the simulation program using GUI function of MATLAB, an achievement test and a Likert – scale questionnaire. The overall appropriation of the developed training package was at a high level with the average value of 4.53 with the S.D. of 0.14, as shown in Table 2.

Table 2 The evaluation results of the training package

Topics	$\overline{X}$	S.D.	Interpret
Trainer's manual			
1. Instruction help trainer to understand, and use training package correctly	4.20	0.84	High
2. The process of training in manual is related to P-PIADA training Model	4.60	0.55	Very High
3. Explain how to select the appropriate activity for the training	4.40	0.55	High
4. The trainer can use manual for training following the P-PIADA training model	4.80	0.45	Very High
Total value	4.50	0.40	Very high
The learning information sheet			
1. Related to the objectives	4.80	0.45	Very High
2. Accurate	4.80	0.45	Very High
3. Encourage understanding	4.40	0.55	High
4. Use graphic, picture effectively	4.80	0.45	Very High
Total value	4.70	0.11	Very high
The presentation on PowerPoint			
1. Appropriate font and size	4.40	0.55	High
2. Appropriate graphic and picture	4.40	0.55	High
3. Appropriate detail of information	4.40	0.55	High
4. Increase of motivation	4.20	0.45	High
Total value	4.35	0.14	High
The assessment and evaluation			
1. Questions related to the topic and objectives	4.40	0.55	High
2. Appropriate number of questions	4.80	0.45	Very high
3. Questions are clear and understandable	4.40	0.55	High
4. Appropriate time	4.60	0.55	Very high
Total value	4.55	0.21	Very high
Total average value	4.53	0.14	Very high

3.3 The efficiency of the P-PIADA training model

The developed P-PIADA training model was implemented [13] using 25 trainees who registered in the training course. Before and after the training of all lessons, trainees were required to the pretest and posttest, respectively, as shown in Figure 6.

The collected data was analyzed for efficiency validation by Meguigans's theory [14], as shown in Table 3. We found that the developed P-PIADA training model was efficient with the Meguigans value equal to 1.08 according to Meguigans' formula (if the mean value is more than 1.0, the effective learning and teaching is considered validated.)

Table 3 The evaluation results of the P-PIADA training model

Topics	Full score	Maximum score	Minimum core	Mean value	Meguigans' value
Pre – test	25	14	7	78.13	1.018
Post – Test	25	22	12	77.78	

3.4 The quality of the developed training package

Table 4 illustrates the evaluation results of the 25 trainees' satisfaction with the developed training package based on the P-PIADA training model. Considering the topic of the developed training package and content sheet, most trainees were satisfied (the average value was 4.44). The overall appropriate level of usage of the P-PIADA training model was at a high level (the average value of 4.38 with the S.D. of 0.33).

Table 4 The results of trainee's satisfaction with the training package

Topics	$\overline{X}$	S.D.	Interpret
The developed training package			
1. Training process related to the content and objectives	4.44	0.51	High
2. Appropriate level of the content	4.40	0.58	High
3. Appropriate activities	4.40	0.82	High
4. Appropriate instructional Medias	4.56	0.58	Very High
Total value	4.45	0.34	High
The learning information sheet			
1. Related to the objectives	4.52	0.65	Very High
2. Accurate	4.28	0.79	High
3. Encourage understanding	4.36	0.70	High
4. Use graphic, picture effectively	4.60	0.58	Very High
Total value	4.44	0.56	High
The presentation on PowerPoint			
1. Appropriate font and size	4.32	0.85	High
2. Appropriate graphic and picture	4.48	0.59	High
3. Appropriate detail of information	4.36	0.64	High
4. Increase of motivation	4.28	0.68	High
Total value	4.36	0.50	High
The assessment and evaluation			
1. Questions related to the topic and objectives	4.28	0.61	High
2. Appropriate number of questions	4.28	0.46	High
3. Questions are clear and understandable	4.24	0.60	High
4. Appropriate time	4.28	0.68	High
Total value	4.27	0.40	High
Total average value	4.38	0.33	High

4. Conclusions

The development of training package using the P-PIADA training model for a case study on the usage of GUI–MATLAB program supporting the 21st century education has been presented. The P-PIADA training model based on STEM education consists of six steps: Preparation, Pre-learning, Informing, Application, Discussion and Assessment. The evaluation results show that, 1) the quality of developed P-PIADA training model was suitable at high level and 2) the trainee's satisfaction was at high level. Therefore, the developed P-PIADA training model can be applied in the training for engineering education or other related programs as seen efficient.

Although the STEM based training model becomes increasingly popular, educational experts agree that it will never completely replace classrooms. In this paper, the efficient training development includes a training package, training activities and aids which are available to create a successful training program. Therefore, the P-PIADA training model is considered an active training model based on the STEM education. Moreover, the training environment should encourage trainees to acquire knowledge, skills and attitude using "various activities" including appropriate learning, practice and assessment.

5. Acknowledgements

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6. References

[1] Griffin P and Esther C., 2012. Assessment and Teaching of 21st Century Skill. Springer, Netherlands.
[2] Intalapaporn C, Patphol M, Wongyai W, S., 2015. Pumsa-ard. Development of Training Curriculum to enhance the ability of STEM Education Learning Management for School Teachers. Veridian E- Journal of Silpakorn University 2, 49-56.
[3] Gonzalez H, Kuenzi J., 2012. Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer Congressional Research Service. Library of Congress, Washington, D.C., United States
[4] Pellegrino J, H. Margaret., 2012. Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century. National Academy Press, Washington, D.C., United States.
[5] Yogendra P., 2016. Comparative Study of Students' Problem Based Learning Over Two Years through Semester Projects in Fluid Mechanics. The 2016 ASEE North Central Section Conference, 1-14.
[6] Robert K., 2017. Problem- Based Learning in Engineering Ethics Course. Interdisciplinary Journal of Problem-Based Learning, 11,1.
[7] Kanyawit K, Warinee W, Pichit U, A. Somsak., 2016. Development of REPEA Learning Model based on STEM-T Education. The International STEM Education Conference, 123-126.
[8] Nipont T, Somsak A., 2016. Engineering Instructional Management using MISOP Integrated Learning model. The International STEM Education Conference, 4-7.
[9] Khemmani T., 2016. Teaching Science: Body of Knowledge for Effective Learning Experience. 20th Edition. Chula Press, Bangkok, Thailand.
[10] Siripatharachai P., 2013. STEM Education and 21st Century Skills Development, Journal of Executive 33, 49-56.
[11] Klomim K., 2016. Learning Management based on STEM Education for student Teachers. Journal of Education Naresuan University 18, 334-348.
[12] Lyman Ott R, Micheal T., 2000. An Introduction to Statistical Methods and Data Analysis. Duxbury Press, California.
[13] Thanin S., 2012. Research and Statistical Analysis with SPSS and AMOS. Thirteen Edition: Bangkok, Thailand.
[14] Haddad W. D., 2002. Technologies for Education," Academy for Education Development. Washington, D.C., United States.