

## PORTFOLIO-BASED PHYSICS LEARNING MODEL TO IMPROVE CRITICAL THINKING SKILLS

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### ABSTRACT

The purpose of this study is to find out whether the implementation of Portfolios–based physics learning model can enhance students' thinking skills and to study the nature of critical teacher and student responses to the implementation of Portfolios–based physics learning model. The method used is mixed with the method of experimental research design embedded. The results showed that all the syntaxes of physics-based learning model portfolio were performing well. Implementation of the model was found that N-gain gain critical thinking skills higher than conventional learning. There are significant differences in critical thinking skills of students who follow physics-based learning model portfolio with students taking conventional learning. Responses of teachers and students towards the learning and implementation of physics-based learning model portfolio were very positive.

**Keywords:** Portfolios–based physics learning, critical thinking skills

### 1. INTRODUCTION

During the last decade there are demand on schools and teachers to be more accountable and responsible and to higher academic standards. There is a common belief that the practice of assessment refers to the minimum competency tests and measured with a standard, objective types, have failed to develop and measure higher-order thinking skills required in the present world. Many educators, citizens, and measurement experts believe that this situation can be overcome by introducing a learning model called the Portfolios–based physics learning model.

The problem arises is how the effect of the implementation of portfolio-based learning model, along with an assessment system that can drive to higher level thinking skills?, this study is aimed to implement a portfolio–based physics learning model and device-oriented learning critical thinking skills.

Syntaxes of portfolio–based physics learning comprises eight phases: Phase-I. Teachers convey the purpose and motivating students; Phase-II. Teachers identify problems; Phase-III. Teachers posing problems for the study of class and return portfolio directed students to choose problems; Phase-IV. Teachers guide the groups and practice critical thinking skills; Phase-V. Teachers direct the portfolio delivery and documentation to document the portfolio; Phase-VI.

Teacher directs students to the discussion; Phase-VII. Teacher evaluates student portfolios, and Phase-VIII. Teacher appreciates and efforts both individuals and groups.

## 2. UNDERSTANDING ASSESSMENT AND PORTFOLIO

Understanding assessment in the portfolios-based physics learning model SMA/MA stated that the assessment not only includes the judge, but also significant: (1) to help students learn, (2) individual and group, (3) multi-context, (4) anti-bias, and (5) emphasis on student excellence. Webb (1993:68) defines assessment as a tool that can be used by teacher to help students attain the goals of a curriculum. According to Blaustein (1999), assessment is the process of gathering information and making decisions based on that information (in Ibrahim, 2005:3). Thus it can be said that the assessment is a system of assessment by teacher throughout the learning process undertaken by the students and for helping students to achieve the learning objectives.

According to Johnson and Johnson (2003:103), a portfolio is an organized collection of evidence accumulated over time on a student's or group's academic progress, achievement, skills, and attitudes. Lim (1977) stated that, a portfolio is a collection of work over time that reflects processed, products, achievement, and progress. It is valuable to the teacher, and to the student, and to the student's family. Ibrahim (2005), defines a portfolio as a collection of representative student work showing the development of students' skills from time to time. Paulson (1991:21) pointed out that, a portfolio of student work samples that demonstrate effort, progress and proficiency in one or more areas. Gronlund (1998), defines a portfolio as a collection of student work samples depend on the breadth of objectives. Examples of student work provides a basis for consideration of the progress of learning and can be communicated to students, parents and other interested parties. Based on these definitions, it can be concluded that portfolio is a collection of student working which has the objective to collect a series of basic performance information (performance) or student work, evidence of accomplishments, skills, and attitudes. Collection of information represents achievement or improvement experienced by the students from time to time to achieve certain objectives of the curriculum. Focus of the portfolio is problem solving, thinking, and comprehension, written communication, science relationship, and students reflection on learning science.

## 3. IMPLEMENTATION OF THE LEARNING PORTFOLIO

Nur (2002) pointed out that according to O'Malley and Pierce, portfolio is very student-centered, which means that students have input not only on what is included in the portfolio but also on how the content is evaluated. Teachers are encouraged to incorporate new roles for teachers and students into the classroom so that the portfolio can be more student-centered than teacher-centered. Based on this description, it can be said that the student-centered features the portfolio as a "spirit" portfolio where the position of teacher is as a facilitator.

Studies of portfolio strategy showed that the implementation of portfolio in science learning, is highly effective in improving conceptual understanding, students' attitudes, and cognitive processes in science lessons (Leonard, 1996). Regarding the effect of the application of portfolio

learning on learning outcomes. Budimansyah (2002) explains that students will be able to assess themselves against the results of the performance, so as to identify the weaknesses and advantages in completing a task performance. Furthermore, students will have the nature of honesty, and high interpersonal. Such capability is needed in the era of globalization. Correspondingly, Nur (2002) also suggests that the portfolio-based learning can lead to improve learning outcomes are real. The above descriptions indicate that the application of portfolios may have implications for the improvement of learning outcomes.

#### **4. CRITICAL THINKING SKILLS**

Critical thinking is an important thing which make a person to be creative. Torrance (Carin & Sund, 1995), and Lawson (1979), & Taeffinger., et al (1982), pointed out that critical thinking is the process of 1) difficulties sensing problems, missing elements, 2) making guesses and formulating ideas or hypotheses about these deficiencies; 3) Evaluating and testing these guesses and hypotheses; 4) Revising possibility retesting them, and finally, 5) communicating the results.

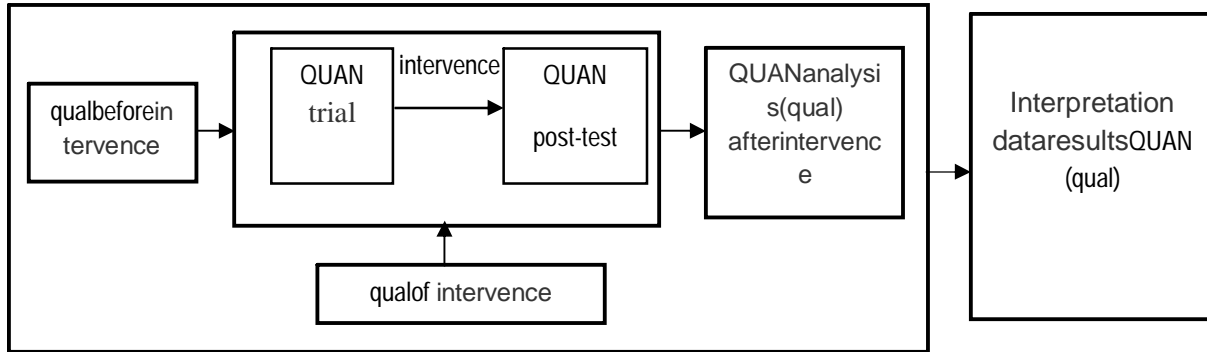
The definition suggests that critical thinking is as a critical process, which sensing difficulties, the problem of information gap, the missing element and disharmony, clearly defining the problem, make a hypothesis, testing the hypothesis back or even redefine the problem and finally communicating the results.

Critical thinking will be easily realized in a learning environment that directly provide opportunities for students to think open and flexible without fear or shy. For example, set up learning situations should be facilitating the discussion, encourage someone to express ideas. According to Carin and Sund (1995) to induce creativity in learning aspects needs (1) to develop a high confidence and minimize fear, (2) to encourage free communication, (3) conduct limited objective and individual assessment by the students; and (4) control is not too tight.

Critical thinking can be developed rapidly using a portfolio-based learning because learning model is able to facilitate almost all students' skills, ie skills to develop knowledge already possessed by students, skills predict from limited information, skills find the problem, formulate hypotheses skills, skills testing hypotheses, and skill saw information from a different perspective.

### 5. RESEARCH METHODS

The research method used is mixed methods research design Embedded Experimental Model (Creswell, & Clark, 2007) as shown in Figure 1.



**Figure 1.** Embedded Experimental Model

Embedded Experimental Model Design box stating this data set and the results, while quantitative data QUAN stated that the data in the form of numbers. In this research, quantitative data is data validation of the analytical results based on field trial on a limited class and qualitative data related to the category. In this research, qualitative data are: analysis of the syllabus, teacher needs analysis, environmental analysis, analysis of questionnaires.

The subjects of this study is all SMA student of academic year 2010/2011. The research instrument consisted of: (1) a test of critical thinking skills, (2) questionnaires, and (3) the observation sheet activities of teachers and students.

Data critical thinking skills was collected using critical skills tests. Data responses of teachers and students was measured by using questionnaires and the activities of teachers and students by using the observation sheet. Data processing techniques are descriptive and inferential analysis. The gain occurred before and after the learning calculated by the normalized formula (N-gain) (Meltzer, 2002).

$$g = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

S<sub>post</sub> is the final test scores; S<sub>pre</sub> earlier test scores, and S<sub>max</sub> is the maximum score. N-gain level criteria is showing in Table 1 (Meltzer, 2002).

**Table 1.** The N-Gain Category

Limitation	Category
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Medium
$g < 0,3$	Low

## 6. RESULTS AND DISCUSSION

The average N-gain critical thinking skills of students on the subject of temperature and heat for experimental class is 0.9 in high category and control class is 0.3 in low category. The average N-gain critical thinking skills of students on any topic and heat temperatures as shown in Table 2.

**Table 2.** The average N-gain Critical Thinking Skills Every Topic Temperature and Heat

No	Topic	The average N-gain Critical Thinking Skills In Topic					
		Experimental class			Control Class		
		T	S	R	T	S	R
1.	Liquid expansion	0,9	-	-	-	-	0,3
2.	Specific heat of substances	0,9	-	-	-	-	0,3
3.	Heat melting ice	0,9	-	-	-	-	0,3

Description T= high, C = medium, R= low

Table 2 shows that the critical thinking skills of students on the topic of temperature and heat have increased and are in high category involving the topics of it was consecutively melting heat, specific heat substances and liquid expansion. In the control class found that students' critical thinking skills for all subjects are in low category. These results show that students who take portfolio-based physics learning increased in critical thinking skills for all the topics of temperature and heat compared to students who attend conventional learning. However, students in control class have critical thinking skills at each temperature and the heat thought topics skills are still low. The average N-gain on every indicator of students' critical thinking skills is shown by Table 3.

**Table 3.** The average N-gain In Every indicator Critical Thinking Skills

No.	Skills indicator critical thinking	The average N-gain indicator Critical Thinking Skills					
		Experimental class			Control Class		
		T	S	R	T	S	R
1.	Provides simple explanation	0,9	-	-	-	-	0,3
2.	Build basic skills	-	0,9	-	-	-	0,3
3.	Making induction and consider induction with an explanation: making inferences and hypotheses	0,9	-	-	-	-	0,3
4.	Creating and consider the decision with the explanation: the application of the principle	0,9	-	-	-	-	0,3

Description T= high, C = medium, R= low

Based on Table 3 all the indicators of critical thinking skills have increased. The most improved indicators included in the category increased height is to develop a simple explanation followed, Build basic skills, making induction and consider induction with an explanation: making inferences and hypotheses, make decisions and consider the explanation: the application of the principle. In the control classes it was found that all the indicators of critical thinking skills are included in the low category. These results show that students who take physics based learning portfolio increased in critical thinking skills for all indicators of effective critical thinking skills than students who take conventional learning, however, students in the control classes have critical thinking skills on each indicator though lower. Thus it can be said that each student who attend both portfolio based physics learning and following the conventional learning basically have critical thinking skills, which distinguishes them to that students who take portfolio based physics learning had the opportunity to practice a gradual and sustained so that the thinking skills their critical to experience is growing compared to students who did not get a chance to practice intensively thinking skills.

Students' response to the learning component and implementation of physics-based learning portfolio showed very positive (80%) in the aspect of interest, positive (93%) in the aspect of renewal, positive (70%) in the aspects of ease of understanding, positive (85%) in the aspects of the application and very positive (80%) in the delivery aspects of teacher clarity. The results of the response of teachers of physics to physics-based learning model portfolio of highly positive (100%) in both the role and quality aspects and teachers do not experience hurdle in implementing physics-based learning portfolio in both the regulating the implementation of physics-based learning portfolio, preparing time to implement portfolio based physics learning and deliver the tasks to be done by students.

According to teacher, the benefits that can be obtained through thin model is portfolios students quickly grasp the concepts that have been taught and quickly develops critical thinking skills.

Comments from teachers showed that the temperature and heat of physics-based learning portfolio is a form of learning that is loaded with innovations is something new. This indicates that all the syntacof physics-based learning model portfolio working well.

This will increase the activity of students in discovering the concepts, principles and theories of physics. Similarly, the teacher will present the course material critical guidance in learning and doing. This is because the portfolio based physics learning of students trained to think critically, especially in terms of posing problems, and investigate the matter through trial. Students can determine the level of critical thinking skills through portfolio assessment, this information will better motivate students to learn physics and ultimately will improve their critical thinking skills. This is consistent with the theory that active learning on students construct their own skills and knowledge. Conventional learning students do not get the opportunity to develop critical skills so that when working on problems they could not resolve correctly.

Responses of teachers and students towards the learning and implementation of physics-based learning portfolio is very positive. This suggests that the portfolio based physics learning, along with his supporters to generate interest and motivation in learning a physics student, and ultimately improving student learning outcomes. Teachers have high motivation in implementing the learning, because teachers in this very important role as a facilitator in the learning and teaching tools are very helpful in implementing the learning process in the classroom. Learning device applied in this study allows students and teachers implement all phases of learning. This is consistent with theoretical models of learning (Joyce, Weil, & Showers (1992:14) that emphasizes supporting aspects implementationto portfolio based physics learning model.

## **7. CONCLUSION**

Portfolio based physics learning model portfolio consists of: a) learning syntax (preliminary: core learning: making the exercise trial, stabilization concepts related to experiments and cover: the provision and evaluation tasks), b) the social system (the collaboration between students and students and teachers c) principles: (teacher acts as a facilitator), d) support systems (learning devices, lab equipment), e) the impact of instructional (critical thinking skills) and the impact of accompaniment (the ability to make the experiment). Application of portfolio based physics learning can further enhance students' critical thinking skills compared with conventional learning application. Teachers and students are responding very positively to the physics-based learning portfolio and its implementation in pembelajaran temperature and heat.

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